European Transport Research Alliance

EDUCATION AND TRAINING ISSUES FOR THE TRANSPORT RESEARCHERS OF THE FUTURE EUROPEAN RESEARCH AREA (ERA/T)

An ETRA report based on the presentations and discussions during the ETRA invited Session, with the same title, at the TRA2014 Conference

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This report draws material from the PowerPoint presentations made during the ETRA organised, TRA 2014 invited session no. 43 with the same title. The presenters during that Session were (in alphabetic order):

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The ***European Transport Research Alliance (ETRA)*** was formed in September 2012 to promote and support the creation of the *European Research Area* in the field of Transport *(ERA-T)*. In doing so, it undertakes or coordinates activities on commonly agreed issues concerning European Transport Research. The founding Partners of ETRA are the following five European Associations: ECTRI, FERSI, FEHRL, EURNEX, and HUMANIST. They bring together the strengths of their wide range of member organisations employing, collectively, many thousands of transport researchers.

One of the priorities of the *ETRA,* according to its "*Purpose and Vision*" document, is to: "*facilitate the free and unimpeded flow of competent researchers in the transport field and the provision of proper education and training opportunities*".

To fulfil this priority, *ETRA* is committed to supporting the on-going, as well as creating new, activities for more harmonized and focused education and training opportunities for scientists and researchers in the transport field. This report is part of this commitment.

For further info about the Alliance, see: **www.etralliance.eu**

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Introduction

The European transport research sector faces growing problems today to develop, attract and retain appropriate staff as work in other fields of transport, tends to offer greater financial incentives and work opportunities. For Europe, the gradual creation of the "single space" for research and innovation – the so called ***European Research Area,*** or ***ERA*** – will mean that in the near to medium term future the fully integrated and unified research space between all EU member countries (and the opening to several more) will require extra skills and knowledge among transport researchers in order to face the competition and the scientific challenges of their jobs. Similar needs exist for all the scientific personnel working in the field of transport in general.

Transport is now a rapidly developing and changing sector. A key issue is to get players and activities aligned towards a common vision. This requires leadership but we also need to leave room for the questions that will arise in the future. It is not about smart answers now, it is about smart questions. This requires highly educated and well trained people.

Using the UK as an example: a 2012 Royal Academy of Engineering study said that UK industry will need 100,000 new graduates in science, technology engineering and maths every year until 2020 just to maintain current levels of employment. The UK was at that point running ~10% short. So there could be a "pipeline issue" affecting not just transport but the wider engineering sectors.

The future transport professional will therefore require skills at an advanced level in, for example, vehicle and infrastructure engineering, and in back office operations. There will also be a requirement for more safety, security and fleet management professionals. Other growth areas will be trip planning and smart cities. We need transport professionals from every engineering and planning discipline, but we also need marketing, business, economic, and legal experts, behavioural sciences and psychology professionals to create a multi-disciplinary environment.

A well timed campaign for the appropriate education of the transport researchers as well as their on-going training in the future, is a necessary pre-condition for the success of the ERA in the field of Transport , or ERA/T. The word "appropriate" here can take a number of connotations such as ("appropriate" in terms of):

- ✓ Content of initial transport education courses (at undergraduate and postgraduate level);
- ✓ Lifelong training opportunities for special skills and competences;

- ✓ Research governance and research management skills provision for cooperative research work at all levels;
- ✓ Harmonization and certification of the transport education degrees;
- ✓ Establishment of permanent and constant liaisons with the industry so that their requirements in terms of research capacities are properly met;
- ✓ and so on…

Closer cooperation between academic institutions and research or personnel "end-user" or "facilitator" Organisations is therefore needed in order to inform and, above all, train appropriately the personnel that will work on transport research. The ETRA, as such a "facilitator" Organisation, has made it one of its main tasks in its current 4-year activity plan, to promote the proper education and training of Transport research personnel. This effort takes on a more practical meaning, and becomes more imperative, now that the new *Horizon 2020* programme of EU funded research is moving on to its second year and can still be influenced to potentially include the appropriate actions that can help this commonly defined and supported education and training effort for transport related personnel, to materialise.

So far, the ETRA has actively pursued its above goals by:

1) Issuing and disseminating to all appropriate quarters in the EU Commission and other relevant stakeholders, of a position paper entitled *"ETRA inputs to the Commission on the first work programme for the Transport societal challenge"* (June 2013).

2) Supporting the on-going biannual activity of three of its partners: ECTRI, FEHRL, FERSI for the education and training of young researchers in the transport field. This activity, known as the *Young Researchers Seminar (YRS),* started in 2003 and now is being organised for the 7th time in 2015[1]. During the three days of this Seminar, some 60-70 young transport researchers from across the world gather together and participate in a series of scientific sessions in which they present their papers and get advice and support from specially designated tutors. This is definitely a success story that needs to be continued and enhanced in the future, and ETRA is proud to assist in this on-going process.

3) Organising the special Invited Session within the TRA2014 Conference on ***Education and Training issues for transport researchers of the future ERA*** the outcome of which is this report.

4) Planning future activities that will include:
   i. Further organisation of sessions / workshops / or Conferences in order to present and highlight the current problems and promote the dialogue between the appropriate University Associations and leading education establishments in Europe and abroad in order to discuss the feasibility and interest in developing / harmonizing specialized transport related courses.

[1] The next, *2015 Young Researchers Seminar* is to be organised in the *Centre for Transport and Logistics (CTL)*, "Sapienza" University of Rome (Prof. Luca Persia). Information is available at: www.ectri.org/YRS15/.

ii. Promoting the implementations of the recommendations of this report.
iii. Promoting specific and focused education and training activities for the transport professionals (researchers as well as transport specialists), such as:
    a. Special *shor*t training courses for transport researchers.
    b. Support further harmonization of University courses and degrees aimed at the transport professional / researcher.
    c. Support the establishment of mechanisms and platforms for the *education & training on demand*, by virtual (i.e. internet based) short courses, summer schools, master courses and workshops, as for example in the virtual EURNEX organised *EURAIL University*.

Finally, special mention should be made here of the collective effort and recommendations put forward on these issues (of education and training) in the final report of the *DETRA (Developing the European Transport Research Alliance)* project. This project was the initiator of ETRA and its findings give very valuable information on the *ETRA* Partners common thinking[2].

A note on the context

During the past 15 years a number of initiatives and policies have been taken at European level to promote education and training activities in general (unfortunately not specifically for the field of Transport). The most notable of these are the following:

2000 – Initiation of the concept of the European Research Area (ERA): This entails the creation of an 'internal market' for research covering all EU members and eventually all of Europe i.e. an area of free movement of knowledge**,** research (i.e. researchers), and technological innovation, with the aim of increasing cooperation, stimulating competition and achieving a better allocation of resources.

2007 – EU's Green paper aiming to deepen and widen the ERA, by:

- Removing the institutional and national barriers hampering free movement of researchers;
- improving their working conditions and widening their career prospects.

2012 – EU Communication: "A Reinforced European Research Area Partnership for Excellence and Growth", aiming at deepening and re-ensuring the removal of barriers to researcher mobility, training and attractive careers for an open labor market for researchers.

[2] The final report of this project can be found at : http://detra.fehrl.org/index.php?m=3&mode=download&id_file=14957

2000 – 2013: Several other initiatives and actions by a number of relevant Organisations, e.g.:

A. *EU supported initiatives, such as the:*
   - ✓ *European Charter of Researchers (principles supporting researcher rights and mobility -favouring young researchers),*
   - ✓ *Marie Curie Scheme*
   - ✓ *ERC's (European Research Council) - starting Scientists Grants,*
   - ✓ *Researchers' recognition and scientific visa,*
   - ✓ *Mobility centres network,*
   - ✓ *European portal for researchers mobility (Euraxess)*[3].

B. *A number of other support schemes and programmes especially for early stage scientists and researchers, such as the:*
   - ✓ *COST programme*
   - ✓ *Initiatives by NoEs-VCEs (e.g. HUMANIST, EURNEX, NEARCTIS)*
   - ✓ *Initiatives by research Associations such as ECTRI (e.g. The Young Researchers Seminar by ECTRI/FERSI/FEHRL)*
   - ✓ *Erasmus, Erasmus Mundus, etc.*
   - ✓ *The European Partnership for Researchers (EPR)*[4].

If one adds to the above, the various relevant National activities (i.e. those carried and financed inside member countries) one can say that there have been quite many "education and training" activities around in the last 15 years. However, these activities usually lack coordination and are directed to a multitude of sectors and scientific areas, usually other than Transport.

In spite the aforementioned lack of coordination there are some common characteristics that can be identified in almost all of these activities as follows:

a. Main focus is on young researchers normally through:
   - preparation of projects to be funded when favouring young researchers; or

[3] *EURAXESS - Researchers in Motion,* is a pan-European initiative providing access to a range of information and support services to researchers wishing to pursue their research careers in Europe or stay connected to it. See also: http://ec.europa.eu/euraxess/.

[4] The *European Partnership for Researchers (EPR)* aims at improving career prospects for researchers in Europe, stimulating young people to embark on research careers and helping to retain European talent and attracting researchers from other world regions. The Partnership facilitates mobility between countries, academia and industry. Improving the career prospects and mobility enhances the diffusion of knowledge (fifth Freedom) throughout Europe, balances demand and supply for researchers at European level, helps to create centers of excellence and improves the skills of researchers in Europe. The EPR is one of the five ERA initiatives to help creating the European Research Area. See more at: http://ec.europa.eu/research/era/areas/researchers/researchers_en.htm.

- giving prizes to young researchers for research projects or articles in Conferences and other fora.

b. Training activities are supported in the Marie Curie programme, the COST Actions, and so on, but without any synergy among them.
c. At University educational level there are possibilities for: exchanges between educational programmes at master level, forming joint courses, giving double degrees, extensive Erasmus exchanges.

What can be identified as "weaknesses" of the current system, are the following:

1) Promotion of exchanges of researchers between universities, research centres, industries , etc. **not on a project basis** (i.e. EU project, COST actions, etc), but related to **common research interests.** This grouping according to research interests is usually made on the personal initiative of the researchers themselves...
2) Non existence of a **common understanding** and **specifications** for individual or joint courses (e.g. PhD programmes) on a select number of major sectors or themes (and Transport is one of them) to provide a common "language" and a common approach to research excellence in the different countries.
3) Facilitation of the **exchange of senior researchers** (as opposed to only junior ones) and the transfer of knowledge, with adequate policies.
4) Promotion of a **transfer of knowledge programme** specifically aimed at Transport.
5) Supporting of the **exchange between the academic** and **industry** worlds, valorising especially the PhD students.

Basic training and knowledge transfer issues

Training as a prerequisite for jobs and skills acquisition

The transport sector and its different modal subsectors are undergoing major structural changes that need to be identified. The major ones are:

- ✓ production methods and industry structure,
- ✓ value added and changes in volume trends,
- ✓ employment trends.

All these changes have subsequent consequences in Training and education issues.

New value chains, networks and transport actors necessitate the identification of the customers and the product flow paths together with the right treatment of information.

As the general trend is to increase automation, transport staff will most likely have to deal with specialized equipments and products, requiring more skills and more trans-disciplinary approaches. Furthermore, the intermodality issues and logistic technologies are becoming increasingly more important with the ultimate aim to reduce process costs, address modularization / standardisation issues and offer new services to new customer requirements.

Finally, the trade globalization and internal competition between modes (and even within mode sectors) gives a new dimension to skills development and changing trends in staff requirements while the legal and regulatory environment is becoming also more relevant requiring specific skills and knowledge in specific issues e.g. those in the safety domain.

Objectives of education and training actions

There can be many such objectives stated. What needs to be stated right from the beginning here, is that education and training activities must be seen as starting early and extending throughout one's life. It is therefore, a joint responsibility of the providers, the employers and the professionals to all be involved. Many routes beyond the traditional education approaches will be required as the transport and mobility sector develops and changes into the future but for the types of education and training actions stipulated in this report we can state the following objectives as being the most relevant:

- Disseminating the scientific, social and industrial know-how and research state-of-the-art so that all persons involved are well informed and updated.
- Disseminating the benefits from adopting novel and advanced transport strategic, economic, urban and logistic issues in the different transport modes and cross modal domains.
- Developing innovative forms of organisation and business models in the transport sector.
- Promoting cooperation between academia institutions and industry.
- Connecting the advanced engineering education to research and technological developments.
- Providing access of the research / academic world to a range of professionals and other industrial groups in Europe active in transport related activities.

Knowledge transfer and dissemination actions in the EU

The issues concerning the education and training environment of the future transport researchers is currently not addressed in any specific way by policy or decision making bodies at European or National level in Europe. It is, however, an issue of increased concern and

interaction among the most relevant professional Associations (among which those of the ETRA partners).

At the level of the EU, the transport research education and training issues are addressed collectively within the overall education and training activities of the "*Excellent Science*" pillar of the Horizon 2020 programme of the Union[5]. These are primarily carried out through the well known Marie Skłodowska-Curie or simply ***Marie Curie programme***.

Based on experience so far with the *Marie Curie* programme, it is possible to formulate the following remarks[6]:

Overall the *Marie Curie* Programme of the EU, at least its actions in the last 10 years, is considered by the academic and research communities as successful. It can be improved by some specific improvements such as the following, but overall its performance is considered as successful. Suggested improvements include:

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[5] The Horizon 2020 programme 3 main pillars, and their sub-sections, are:

A. Excellent Science, *containing the actions on:*

- The European Research Council
- Future and Emerging Technologies
- Marie Skłodowska-Curie programme
- European Research Infrastructures, including e-Infrastructures.

B. Industrial Leadership, *containing the programmes:*

- Leadership in Enabling and Industrial Technologies
  - Information and Communication Technologies
  - Nanotechnologies, Advanced Materials, Advanced Manufacturing and Processing, and Biotechnology
  - Space
- Access to risk finance
- Innovation in SMEs .

C. Societal Challenges, *containing the collaborative research programmes on:*

- Health, Demographic Change and Wellbeing
- Food Security, Sustainable Agriculture and Forestry, Marine, Maritime and Inland Water Research and the Bioeconomy
- Secure, Clean and Efficient Energy
- Smart, Green and Integrated Transport
- Climate Action, Environment, Resource Efficiency and Raw Materials
- Europe in a changing world - Inclusive, innovative and reflective societies
- Secure societies – Protecting freedom and security of Europe and its citizens

Also actions are taken within H2020, along the following 4 areas:

- ✓ ***Spreading Excellence and Widening Participation***
- ✓ ***Science with and for Society***
- ✓ ***European Institute of Innovation and Technology (EIT)***
- ✓ ***Euratom.***

[6] Based on the presentation: ***"Training Europe's future transport researchers"*** *by:* ***Alan Stevens,*** *Chief scientist, TRL, UK, at: ETRA Invited Session no 43, in TRA 2014, Paris 17-4-2014 .*

a. providing funding for supervisory activities in hosting institutions, i.e. for tutoring or academic supervision of the hosted researchers.
b. Increasing the allowable percentage of commercial work that a *Marie Curie* programme supported researcher can undertake for the institution he/she is placed with. This will give the individual researcher some commercial experience and skills that are necessary to a researcher, and will help manage the hosts' institutional costs especially for organisations with no Government funding.
c. The programme should also consider increasing the incentives to encourage stronger and more commercially oriented research institutions to provide highly skilled researchers as "stagers" to lesser developed or developing research organisations.
d. Supporting the creation of a pan-European database of researchers per sector (in our case for the Transport sector). Such database would be useful for more efficient and widespread transport research mobility all around.

The training activities that take place with the support of the *Marie Curie* programme should be complemented by relevant actions that could be supported by the rest of the H2020 activities most notably through the process of funding and implementation of collaborative research in general. In this respect it is proposed that the main collaborative research pillar of the "societal challenges" research of the H2020 programme could include some funding for actions (through projects) in the following areas:

- Instituting web-training and short courses as well as training workshops in various subjects related to the specific subject of the research carried out according to the Descriptions of Work of the specific research projects;
- Activities within research projects that provide training materials, short training courses and / or publishing textbooks. Such activities could be given some sort of priority in funding especially when this is done with involvement of leading international academic organizations.
- Projects doing solely the above, could also be funded in specific sectors that are considered as particularly important.

In conclusion, *knowledge transfer* and dissemination actions in the EU, show a number of weaknesses that can be summed up in the following sentences:

a. Current dissemination activities of R&D projects are not well-attended or given emphasis in the transport research work programmes;
b. Dissemination and knowledge transfer activities of EU funded research projects should be primarily focused to international audiences for making European research more easily reachable by such audiences;

c. There is a need for more project "tail" funding to ensure appropriate dissemination and knowledge transfer actions after the project analysis work ends;
d. Dissemination work should be content oriented rather than process (i.e. work package) led;
e. Project or EC websites should be durable and easily searchable by keywords and not only just by project acronym.

The "competence" gaps across the Transport Sector

In discussing the issues of education and training in the field of Transport it is of paramount importance to examine what are the needs and expectations of the "end-users" of such activities. Such "end-users" are – naturally – the Transport research Organisations (which are of primary interest for this report) but also all the Transport industrial and service providing Organisations that are called to employ transport scientists. To this end, a recent survey and study among 147 European industries and 222 education providing programmes (courses) examined and analysed the so called "competence needs and gaps" in the transport sector. The results of this study were presented in the ETRA organised session for the TRA2014 Conference, and these will be summarily presented here[7].

First, there is a profound contextual evolution within the EU and worldwide, for *competence* in the Transport Sector over the last decades due to:

- ✓ Growing demand for specialized Transport services;
- ✓ The economic turmoil that affects currently most European economies;
- ✓ The need for efficiencies across all stages of the transport chain;
- ✓ The need to achieve "sustainability" and sustainable development;
- ✓ Many and varied technological advancements in a wide spectrum of technological areas that are utilized in the Transport field; and the existence of
- ✓ New Educational Tools and Paradigms.

The meaning of "*Competence*", in the above context, is the outcome of skills acquired through knowledge and intellectual capabilities that are obtained through education or training

[7] Based on the presentation: ***"Uncovering Competence Gaps Across the Transport Sector"*** *by:* **Rosário Macário, Vasco Reis** *Instituto Superior Técnico, Universidade de Lisboa, and* **Eddy Van de Voorde** *University of Antwerp, ETRA Invited Session no 43, in TRA 2014, Paris 17-4-2014* . The presentation was based on the results of the EU funded projects:

- ***TUNRail*** *- Tuning Transatlantic Cooperation in Rail Higher Education, European Commission, Atlantis Programme.*
- ***EDUCAIR*** *– Assessing the Educational Gaps in Aeronautics and Air Transport, European Commission, 7FP Programme.*
- ***Bus Rapid Transit****- Centre of Excellence on Bus Rapid Transit, Volvo Education and Research Foundations.*

programmes offered at basic (initial) level or subsequent (specialization or lifelong learning through training) level.

Secondly, the following specific realizations (all refer to the Transport sector) affect the situation as regards the "competences" offered in the transport sector at European level:

a. The multidisciplinary nature of the Transport industry requires competencies from multiple bodies of knowledge, matching with the multidisciplinary character of mobility systems.
b. Educational Programs tend to be structured and organized by disciplines or body of knowledge (vertical silos).
c. Current educational offers tend to be adequate on a single competency basis i.e. different programs cover different individual competencies. As a result all single competencies are covered in a kind of "isolated" way and thus "end-users" requiring such "single discipline" *competencies* have no difficulty finding well-suited applicants.
d. The Transport industry, however, usually demands a "mixture" of *competencies* i.e. across different educational domains and not "single discipline" *competencies*.
e. The needs of the "end-users" are not constant over time. They are changing, reflecting the current and future needs of society and technology (e.g. corresponding to environmental protection concerns, use of new materials, the impact of new technological advances, new energy sources, etc).

As a result, there are GAPS that can be identified between "end-user" (primarily industry) demands or needs, and the competences that are offered by the research or academic community. These "gaps" are greater or lesser depending on the type of industry[8]:

The gaps identified by the studies referred to above are diagrammatically presented in Figure 1, and , can be described as follows:

1. The "*Market Delivery" Gap*: This is defined as the gap between the competences of the trained (students, researchers) and the competences actually useful in their working daily activities.
2. The "*Meeting Expectations*" Gap: This is defined as the gap between the knowledge that the companies need and the actual competences of their employees.
3. The "*Miscommunication" Gap*: This is defined as the gap between the knowledge generated by research and the knowledge transferred in the courses.

[8] The aviation industry seems to be the one with the smaller such "gap". According to the report *Flightpath 2050: Europe's Vision for Aviation: "Students are attracted to careers in aviation. Courses offered by European Universities closely match the needs of the Aviation Industry, its research establishments and administrations and evolve continuously as those needs develop. Lifelong and continuous education in aviation is the norm".*

4. The *"Market Misreading" Gap*: This is defined as the gap between the knowledge the market needs and the knowledge the Universities provide (i.e. are the universities' research and teaching activities of relevance for the companies?).

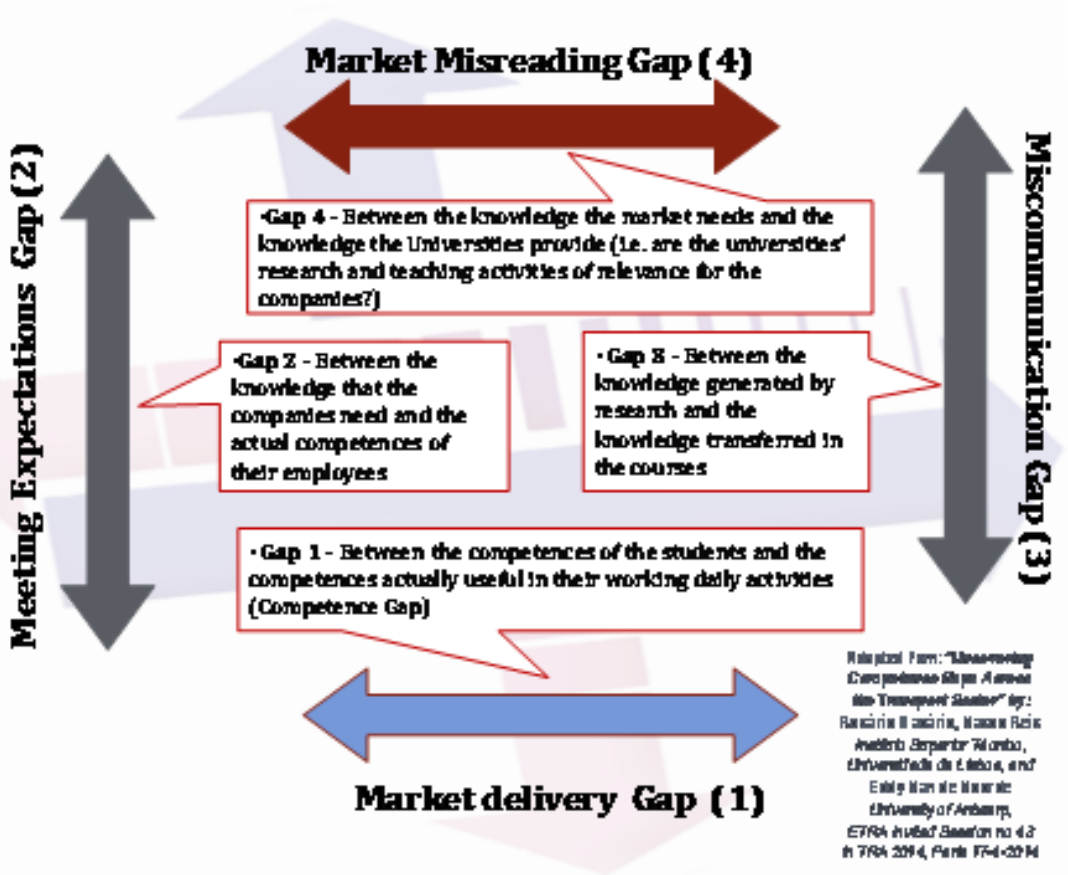

Figure 1: The "competence gaps" in the Transport Sector[9]

Some recommendations that can be made for closing the above gaps and meet the expectations of "end users" are as follows:

A. Create innovative programs for "proficiency" through:
   - Innovation bringing together teaching, research and knowledge development by academicians, practitioners and students.

[9] Taken from the presentation of Prof. R. Macario, et al, during the ETRA invited Session on *Education and training for transport researchers of the future ERA,* at the TRA2014 Conference, Thursday 17th April, 2014.

B. Create or complement new transversal educational offers for:
   - Higher Educational Courses and Programs;
   - Specializations through Lifelong Learning and Vocational Training actions.

C. Promote higher flexibility, tailored contents, operational and practical subjects for educational courses in the Transport sector all over.

D. Promote and / or reinforce the interaction between educational establishments and industry, through:
   - ✓ "trusting partnerships" between academia and practitioners to develop regular problem solving workshops and research projects.
   - ✓ Strategic alliances for on job coaching of practitioners (e.g. "seed planting" approach).

E. Promote full and unhindered mobility of students, professors / teaching staff, and industry professionals.

A further relevant recommendation here, would be the idea for creating an: *European Observatory for Education and Employment in Transport*. Such Organisation would gather all relevant EU-wide available data on transport-related employment, collect and analyse the many national statistics that are available, but – unfortunately – not or difficult to compare, and collect new reliable statistics on transport-related education and training courses which today are almost non-existent.

Benchmarking issues – Towards a Harmonized European Transport PhD

Creating a common understanding and common conditions, at European level, for carrying out the necessary education and training actions in the field of Transport, is undoubtedly a major step in the right direction when considering the creation of ERA-T[10].

Concerted attempts and suggestions at benchmarking (for Transport courses and training material and curricula) have been made over the past decade mainly through EU funded research projects in the FP6, FP7, and now in the H2020 programme. Two of them merit special mention here: the *DETRA* project (*Developing the European Transport Research Alliance*)[11], and the *MORE* and *MORE2* projects (***MO**bility patterns and career paths of **RE**searchers*)[12].

[10] The *European Research Area* in the field of Transport.

[11] DETRA, "Developing the European Transport Research Alliance", project funded by the EU under the 7th FP *(Grant n°266051)* http://detra.fehrl.org/.

[12] MORE2 is the sequel to MORE study on the mobility patterns and career paths of EU researchers. It builds upon existing data (IISER project, MORE project) and at the same time collects and analyses new data on the stock and flows of European researchers. More on: http://www.more-2.eu/.

The main scope of benchmarking, which will consist a further step towards the implementation of the "Vision 2020" of the European Commission's recommendations on the Mobility of researchers, is to:

- → build up a new generation of transport researchers in the European Union and its Associated States;
- → increase their skills, to improve their employability; and
- → favour their trans-national mobility in a multicultural and multidisciplinary context.

A relevant major recommendation of the project *DETRA* was the need for a commonly defined "*European Doctorate (PhD) in Transport*" and the need to define specific guidelines for such a PhD format[13]. The same recommendation noted that full "standardization" may not be possible as it could create compatibility problems with national legislations already in place, but nevertheless some common vision and framework in this respect is necessary in order to face the current and future needs of the decision-making process at European level.

A commonly defined "European Doctorate (PhD) in Transport" would provide, among other features, the acquisition of:

1. Knowledge from basic disciplines (e.g. Mathematics, statistics) in order to enable analysis and management of complex systems;
2. Specific and high-level knowledge related to the various transport disciplines;
3. Experience in project management with development of leadership, mediation and communication skills.

The relevant stakeholders that should take the initiative for the design and implementation of such an *EU PhD in Transport* are:

- **Universities** in charge of PhD programs,
- **Research centres** hosting PhD students,
- Networks of Excellence (**NoEs)** that encourage training and mobility activities,
- **Industries** capitalising on researchers' know-how and abilities, and of course
- The relevant **governmental** bodies.

The proposed format of such a European PhD, could include the main following characteristics (see also Figure 2):

- Admission to PhD course through procession of a Master's degree and a individual interview / evaluation selection process.
- Length of course: 3 to 4 years.

[13] Based on the presentation: ***"Benchmarking on Education and Training in Transport"***, by **Prof. Cristina Pronello**, Politecnico di Torino, Interuniversity Department of Regional and Urban Studies and Planning, *ETRA Invited Session no 43, in TRA 2014, Paris 17-4-2014* .

- Focus: mainly on research with some training courses.
- Required Mobility period: a minimum of a 3- month internship in "industrial" practice.
- Final defence: The written dissertation and an oral presentation / defence procedure.

These are (on purpose) not much different from those of most current PhD programmes. The difference would be on the (common) strict specification and accreditation procedures that would have to be established to ensure compatibility among the different degree conferring bodies (Universities or research organisations).

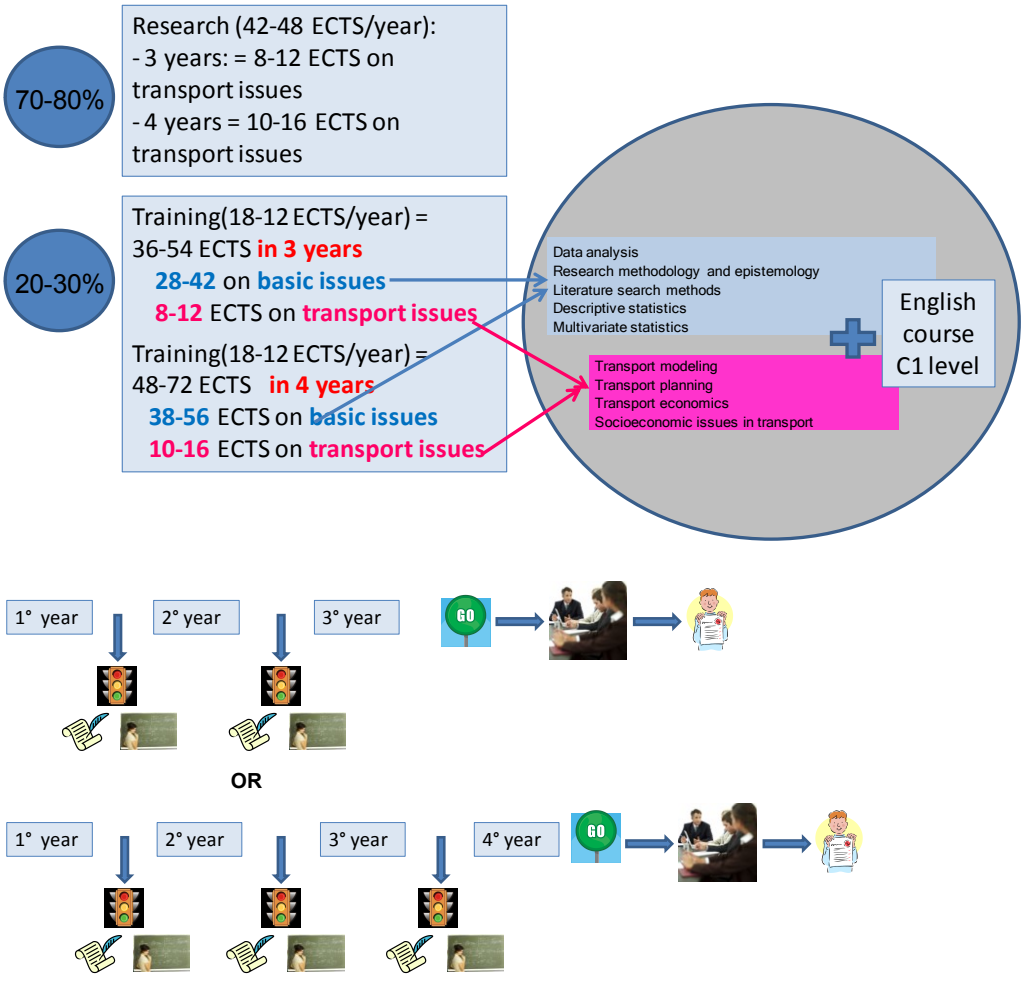

Figure 2: A figurative representation of the main features of the common *European PhD in Transport*[14].

[14] Taken from the presentation of Prof. Cristina Pronello during the ETRA invited Session on *Education and training for transport researchers of the future ERA,* at the TRA2014 Conference, Thursday 17th April, 2014.

The process with which such common *European (or EU) PhD in Transport* would be implemented could be similar (although in much more simplified level) to the so called *Bologna process* which instituted (some 20 years ago) a more uniformly specified higher education system for Europe[15].
Such process could specify and eventually enforce the technical aspects of the "*European Doctorate (PhD) in Transport*" in terms of duration, accession standards, examinations, credits, etc as well as its accreditation and implementation procedures.

Further considerations and critical elements towards building the transport education and training structures of the future

Starting education from the early Stages

Education in the earliest stages of the transport professional pipeline is important: children age 12-14, start thinking about future careers but they are almost completely unaware of the existence of a mobility sector. To combat this, Ireland has had success with school science competitions where children can win a trip to the European Space Centre in Brussels. The competition sets the task of answering the question "what will transport look like in 2030?" It is very encouraging to see these children take an active interest in transport technology.

There is a challenge associated with the need for young people to pick their career path forever at the age of seventeen or thereabouts –whether they realise that this is the effect of the education and training choices they make then, or not.

To reach young people of school age, working with teachers is the best way, perhaps using teachers' professional associations. Both formal and informal channels are needed.

Promoting transport education in Universities and their Graduates

[15] The *Bologna Process* is a series of ministerial meetings and agreements between European countries designed to ensure comparability in the standards and quality of higher education qualifications. Through the *Bologna Accords*, the process has created the *European Higher Education Area*, which was put in place under the *Lisbon Recognition Convention*. It is named after the place it was proposed, the University of Bologna, with the signing of the Bologna declaration by Education Ministers from 29 European countries in 1999. It opened up to other countries signatories to the European Cultural convention of the Council of Europe. Further governmental meetings on the subject of harmonization of higher education courses and curricula have been held in Prague (2001), Berlin (2003), Bergen (2005), London (2007), and Leuven (2009).

A good basic and rounded education is the foundation for attracting students. More students should therefore be confronted with transport during their undergraduate education. This means promoting university education in general and then the interest in transportation will follow.

As an example, six Swedish universities have worked together to develop an organisation known as the Swedish Postgraduate School. This provides a focus for transportation studies within the universities and is also important as a networking forum. It creates a community where students feel they "belong" to the school.

Recruiting to Transportation

There is a trend for young people to be interested in work which is "useful" and not just working for money or status. Students of today want to combine their work with their personal interest - choosing a job is not just about earning money or acquiring social status for them. They also expect dynamic work conditions where training and learning are constant. In all these areas, creative thinking and problem solving ability are essential. There is also a strong international perspective – many students wish to go on to work abroad for at least part of their careers.

There is still work to be done to promote transportation as one field where it is possible to work both usefully in that sense, and also for personal interest.

Network with young Professionals

Transportation is local and cannot be outsourced, but it is possible to work anywhere in the world if you are a transportation professional.

Young professions are very keen on training and make the link with Professional Institutions and the benefits of Chartered Engineer qualifications.

Young professionals network in new ways. Networking is important for the development of young professionals, but for them it is very clear that an informal approach works best, such as informal evening social events and events located away from the workplace or conference venue.

In transportation it is difficult for a generalist to be successful – it seems better to have one strong specialism in order to make an impact, but then also to know something about other specialists and be open to collaboration with them.

The Role of Employers

We also need a new generation employer for our next generation professionals.

We need innovation and future thinking within and by our public administrations and therefore those administrations must employ young professionals and allow them to work in their own way, not change to conform to earlier norms. Perhaps we put too much emphasis on technical "answers" and not enough on vision, leadership, output, and wealth creation. All employees need to identify with a project to be a strong force and create something new.

Organisations need to offer career progression and training (in a broad sense both formal and experience-based)

It isn't easy to change organisational cultures to accommodate new ways of working and thinking and new entrants from different backgrounds, while at the same time being a good employer of the increasing number of people working to age 70 and beyond. The best organisations take advantage of all their generations.

The key approach is openness and transparency on both sides. Different age groups do have different expectations of their workplaces but open management styles, ensuring that everybody is listened to and feels involved, and a willingness to take risks on both sides (which is supported by openness and inclusivity) will yield good results. Above all young professionals should be taken seriously and given trust. That way they will feel valued

Fresh thinking is very important and many employers acknowledge this by hiring from different backgrounds. As an example, the Finnish transport agency has initiated a dedicated team of "Student Visionaries". The group of young people chosen for these roles as a rule have no previous experience in r transport, but bring other perspectives to creating visions for Finnish transport. Their task is to envision Finnish transport and mobility for 2025. The visionaries want to be part of a revolution in Finnish transport: to "be a pirate in the revolution against the old mobility" and make the world a safer, more ecological and comfortable place. Mobility is seen by them as a human right and also the basis for democracy.

An example from the Rail sector

Within Pole 10 of the EURNEX[16] Association, the European Railway University - EURAIL concept has been developed and is being gradually implemented. This is a virtual rail University that aspires to foster, at European level, excellence by gathering and networking relevant Organizations and institutions around an educational project suitable to the needs of the

[16] *European Rail Research Network of Excellence,* an ETRA partner.

European Rail sector. The EURAIL's unique feature is the concentration of high-level knowledge and expertise in one single sector/problem-oriented institution. It is expected that EURAIL will form a coherent community able to define lines of actions and conduct sustainable business in close liaison with EURNEX. Such activities now rank high in the priorities of ERRAC[17] and now within the SHIFT2RAIL Joint Technology Initiative (JTI).

This virtual rail University idea was the result of EU funded project *SKILLRAIL* which provided relevant information of competences needs by domain and level of education in the rail sector and it also specified the Topics that are likely to be of importance and interest in future training activities. These Topics are:

- Legal domain:
  - Working condition directives, harmonization of safety rules, interoperability directives, certification of rail staff, environmental policies.
- Technical domain:
  - ETCS, GSM-R, Galileo, Electronic ticketing, Information systems, Energy efficient driving, modularization, standardisation.
- Market domain:
  - Cross-border operations, Internationalization, change in job preferences, Liberalization, Low fare airlines, Monster trucks, restructuring, Social objectives, life-long learning, customer demands, older and smaller population, demographics.
- Scientific Topics for cross fertilization:
  - Test simulation, Occupant safety, Engine/emissions testing, Materials testing, Aerodynamic and wind tunnel testing, Vibration and shock testing, Acoustic testing , Environmental testing, Mechanical testing | Hydraulics testing, Electrical system testing, Reliability/lifecycle testing, Automated test equipment (ATE), Fuels and integrated systems testing, Test management software, Crash test analysis, Tire testing, Data acquisition and signal analysis, Impact testing, Electronics and microelectronics testing, Fatigue/fracture testing, Torsion testing, Component testing, Impact and crash testing, EMC/electrical interference testing, Structural and fatigue testing, Sensors and transducers, Test facility design, Quality testing and inspection Telemetry systems , Automatic inspection, Stress/strain testing, Calibration, Laboratory instrumentation, Software test and development, Quality management solutions.

[17] The European Rail Research Advisory Council.

The aim for the future [18] is to further develop and consolidate a well characterized landscape of education that offers in transport domains across Europe, and also across the euro-Asian regions - see also the recommendations of the EU funded project *NEAR2*- a number of features and benefits such as to:

- Analyse and define the evolving skill needs of the transport sector and propose changes to the education of transport engineers accordingly, and to attract more young people to transport careers.
- Reduce the fragmentation in the dissemination of scientific and technical knowledge in Europe and enhance its global impact.
- Identify the skills needs in the transport sector, and further contribute to the harmonization of the content of the curricula for rail engineers towards the creation of a Europe wide system. The action should also develop and share outreach material and organise events to attract young people to studies leading to transport careers.
- Build on existing mechanisms and associations, including representatives from the Rail industry, research establishments and education institutions so that the proposed solutions can acquire recognition and support from these different stakeholders.
- Harmonize dissemination activities of scientific and technical knowledge with actions such as:
    - creation of a Europe wide coordination mechanism gathering a representative group of associations active in the field of transport to harmonize and rationalize conferences, events and publications.
    - Contribution to enhance the impact and accessibility of publications relevant to European transport sectors, in particular those issued from EU funded projects.

Synthesis and recommendations

Some basic realizations can be drawn from the previous analysis and facts that were presented in the previous sections. The reader is advised to read the specific sections or the whole report where he can find more details and descriptive texts. The following provide a summary synthesis of the most prominent findings and recommendations of this report.

Perhaps the most important realisation to make is that transport education and training must be seen as an activity that is starting early and extending throughout one's life. As such they are the joint responsibility of the education providers, the transport employers and the other

[18] According to the SKILRAIL project recommendations.

relevant professionals that should all be involved and contributing to their successful performance and implementation.

We are in the middle of a profound contextual evolution for education and training needs in the Transport Sector. This evolution is evident not only in EU but also worldwide, and is more pronounced over the last decade, due to the:

- ✓ Growing demand for skilled personnel in the field of Transport;
- ✓ Economic turmoil and crisis introducing new fields of interest;
- ✓ Needs for sustainable development and high level mobility services;
- ✓ New and very specialised technological advancements;
- ✓ New educational tools and paradigms in the Transport sector.

New demands are created for professional competences and skills in the Transport sector which are cutting across disciplines, novel knowledge fields, and so on.
There is a need to follow on new policy goals, especially those of the current EU Transport policies.
We will also need to face the:

- o growing mobility of professionals between economic activities and between educational Institutions (especially due to the economic crisis).
- o Existing inertia of educational Institutions and Programmes not always compatible with the (transport) industry's dynamics.
- o Gaps or misalignments that exist between Industry needs and the availability of competences and skills.

The growing demands for a comprehensive transport education and training system that will start from the early age until the end of one's professional life, call for:

- → Building a new generation of transport scientists and / or researchers that matches the cross-disciplinary and other market requirements of the Transport field and the socio-economic context of the Area;
- → Increasing the skills acquired by the educational system in the various Transport or Transport related disciplines and improve the employability of graduates;
- → Promoting trans-national mobility of transport researchers and transport personnel in general in a multicultural and multidisciplinary context;
- → Fully exploiting the European Commission's rules and recommendations regarding the Mobility of researchers and other related schemes;
- → Harmonising the higher level education courses in the Transport field and related training initiatives.

Facing these demands we are experiencing a number of weaknesses which are characterized by an incomplete and uncoordinated information provision about curricula and funding opportunities, lack of a shared approach in defining Transport education and training curricula and Transport degree conferring requirements. Also there is no sufficient coordination between

the contents of the courses and curricula offered, with the market needs and policy goals (especially when looking to the needs 10 years ahead).

Similar weaknesses exist as regards the current programmes for the mobility of researchers in the Transport sector.

The following *recommendations* are offered in view of the above realisations*:*

A. ***Create new innovative "postgraduate" programs*** *through bringing together: teaching, research and industrial needs by enhancing cooperation of academicians, practitioners and researchers.*
B. ***Create new or complement existing transport educational "offers",*** *through :*
   - *New courses and programs (more flexible and not focusing on fundamental disciplines only).*
   - *Specialization courses offering higher flexibility, tailored contents, operational and practical subjects; and through offering well designed and coordinated at European level.*
   - *Lifelong Learning and Vocational Training courses.*
C. ***Reinforce University-Industry Interaction,*** *through:*
   - *Partnerships between academia and practitioners to develop programmes and problem solving content.*
   - *Creating strategic alliances for on job coaching of practitioners – the so called "seed planting" approach.*
   - *Promoting mobility of students, teachers and industry professionals further and above all in a coordinated and fully transparent way.*
D. ***Create an European Observatory for Education and Employment in Transport,*** *in order to:*
   - *Collect and analyze data on transport-related employment;*
   - *Compare and harmonize the many relevant but not comparable national statistics;*
   - *Collect reliable statistics on transport-related education.*
E. **Improve the Marie-Curie programme** through:
   a. providing funding for supervisory activities in hosting institutions, i.e. for tutoring or academic supervision of the hosted researchers.
   b. Increasing the allowable percentage of commercial work that a *Marie Curie* programme supported researcher can undertake for the institution he/she is placed with. This will give the individual researcher some commercial experience and skills that are necessary to a researcher, and will help manage the hosts' institutional costs especially for organisations with no Government funding.
   c. Increasing the incentives to encourage stronger and more commercially oriented research institutions to provide highly skilled researchers as "stagers" to lesser developed or developing research organisations.

d. Supporting the creation of a pan-European database of researchers per sector (in our case for the Transport sector). Such database would be useful for more efficient and widespread transport research mobility all around.

F. Promote transport education and specialization within the young University students and graduates.

G. Promote networking of young transport professionals in order to strengthen "specialism" and also get them to know more about other specialists and be open to collaboration with them.

H. Work and "educate" the transport employers of the need to facilitate and promote the further ands lifelong education and training of their employees.

I. Finally, work towards establishing some harmonized and well specified Transport degrees starting with a "***European Transport PhD*"** which will feature:

1. Acquisition of knowledge from **basic disciplines** (e.g. Mathematics, statistics, etc) to handle complex numerical systems;
2. Acquisition of **specific and high-level knowledge** related to <u>many</u> transport disciplines;
3. Acquisition of **experience in industry relevant to the subject of the PhD.**
4. Acquisition of **experience in project management** with concurrent development of skills in the leadership, mediation and communication areas.
5. Other common, more flexible and interdisciplinary technical features in terms of duration, accession, exams, credits, etc which although not very different from the existing ones (e.g. pre-requisites for admission, minimum length, exams, etc), would nevertheless be subject to strict specification and enforcement mechanisms.

The process to establish such "commonly specified" European degree in the field of Transport could be similar (but somewhat lesser complex and time consuming) to the so called "Bologna process" that initiated the harmonization of procedures and outcomes in the higher education sector in Europe 20 years ago.

APPENDIX

More about ETRA

The current partners (members) of the European Transport Research Alliance (ETRA) are the following European Associations (in alphabetical order):

- ECTRI (European Conference of Transport Research Institutes)
- EURNEX (European Rail Research Network of Excellence)
- FEHRL (Forum of European National Highway Research Laboratories)
- FERSI (Forum of European Road Safety Institutes)
- HUMANIST (Human centered design Network for Information Society Technologies)

The members of the above partners of the European Transport Research Alliance, are approximately 75 individual Transport Research providing Organisations employing many thousands of transport researchers, from almost all countries of Europe.

For more information and data concerning each of these Organisations and their activities visit the sites of the ETRA partner Organisations through the ETRA site (www.etralliance.eu) or the links provided in the names above.

For more information and terms for joining the ETRA, please refer to its site where you can find all the basic documents of the Alliance (such as the Alliance's Terms of Reference and its scope and vision document).