D4.3 Recommendations on furthering and strengthening the current and future competitive position of the European transport manufacturing industry

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Consortium

No	Participant organisation name	Short Name	Country
1	VDI/VDE Innovation + Technik GmbH	VDI/VDE-IT	DE
2	Railenium	Railenium	FR
3	Cranfield University	CU	UK
4	Maritime University of Szczecin	MUS	PL
5	Transportøkonomisk Institutt	TOI	NO
6	Institute of Shipping Economics and Logistics	ISL	DE
7	IK4 Research Alliance	IK4	ES
8	Intl. Association of Public Transport Operators	UITP	BE

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1 Introduction

This report was created within the SCORE project “Scoreboard of Competitiveness of European Transport Manufacturing Industry”. It is the third report for Work Package 4 “**Framework and Recommendations**” and covers Task 4.2 “Derivation of recommendations towards individual stakeholder groups”.

1.1 Project background

WP 4 “Framework and Recommendations”, led by TOI, investigates framework conditions, legacy instruments and derives a comprehensive set of tangible recommendations for relevant public and private stakeholder groups.

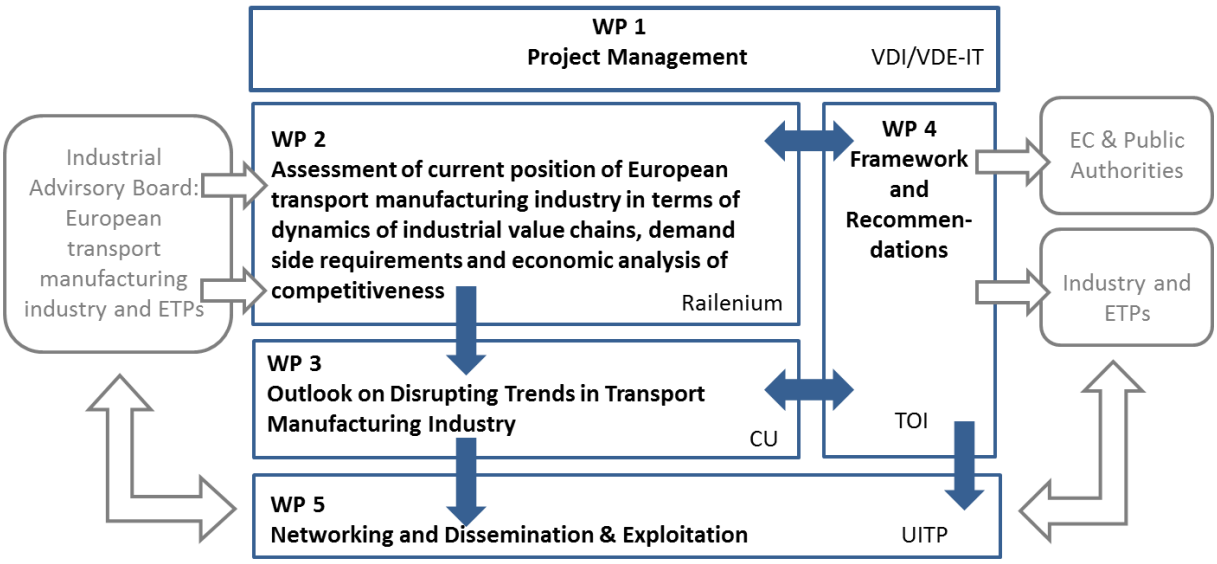


Figure 1: Work Package Relations of the SCORE project

1.2 Objective of the task

The current global competitive position of the European transport manufacturing industry as well as the trends and future developments having an impact on them are significantly affected by policy and legal developments. Hence, WP 4 provides information on relevant framework conditions and current anticipated developments in relevant policy areas for the work in WP 2 and WP 3. Major objective of WP 4 is, however, to derive a comprehensive set of tangible recommendations for relevant decision makers in industry and public authorities. This is achieved by building on the profound knowledge base that has been developed within WP 2 and WP 3. Specific objective of WP 4 thus is:

- Derive tangible recommendations regarding policy, regulation and legislation, skills and education, R&D strategies, innovation capabilities etc. for relevant stakeholder groups such as European and national public authorities and policy makers as well as transport manufacturing industries of all four sectors.

The different policy areas within this inventory of policies and actors were analyzed with regard to their aims, strategies, instruments and implementation measures. Furthermore, future developments and perspectives on novel policies and legislative measures were anticipated. Moreover, the binding character of these policies are assessed, i.e. on the one hand to what extent mandatory laws do exist and on the other hand whether there are areas allowing a certain degree of administrative discretion. This analysis differentiates among different policy levels, i.e. MS, EU, global and non-EU national.

The derivation of impacts of policies on the transport manufacturers' competitiveness and also on trends and future developments that also affect the competitiveness of transport manufacturers are carried out in in collaboration with WP 2 and WP 3.

2 Recommendations to secure the future competitiveness of the European Transport Manufacturing Industry

To assess the competitiveness of the European Transport Manufacturing Industry, various essential areas were identified during the course of this project. In the following a short summary of the areas focusing on the conclusions is given, details can be looked up in the respective SCORE deliverable documents.

2.1 Cross-sectoral collaboration

Cross-sectoral collaboration was identified as one of the most promising and important topics for future policy options. In the project's first Industry Workshop the research area was identified and discussed by experts of and within the European transport manufacturing industry. Therein first potentials for cross-sectoral collaboration were elaborated[1]. In the second Industry Workshop at the Through-Life-Engineering Service Conference this topic was further developed by the identification of barriers and opportunities. In a concluding session, important questions were raised on how the policy framework, funding instruments and political initiatives foster cross-sectoral collaboration and which specific key aspects they should target.[2] The topic was also reflected in the expert survey with several specific questions[3] and is also reported in detail in D4.2 "Report on future perspectives regarding framework conditions for the European transport manufacturing industry."

In summary, the main opportunities identified for cross-sectoral collaboration are:

- Automation
  Automation technologies, spanning from Driver Assistance Systems to the fully autonomous vehicle, are an essential research topic in all sectors. Irrespective of the branch companies invest large amounts to achieve global technological leadership and try to make use of the opportunity to influence upcoming standards.[4]

- Digitalisation
  Digital transformation is one of the top priorities identified. Digital technology accelerates and enables new business models, creates new value through servitisation (adding a service to a product or replacing it), and rapidly increases innovation speed. Future challenges are e.g. proper data management, constant connectivity including communication channels and establishing a sufficient level of cyber-security.[5]

- Material research
  Synergies in material research should be further intensified. There is a huge potential to optimize the development of materials as well as the production processes themselves.

- Knowledge transfer

[1] D5.2 First Industry Workshop

[2] D5.3 2nd Industry Workshop

[3] D3.3 Analysis of future global competition arenas for the European transport manufacturing industry

[4] D2.1 Mapping of the current status of dynamics of value chain of European transport manufacturing industry & D3.1 Mapping of future perspectives and challenges for the value chain of European transport manufacturing industry

[5] All deliverables in WP 3

Efficient and effective knowledge-sharing between different industry sectors is still not sufficiently institutionalised and many companies (especially SMEs) are more or less silo-oriented. Best practices, methodologies, applications, processes and technologies are considered to be potential topics for knowledge transfer.

- Circular economy
  The environmentally sustainable approach to effectively and holistically consider all utilised resources for the whole lifecycle – ranging from design to manufacturing, usage, repair and recycling – is moving more and more into the focus of attention. This is mainly due to environmental aspects and sustainable approaches all around the globe.

The main barriers identified for cross-sectoral collaboration are:

1. Innovation cycles
   Considered industry segments follow diverging time lines for the qualification and implementation of new manufacturing technologies. This issue becomes a little weaker with service innovations in the ICT area but still holds true for general technology developments.

2. Regulatory structure
   Different regulations massively impede collaborative structures between companies and academia working in different industry sectors. This is due to their high complexity. Further gaps exist between Technology Readiness Levels (TRLs) or sector-specific industry standards.

3. Value chain structure and business models
   Although various papers and approaches proclaim Multimodality or Mobility-on-Demand as essential aspects for the future, most work procedures and established value chains are still rather silo-oriented.

4. Work culture & ethics
   Different working environments, skill requirements and labour conditions become manifested in a fundamentally diverging working culture, language and atmosphere which hinders an efficient collaboration across industry sectors.

The main conclusions derived from these assessments are:

- Cross-sectoral collaboration is getting increasingly important for all industry sectors. Not only because of the user-driven concepts of mobility-on-demand and multimodality, but also to leverage synergies between the different transport modes regarding aspects like best practice sharing and structured or institutionalised technology transfer between industry sectors (e.g. for key technology trends like automation or cyber-security).
- Barriers for cross-sectoral collaboration should be further lowered and technology transfer across different industry sectors should be fostered. This could also be implemented by joint workshops of funded projects of the European Commission.
- As already stated, the creation of a cross-modal European Technology Platform to foster European Research, Development and Implementation would be beneficial to increase the future competitiveness of the industry and fundamental to achieving cross-sectoral collaboration.

Concluding the above, there is a strong necessity to work across sectors in the future. To achieve this, suitable funding and policy instruments need to be established, such as the creation of a cross-modal European Technology Platform to foster European R&D&I. It is seen as desirable for increasing the

future competitiveness in the industry and for achieving cross-sectoral collaboration. Strategic partnerships are the preferred industrial collaboration model.

2.2 China as an opportunity but also as a challenge

The enormous Chinese demand for transport components, solutions and systems constitutes the biggest and therefore most important market for most industry segments. China, a country that used to be a major importer of transport systems and components, is now following a more competitive approach with Chinese companies focusing on and supplying mainly the domestic market and to a lesser extent – but still increasing – also offering its competitive products internationally. In the rail rolling stock industry, for instance, Chinese companies are already the biggest supplier of high-speed trains (with around two-thirds of deliveries). This has been achieved solely by serving the substantial domestic demand and not by accessing international markets. Also in the automotive market Chinese companies are already the world's largest electric vehicle manufacturer.[6] Even though protectionism, and hence reduced market access to major markets of interest, was perceived as a likely risk at the expert survey, the upcoming Chinese competition was the top-ranked risk in the project's expert survey.[7]

Of course, the strong competition setting imposed by China is not only felt by transport manufacturers but by all advanced manufacturing sectors in Europe. The recent publication of an extensive report (463 pages) on Chinese state-induced market distortions[8] by the European Commission shows the importance of the issue at a macro-level. This report follows the adoption by the Commission of a new dumping methodology addressing cost and price distortions.[9] Whether the modernization of the EU anti-dumping regulations will be of any benefit to transport manufacturers remains yet to be seen. However, it is likely that this regulatory change facilitates imposing anti-dumping duties at a faster pace.

The amount European companies invest in Research and Development (R&D) activities compared to their global rivals has a significant impact on their innovation capabilities and will be reflected in the long run also in the maturity of products, services and manufacturing processes. Research and development expenditures play a crucial role in the capacity to innovate, improve or create new products; gain new markets and increase productivity; and hence, ensure competitiveness and growth. Investing in R&D is therefore crucial for several topics mentioned above, e.g. retaining technical leadership of EU manufacturers, developing skills and facing upcoming competition from China. China's R&D expenditures have been increasing throughout past years and reached a record high in 2017. It seems as if the Chinese government wants innovation to become the driver of their economy. In view of R&D expenditure Asia leads the competition in several industry sectors while some of the EU transport manufacturing sectors show a decreasing trend in private R&D investments.[10]

Despite various expert analyses and multiple discussions between the SCORE consortium and industrial experts, there was no real agreement about the set-up of appropriate counter-measures against protectionist tendencies Europe is facing at the moment. Some experts are in clear favour of

[6] D2.1 Mapping of the current status of dynamics of value chain of European transport manufacturing industry and D2.2:Push and pull factors for industry as derived from comprehensive demand side analysis

[7] D3.3 Analysis of future global competition arenas for the European transport manufacturing industry

[8] European Commission 2017

[9] EU Regulation 2017

[10] D2.1 Mapping of the current status of dynamics of value chain of European transport manufacturing industry and D3.1Mapping of future perspectives and challenges for the value chain of European transport manufacturing industry

trade liberation, free markets and the resulting need to strive for global technological leadership of European companies. Other experts recommend a change in EU trade policy, connecting the licensing of Chinese external industrial investments in Europe (FDI) with the broadening/liberalisation of market access for European manufacturers. Although there is no agreement about protecting Europe's intellectual property and competences, the liberalisation of the Chinese market is encouraged by all stakeholders of the SCORE project.

2.3 Highly qualified workforce

Skilled employees and workers are crucial assets for innovations, R&D activities and technological leadership. In the knowledge-intensive environment of digital innovations, this topic becomes more relevant than ever as the general trend indicates that competition for excellent workers will further intensify. An increased effort in education and training, especially for rapidly emerging areas which are relevant in all industry sectors (e.g. cybersecurity), should be further intensified. In Work Package 2 a detailed analysis with a specifically designated research area for the topic "WorkForce" was compiled for all considered transport industry sectors.[11] The expert survey also illustrated the clear need of the industry for highly skilled people[12] which was also discussed and emphasized at the SCORE Final Conference in Brussels.[13]

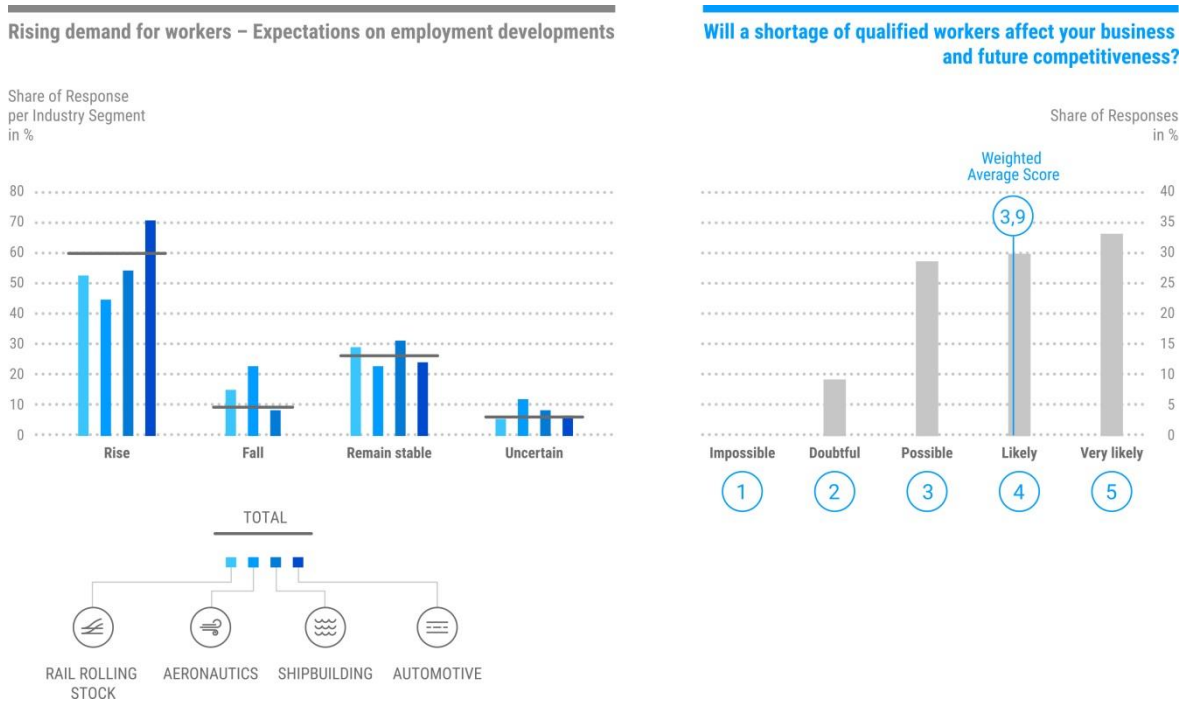


Figure 2: SCORE survey results illustrating the rising need for employees while already expecting a shortage of skilled staff (© VDIVDE-IT 2018)

In conclusion European transport manufacturers are concerned about their future access to sufficiently qualified employees, particularly given the fast developments in emerging technologies and the increasing risk of cyber-incidents. Employees have to be prepared for new digital services and automation technologies

[11] D2.1 Mapping of the current status of dynamics of value chain of European transport manufacturing industry

[12] D3.3 Analysis of future global competition arenas for the European transport manufacturing industry

[13] D5.4 Results of the 3rd Industry Workshop

2.4 Advanced Manufacturing Technologies

During the course of the project many advanced manufacturing and enabling technologies were discussed and assessed in various aspects. The European transport manufacturing industry in general seems to be optimistic about technology developments; emerging technologies are largely perceived as opportunities for future competitiveness, not as risks.[14]

Key manufacturing technologies were intensively discussed in the workshop at the Trough-Life-Engineering Services conference, where one of the main objectives was to identify those potential technologies that are in nature either innovative or disruptive and how the industry is currently planning their activities around these developments.[15]

While there are a lot of important technologies at present and will be in future, the three key technological trends for all transport manufacturing industry sectors are[16]:

Automation

Automated driving will radically change customer behaviour and sets high demands for the industry sectors, starting from advanced driver assistance systems to fully autonomous vehicles and systems. At present, we witness the competitive strive for technological leadership with the opportunity for technical pioneers to realize new business models and essentially influence upcoming standards. The automation of the transport sector and the implications on the respective industry was elaborated from different angles within the SCORE project, e.g. spanning from the quantity and type of filed patents to the estimation of future demand scenarios with a mixed road use. Certainly, this technology will substantially shape the future of mobility.

Electrification

Alternative propulsion technologies are one of the top priorities for developing a sustainable mobility system for the future. This key technological trend was analysed and assessed within the project in various aspects for all industry sectors and is reported in almost all deliverables of work package 2 and work package 3. Specifically designated chapters illustrate the necessity for the European industries[17] to focus on challenges and technological trends, especially on alternative propulsion technologies. The need for change is reflected by present and upcoming demand requirements and political tendencies, e.g. analysing the effect of incumbents and new entrants which are both trying to capture new opportunities along the electric vehicle value chain that did not exist with internal combustion engines. Furthermore, technological aspects dealing with the set-up and level of integration of the value chain of European transport manufacturing industries and its future structure were analysed in specific chapters like e.g. fuel cell propulsion technologies and its comparison with big manufacturers in Japan and Korea for the automotive sector or the slow switch from fossil fuels to alternative energy sources such as bioenergy or fuel cells in the aerospace industry.

Digitalisation

Digital innovations are by far the most rapid developing technology, enabling new structures for the manufacturing value chain by the implementation of cyber-physical systems, disrupting well-established business models offering new opportunities for existing and new competitors and

[14] D3.3 Analysis of future global competition arenas for the European transport manufacturing industry

[15] D5.3 2nd Industry Workshop

[16] All deliverables in work package 2 and work package 3

[17] D2.1 Mapping of the current status of dynamics of value chain of European transport manufacturing industry

enable sophisticated service innovations throughout the whole lifecycle. Various designated chapters within the SCORE project, e.g. analysing the competitive race for ownership of upcoming digital customer interfaces or assessing the implications on transport ecosystems in terms of operation, maintenance and service and its effects on the respective industry structure, demonstrate the importance of these key trends.

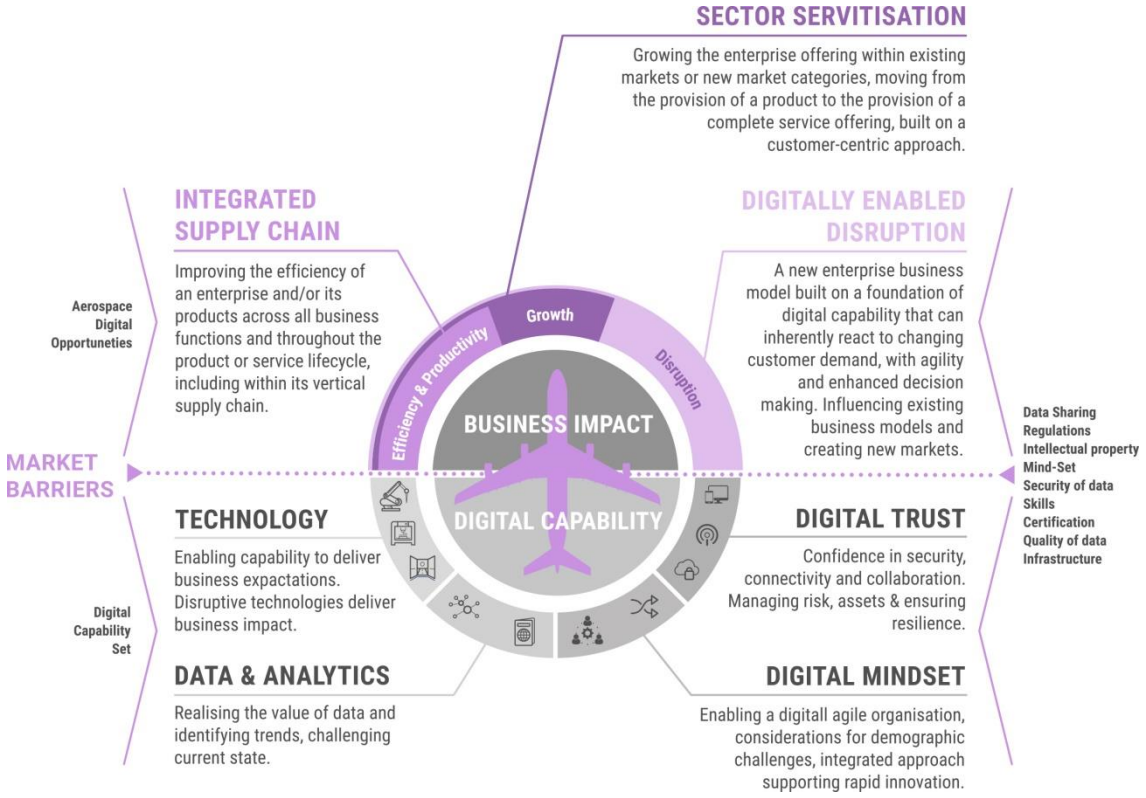


Figure 3: A framework for aerospace sector digitisation. Excerpt from SCORE Deliverable D3.2 Push and pull factors for industry as derived from analysis of disruptive trends shaping future demand side (source: ATI, 2017)

As these key technology trends (and many others) shape the future of the European transport manufacturing industries, effective regulatory frameworks need to keep up with the rapid development and innovation speed and allow pilot implementations, (large-scale) testing in realistic environments and finally the realisation of product applications and the implementation of business models and service innovations for European manufacturers. Potential barriers might be e.g. the prevailing privacy protection instruments in the European Union that are strongest in global comparison.

2.5 Servitisation

The sophisticated combination of products and service innovations offers new business opportunities for the European transport manufacturing industry. This holistic approach, considering business opportunities throughout the whole product lifecycle, is relevant for all industry sectors with consideration of sector-specific industrial requirements. The topic was further elaborated on multiple occasions within the SCORE project. The academic session and the industrial workshop at the Through-Life-Engineering Service conference were specifically addressing this topic[18]. Invited experts at the SCORE Final Conference also specifically mentioned “Servitisation” as one of the most promising business opportunities for manufacturing SMEs and presented opportunities to e.g. test digital service innovations at designated hubs[19]. Servitisation and its impact on present and future

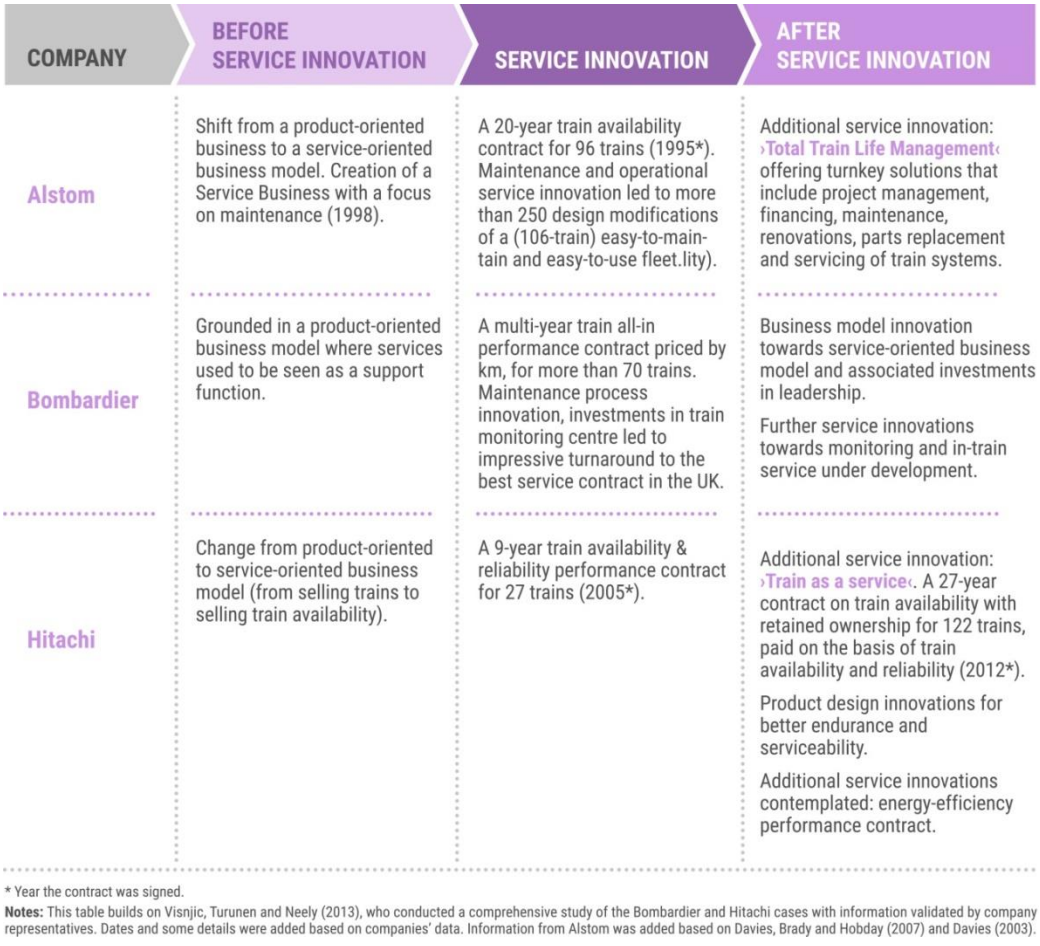
[18] D5.3 2nd Industry Workshop

[19] D5.4 Results of the 3rd Industry workshop

competitiveness of European manufacturers was elaborated multiple times throughout the course of the project.[20]

Example for Rail/Rolling stock industry[21]

In 2030, rolling stock manufacturers will have moved from a product-based business model to advanced train transportation services. This change has the potential to increase both the robustness of the supply chain and the attractiveness of rail transport. European rolling stock manufacturers, who were pioneers in offering train availability services, will undoubtedly enjoy the first-mover advantage capitalised through learning-by-doing competences that will allow them to secure further contracts and remain the global leaders in the provision of train availability services. By 2025, rolling stock manufacturers would be making half of their revenue from selling vehicles and the other half from aftersales and services. While private investments in the US and EU are very high, Asian national authorities invest lower amounts in modernising railways.



COMPANY	BEFORE SERVICE INNOVATION	SERVICE INNOVATION	AFTER SERVICE INNOVATION
Alstom	Shift from a product-oriented business to a service-oriented business model. Creation of a Service Business with a focus on maintenance (1998).	A 20-year train availability contract for 96 trains (1995*). Maintenance and operational service innovation led to more than 250 design modifications of a (106-train) easy-to-maintain and easy-to-use fleet.lity).	Additional service innovation: ›Total Train Life Management‹ offering turnkey solutions that include project management, financing, maintenance, renovations, parts replacement and servicing of train systems.
Bombardier	Grounded in a product-oriented business model where services used to be seen as a support function.	A multi-year train all-in performance contract priced by km, for more than 70 trains. Maintenance process innovation, investments in train monitoring centre led to impressive turnaround to the best service contract in the UK.	Business model innovation towards service-oriented business model and associated investments in leadership. Further service innovations towards monitoring and in-train service under development.
Hitachi	Change from product-oriented to service-oriented business model (from selling trains to selling train availability).	A 9-year train availability & reliability performance contract for 27 trains (2005*).	Additional service innovation: ›Train as a service‹. A 27-year contract on train availability with retained ownership for 122 trains, paid on the basis of train availability and reliability (2012*). Product design innovations for better endurance and serviceability. Additional service innovations contemplated: energy-efficiency performance contract.

* Year the contract was signed.

Notes: This table builds on Visnjic, Turunen and Neely (2013), who conducted a comprehensive study of the Bombardier and Hitachi cases with information validated by company representatives. Dates and some details were added based on companies' data. Information from Alstom was added based on Davies, Brady and Hobday (2007) and Davies (2003).

Figure 4: Service innovations of selected rolling stock suppliers (Excerpt from SCORE Deliverable D3.2 Push and pull factors for industry as derived from analysis of disruptive trends shaping future demand side (source: Visnjic, 2013)

As a conclusion of the SCORE project, it can be stated that the current position of the European Transport Manufacturing Industry is in general rather good, however, prospects for the future are not very promising. To further secure European competitiveness, efforts have to be undertaken and

[20] All deliverables in work package 2, D3.1 Mapping of future perspectives and challenges for the value chain of European transport manufacturing industry, D3.2 Push and pull factors for industry as derived from analysis of disruptive trends shaping future demand side

[21] D3.2 Push and pull factors for industry as derived from analysis of disruptive trends shaping future demand side

appropriate policy regulations and instruments, taking the above conclusions derived within the SCORE project into consideration, should be implemented.

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