Disclaimer and acknowledgement

This project has received funding from the European Union's Horizon 2020 Programme Research and Innovation action under grant agreement No 636071

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Smart-Rail consortium

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### Document Change Log

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<td>02.09.2016</td>
<td>First draft of document</td>
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<tr>
<td>v0.2</td>
<td>16.09.2016</td>
<td>Revised version based on the comments of Johanna Ludvigsen (TNO) and Zsolt Horvath (CER)</td>
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<td>v1.0</td>
<td>23.09.2016</td>
<td>First final version, not considered ready for upload by the scientific coordinator.</td>
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<td>V1.1</td>
<td>30.11.2016</td>
<td>Final version, GA approved, for upload to the participant portal</td>
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<td>Johanna Ludvigsen (TNO, reviewer) Zsolt Horvath (CER, reviewer)</td>
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<td>V1.0</td>
<td>23.09.2016</td>
<td>Ferdinand Stumpf (WP-Leader)</td>
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<tr>
<td>V1.1</td>
<td>30.11.2016</td>
<td>Matic Prosen (WP-Leader)</td>
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### Verification and approval

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<td>Verification Final Draft by WP leader</td>
<td>Mr Ferdinand Stumpf</td>
<td>23.09.2016</td>
</tr>
<tr>
<td>Approval Final Deliverable by coordinator</td>
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<td>06.12.2016</td>
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Executive summary

In the last few years there has been a strong political demand to shift more freight in Europe from road to rail, however no significant improvements have been achieved so far. The rail reform has influenced passenger transport and resulted in a multifaceted picture by companies - at least in those countries implementing the legislation consistently – that had led to higher passenger numbers, but in the contrast, freight transport by rail has stagnated or in some cases slightly declined.

This deliverable presents results of task 3.3 “Development of business models supporting cooperation within the rail sector”. The main objective is to analyse cooperation in the rail sector by using a step-by-step approach and find solutions that would increase cooperation and consequently contribute to the initial goal of the project and EU. One of the key steps is to identify key stakeholders and their characteristics in order to develop and propose an improved business model. The main question being answered in this task is, how can new business models improve cooperation within the rail freight sector by following the key objectives of the Smart-Rail project, reliability, lead time, costs, flexibility and visibility.

The development of a proposed business model is based on a general approach and a step-by-step procedure by taking into account successful practical examples from past projects. This deliverable focuses specifically on the identifying the current state of cooperation in the rail sector. Based on the previous deliverables, the main stakeholders and their interactions have been identified and the proposed business model have been developed in connection with the results of the Work Packages 6 to 8 (Continuous improvement Tracks 1 to 3). Appropriate findings are evaluated by considering the Value Case Methodology, coordination of activities with Work Package 4 is carried out, and experiences from earlier European projects RETRACK and ECOPMS are adopted.

The results of this deliverable show a proposed cooperation model that is based on the CITs. Similar approach as resulted in the proposed business model can be considered also for other segments of the rail sector. The proposed models have several variations, and can be structured based on the complexity of involved stakeholders. Proposed cooperation models that are described in this task are:

- Management of idle capacity,
- Bundling of existing trains for better capacity sharing, and,
- Organisation of new train services.

The key findings of this deliverable are based on the proposed business models in the fact, that a neutral coordination body is required in order to improve rail freight services offered to the final customers, shippers. In addition, there is also a need for a data platform, where all necessary information would be gathered. Both aspects are required for a smooth coordination of the whole process that can consequently contribute to the overall goal of the EU.

Proposed business models can also influence on several bottlenecks identified in previous deliverables. Solutions based on the proposed business models can contribute primarily to the operative and partly the infrastructural problems occurred in the rail freight sector. The proposed cooperation models however, cannot solve regulatory bottlenecks or barriers in accessing the infrastructure which need to be addressed at a much higher level.
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<tr>
<td>4PL</td>
<td>fourth-party-logistics service provider</td>
</tr>
<tr>
<td>ARA</td>
<td>Amsterdam-Rotterdam-Antwerp ports</td>
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<tr>
<td>CANVAS</td>
<td>kind of business model</td>
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<tr>
<td>CCS</td>
<td>common components system</td>
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<tr>
<td>CEO</td>
<td>chief executive officer</td>
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<tr>
<td>CER</td>
<td>Community of European rail (same abbreviation is used for a Hungarian private railway undertaking)</td>
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<tr>
<td>CI</td>
<td>customer interface</td>
</tr>
<tr>
<td>CIM</td>
<td>standardized document for cross-border transport of cargo by rail, based on UN recommendations</td>
</tr>
<tr>
<td>CIS</td>
<td>charging information system</td>
</tr>
<tr>
<td>CIS-states</td>
<td>Commonwealth of Independent States</td>
</tr>
<tr>
<td>CIT</td>
<td>Continuous Improvement Tracks</td>
</tr>
<tr>
<td>COTIF</td>
<td>convention relative aux transports internationaux ferroviaires</td>
</tr>
<tr>
<td>COTS</td>
<td>commercial off-the-shelf (different types of ICT systems)</td>
</tr>
<tr>
<td>CRM</td>
<td>customer relationship management</td>
</tr>
<tr>
<td>CT</td>
<td>container terminal</td>
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<td>CT-Rail</td>
<td>control tower–rail</td>
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<tr>
<td>EC</td>
<td>European Commission</td>
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<tr>
<td>ECOPMS</td>
<td>project: pooled services platform for an ECO multimodal logistics</td>
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<tr>
<td>ERA</td>
<td>European Rail Agency</td>
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<tr>
<td>ERFA</td>
<td>European Rail Freight Association</td>
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<tr>
<td>ERP</td>
<td>enterprise resource planning</td>
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<tr>
<td>ETA</td>
<td>estimated time of arrival</td>
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<tr>
<td>ETD</td>
<td>estimated time of departure</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>ICT</td>
<td>information and communications technology</td>
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<tr>
<td>IM</td>
<td>infrastructure manager</td>
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<tr>
<td>IT</td>
<td>information technology</td>
</tr>
<tr>
<td>IWW</td>
<td>inland waterway</td>
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<tr>
<td>KPI</td>
<td>key performance indicator</td>
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<tr>
<td>LRU</td>
<td>leading railway undertaking (in a transport chain)</td>
</tr>
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<td>LSP</td>
<td>logistic service provider</td>
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<tr>
<td>NHM-Code</td>
<td>Nomenclature Harmonisées Marchandises</td>
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<td>OR</td>
<td>operational research</td>
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<tr>
<td>Acronym</td>
<td>Definition</td>
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<tr>
<td>OSJD</td>
<td>organization for cooperation of railways</td>
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<tr>
<td>PCS</td>
<td>path coordination system</td>
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<td>RETRACK:</td>
<td>project: “REorganisation of Transport networks by advanced RAil freight Concepts”</td>
</tr>
<tr>
<td>RNE</td>
<td>RailNetEurope</td>
</tr>
<tr>
<td>RO</td>
<td>railway operator</td>
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<tr>
<td>RU</td>
<td>railway undertaking</td>
</tr>
<tr>
<td>SC</td>
<td>supply chain</td>
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<td>SHIFT²RAIL</td>
<td>public-private partnership in the rail sector</td>
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<tr>
<td>SME</td>
<td>small and medium sized enterprises</td>
</tr>
<tr>
<td>SMGS</td>
<td>Соглашению о международном железнодорожном грузовом сообщении (Russian freight documentation)</td>
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<tr>
<td>SWL</td>
<td>single wagon load</td>
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<tr>
<td>TAF</td>
<td>telematic applications for freight</td>
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<tr>
<td>TIS</td>
<td>train information system</td>
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<tr>
<td>tkm</td>
<td>ton kilometres</td>
</tr>
<tr>
<td>TMS</td>
<td>transport management systems</td>
</tr>
<tr>
<td>TSI</td>
<td>technical specification for interoperability</td>
</tr>
<tr>
<td>UIC</td>
<td>Union internationale des chemins de fer</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>VCM</td>
<td>value case methodology</td>
</tr>
<tr>
<td>VP</td>
<td>value proposition</td>
</tr>
<tr>
<td>VPI</td>
<td>association of freight wagon owners in Germany Inc.</td>
</tr>
<tr>
<td>WP</td>
<td>work package</td>
</tr>
<tr>
<td>X-Rail</td>
<td>single wagon system of some state-owned railway undertakings</td>
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1 Introduction

1.1 Background Smart-Rail

The aim of the European Railway Agency (ERA) is to construct a safe, modern integrated railway network with the overall target that railways must become more competitive to other transport modes and seek and offer high-quality, end-to-end services without being restricted by national borders.

To achieve the necessary modal shift from road to rail the rail sector faces an unprecedented challenge of providing the capacity for affordable and attractive services required to enable this modal shift. The current European rail freight market is a complex system involving a great number of different public and private stakeholders, such as infrastructure managers, rail operators, terminal operators and freight forwarders who jointly manage the operation of running trains from A to B. The Smart-Rail project is aligned with the objectives of SHIFT²RAIL and will ensure that the results can be used in further research in this programme.

The objectives of Smart-Rail are:

- to contribute to a mental shift of the rail sector toward a client oriented and supply chain focus;
- to develop working business models for cooperation of different stake-holders;
- to develop a methodology and architecture for exchange of data/information required for the optimisation process, between stake-holders, making use of existing initiatives where available (for instance the European Corridor Management and national logistical information centres);
- to establish three Continuous Improvement Tracks (CIT’s) that each focus on different aspects and markets and implement the developed tools, methodologies and concepts. The purpose of the CIT’s is to test and improve the innovative measures in a real life situation. Specific and more dedicated business models, information systems and new rail services will be test.

1.2 WP 3 objectives

This WP addresses the development of business models supporting cooperation within the rail freight sector. Special objective of these business models is to enhance freight services regarding reliability, visibility, flexibility, costs and lead time. In general a business model describes the function of individual components of an enterprise and their interaction. Therefore every company has a business model, answering below entrepreneurial questions:

- What benefits are offered by the company to the customers and its most important partners, who are a part of value creation?
- How does the company render these benefits?
- How does the company make money?

In view of market competition – not only in the rail sector – it is in addition crucial for each company to differentiate its own business model from competitors. For this reason a strategic component has to be added to the existing model, leading to changes suitable for working out advantages against competitors. This is also of special importance regarding cooperation. Defining what are the requirements for a successful business model for cooperation, offering a win-win strategy for all partners and ensuring sustainability of transports, is the aim of this deliverable. Addressees are rail sector partners, in particular railway undertakings, willing to cooperate.

Basic principle to build upon in order to achieve both this objective and realistic results is to combine theory and practice. This includes close interaction with the three Continuous
Improvement Tracks to incorporate their inputs into the new business models. In addition this approach allows tackling problems and bottlenecks affecting cooperation in the rail sector. Among these are:

- Operational problems, inherent or related to the freight train operations, both on the infrastructure side and on the railway undertaking side, affecting adversely reliability, flexibility and lead time of the service;
- Financial problems, related to all types of door-to-door costs (network, equipment, services), integrated transportation and information exchange issues, affecting reliability, flexibility and the costs of services;
- Problems in interaction with users/customers involving information transparency leading to challenging or suboptimal data sharing and, insufficient offer of the services, affecting reliability, flexibility, lead time, visibility and costs;
- Challenging interaction between other stakeholders as challenging data formats standardisation and transferability of the strategies and models, affecting all five aspects of Smart-Rail with the exception of lead time, but most often the flexibility and visibility of the service [1].

For defining the structure of the business model below categories are taken into consideration:

- Shippers/Operators;
- Assets and Vehicles;
- Infrastructure;
- Financial issues;
- Organisation;
- Communication.

To assess the effectivity of business models measurable quantities (KPIs) and/or non-measurable indicators are defined. These will allow determining the most suitable model for cooperation in the rail sector.

The output of this WP will be a guideline for business models supporting cooperation within the rail freight sector.

1.3 Purpose of the document

The main objective of this WP is the selection and development of new business models supporting cooperation within the rail freight sector.

Part of the methodology applied is the assessment of experiences of the three Continuous Improvement Tracks (CIT) in the context of the main objectives. The main features of the CIT’s in the context cooperation within the rail sector are:

- CIT1: operational / equipment
- CIT2: data exchange
- CIT3: commercial / cooperation structures

In the current development of CIT’s the dynamics have to be avoided, rather this work has to be monitored with regard to the same target direction. Based on the working manual the purpose of cooperation has to be described; however, such an understanding leads to a complex network structure which is working in horizontal as well as vertical directions.

A business model supporting cooperation within the rail freight sector has to be developed as a concept of sustainability with an overall continuity of processes. Next to organizational forms (vertical / horizontal) and IT the infrastructure will be defined as the third factor.
Further results are the dialectic of automatic capturing of KPI’s (based on a communication model) as well as to sketch an “early-alert-system” in case of deviating from the process continuity.

1.4 Document structure

1.4.1 Description of work related to deliverable as given in DoW

The development of a business model within the rail freight sector is worked out in three main chapters. Chapter 2 describes the methodology. Based on a step-by-step approach, completed by the experience of the deliverables 3.1, 3.2, 4.1 and 4.2 as well as the outcome of the interviews made in WP8 (CIT 3), the three phase approach and the value case methodology are described. The characteristics of the business model will be reviewed; also a comparison will be made to the experience of the projects RETRACK and ECOPMS.

Based on a mind map resulting from several discussions, the involved stakeholders will be identified and their interactions are described in chapter 3. Therein this discussion also the influence on the stakeholders and their governance structures and issues concerning mobile and immobile assets are described. Further parameters related to the communication will be listed. The chapter closes with a value case analysis and different possible scenarios.

Chapter 4 shows characteristics of the developed business model supporting cooperation within the rail freight sector, according to the structure of CANVAS which is deduced from the results described in chapter 2 and 3. Based on the Smart-Rail working manual three organizational models will be developed.
2 Methodology

2.1 Working procedure according to Smart-Rail manual

2.1.1 Introduction

The main objective of D3.3 is to develop business models to support cooperation within the rail sector, following step by step approach based on the evolution of cooperation over time. In further chapters, railway stakeholders as an important part of the whole transport chain are being analysed. We have analysed also other important stakeholders, that are directly involved in the railway transport chain and also the ones which are indirectly involved, but represent an essential part of the operation of rail focus. Based on that, potential solutions for an improved business model, which reflect past successful projects are proposed.

In the past, there have been several different types of researches made on cooperation business and governance models, and the results have shown that a distinct assignment to a horizontal respectively a vertical format is not realistic, because of the phenomenon, that companies do not pursue a business model with a limited scope of clearly identified activities, but diversify, in order to be able to react flexibly to volatile markets. In respect to railway undertakings, that means diversification incorporating the upstream or downstream value chain, when for instance a company hitherto focused on traction acts as a rail forwarder or intermodal operator. That should be taken into account, when following D3.3 – business models supporting cooperation within the rail freight sector are developed. Fulfilling the task may lead to a complex network, as it was already earlier concluded in D3.1, [1] on the Assessment of the current situation of cooperation within the rail sector, where a detailed analysis of the potential bottlenecks that are influencing on the cooperation in the railway sector has been made. In D3.1, the main bottlenecks that are influencing on the cooperation in the rail sector have been identified and analysed:

- Infrastructure bottlenecks (geographical layout, engineering structure, station track facilities, traction and voltage, traffic management and track maintenance)
- Operative bottlenecks (interlocking, capacity, prevailing passenger traffic, extensive and poor maintenance works)
- Regulatory bottlenecks (inefficient functioning of national institutions set up by the EU legislation, financial and regulatory discrimination of private entrants, access to subsidised loans for state owned incumbents for an acquisition of rolling stock, IT platforms, etc.)
- Barriers in accessing the infrastructure (complex legislation, missing the cross-acceptance, financial barriers, unfair competition, access fees, competitive barriers).

All barriers mentioned above (including IT bottlenecks between different parties), influence on the potential cooperation of rail stakeholders and affect the goal to move more freight by railways. However, some barriers are given and cannot be changed with different business models, but some can be reduced especially from an operational point of view. Besides proposed business model, one of the minor goals is also to check which bottlenecks can be solved with our potential solutions.

Based on the D3.1, [1] there are also some important findings that need to be considered when developing business models. It is clear that cooperation is limited due to several bottlenecks mentioned above and that a challenge is to define the most suitable legislative framework, to develop new models providing incentives for cooperation, including minimising barriers in step by step approach. Therefore, in the D3.3 a stepwise approach is applied – following as close as possible the predetermined instructions by the Smart-Rail working manual. Methodologically in fact nine cases are distinguished, if for each of three steps there are different phases up to realization of the concluded business models are identified. [2] As part of WP8, stakeholders have been interviewed and asked, how do they cope with changed conditions in case of...
infrastructural disruptions. The results show, that both railway undertakings and intermodal operators are currently applying pragmatic approaches in choosing alternative paths or even switch to inland waterway transportation. Those experience reports help to refine the conclusions on business and cooperation models in WP3, deliverables 3.1 and 3.2 [3] as well as in WP4, deliverables 4.1 [4] and 4.2 [5].

A proven method to ascertain structure and parameters of business and cooperation models is the CANVAS method, an ‘tool box’ with a complete set of modules for designing and executing a business plan. These tools will be described and outline the basis for a ‘construction process’ of a business model. The structure according to CANVAS is explained in Chapter 4.2.

2.1.2 A necessity for a new business model

New business models in the European rail sector are required due to specific transport policy objectives of the EU, which aims to shift a large share of freight transport over more than 300 km away from the road to the other available modes as one of the measures to make the transport system more sustainable. This means that freight should be transported by rail, inland waterway transport or short sea as primary mode and then for most cases, transhipped to the road mode to cover the last stretch. On most connections rail, will be the main alternative. However, to meet this objective several challenges should be solved and therefore are part of the work plans of Shift2Rail. These challenges include amongst others optimal use and increasing the capacity of railway infrastructure, efficiency improvement of cargo handling and improvement of service level from a user perspective.

One of the possible solutions that might change this situation is to develop and implement business models in the railway sector which will enable efficient cooperation between the partners. In today’s very significant intra and inter competition in freight transportation, where the boundaries of stakeholders in transport chain are becoming increasingly blurred, the only way to create an added value and improve relative position on transport market is to compose a set of partners that work together in a network. These relationships among the partners can range from loose outsourcing to seamless integration. Win-win relationships in which all parties have incentives to partake and equally share the value produced are necessary prerequisites for long life of these partnerships.

In order to develop a cooperative business model which will enable better positioning of railway transport it is necessary to assess inter-sectoral activities and roles that enable value generation. It is also needed to take into account different requirements of different partners which are in some cases conflicting, to balance it in order to design a sustainable business model.

One of the good examples is the case of Canada and U.S. Regional rail carriers (Class III operators) operate in intraregional area and feed the system of major railway carriers (Class I operators). More precisely, short line operators are in cooperation with class I operators and they are responsible for the relationship with shippers. However, this is not the practice in Europe. Deliverable 3.1 [1] contains some experiences regarding cooperation in deregulated sectors in Europe; however, this business relationship in EU’s railway freight sector is rate. New rail operators enter the market mostly as competitors to existing operators. Also, rail operators mostly operate only on inter regional level and they are less in contact with the local industry compared to road operators or short line operators in North America.

2.1.3 Three-phases-approach to develop a business model for the cooperation within the rail sector

The process of design of a cooperative business model in rail transport as we applied consists of the following three phases:
1. Business concept development. In this phase, it is necessary to draft the business concept.
2. Business model introducing. After the business concept, has been defined the next is its implementation in business practice.
3. Business model development. Systematic further development of existing and newly developed models must be planned in order to cope with changing market conditions, increasing competence and technological development in the transport field.

1) Business concept development phase

Within this first phase there are three steps:

A. idea
B. analysis and
C. design

A) The idea must be based on an assessment of the current situation regarding the business practices in the railway sector. This is described in section 4.1 of the Deliverable 3.1. [1] One good examples of a cooperative business practice described here is X-Rail, an alliance made in order to improve the wagonload traffic, the oldest product and essential part of the railway freight transport. Today, X-rail partners have made considerable progress towards achieving their vision of transparency and quality in wagonload.

The other business relationships mentioned in 4.1. (D3.1) continue to exist beyond their respective key actors, but not in the sense of cooperation, rather via individual expansion in neighbouring countries and other task areas. It has been concluded in D3.1 that railways have to develop themselves further in the direction of less interchangeable service providers with a portfolio which extends geographically, as also in a service related manner. Therefore, there is a need for assessing other ways of partnerships and design respective business models which will enable these forms of relationships.

The challenge in the concept development phase is also to identify the markets which will be targeted by the new business concept. Of course, it is not necessary to define a completely new business concept, substantial improvements and innovative modifications to existing practices can also be the trigger and basis for business models.

B) After the idea about a business model has been defined there is a need to analyse all aspects which are essential to the realization of a business model. The main focus is to identify the concerns and interests of potential stakeholders in railway freight sector. The core elements are shippers as users of service, and there is a need to preliminary assess the value generated by a new potential business idea. Therefore, the railway industries in Europe and target markets have to be analysed in depth.

In this phase, there is also need for an assessment of the capability of partners involved in a potential cooperative business model (human, ICT, mobile assets and infrastructure capacities). Without this assessment, there is a risk of failing at business concept implementation due to the lack of resources.

C) The next step is to design a prototype business model which involves the design of processes required for output and definition of suitable forms of cooperation within the rail sector. The focuses of this part of business concept development are partners in business model (rail operators, terminal operators, infrastructure managers, rail forwarders, mobile assets leasing companies). Prototyping ends with the selection of the best overall solution. In this phase, there still is a need for evaluation of all enablers, processes, partners and financial projections to be evaluated in depth. The output of this process is a detailed specification of how the business model will create value.
2) Business model introduction phase

The second phase is based on the implementation in practice. This requires a detailed planning and consideration of the focuses and objectives of CIT’s in order to select the best possible implementation for the cooperative business model. This also includes determination of the economic success and potential risks of the business model that influence on the potential stakeholders. After a detailed analysis and when planning is completed, all stakeholders are informed about it.

3) Business model development phase

In the third stage, business model development takes place, where all strengths and weaknesses of established service portfolios should be monitored on an ongoing basis in the light of dynamic market conditions. This would create a useful indication of the continuing viability of the portfolio offered to customers.

2.1.4 Value case methodology

Although conceptually the potential of solutions is significant, the actual success of new initiatives is not at all guaranteed. Part of the reason behind this is the complexity that comes along with these solutions, such as for example the requirement of cooperating with competitors, unclear costs and benefits distribution between stakeholders, governance challenges, etc. In order for these solutions to become successful, sufficient attention to the current individual business models of stakeholders and the business model and governance model of the solution is required.

A successful approach to achieve this is by using is the Value Case Methodology (VCM). The VCM is aimed at developing a mutual value case for value aligned solutions and corresponding business models. The objective of the method is to unite the motivation and desires of all stakeholders involved and to address their joint innovation and align their values.

The first step of the VCM is to identify the involved stakeholders. For each stakeholder we describe the goals and the details of the innovation. In addition, the current individual business models of the stakeholders will be defined and the effect of the innovation on the individual business models will be analysed. The VCM will be used to create a mutually shared business model for the innovation. To create insight in the relationships, a Value Network (Ecosystem) of the current situation will be drawn, showing the interrelations between stakeholders and the value provided to other stakeholders.

![Value Network Ecosystem](image)

**Figure 2-1: Concept of Value Network (Ecosystem)**

After analysing the current situation, priorities and preferences will be aggregated and different future improvement scenarios with new business models and ways of cooperation will be defined.

An important part in the VCM is to create transparency in the distribution of effects through implementing the innovation. Some of the effects will be positive for one party (and will be ‘drivers’), the same effects might be negative for the other (barriers). An
overview of all barriers and drivers for all different stakeholders will help in evaluating which party will support the innovation.

In addition to individual drivers and barriers, the power relations of the parties are important. In order to evaluate the power of the stakeholders on the innovation, a ‘socio-gram’ will be drawn.

Creating transparency in the distribution of effects through implementing the innovation includes the who-gets-what and who-does-what, which are quantified in appropriate units and measurements. We analyse which interventions or measures are required to make the step to the desired situation. Interventions or measures may be both measures the business can take and interventions/measures to be taken by the government.

Aspects, such as quantitative and qualitative cost and benefit modelling, visualisation and analysis for determining the point sensitivity of each individual value identified by the stakeholders are involved. Until the multi-stakeholder acceptance is reached, adapted solutions will be generated and evaluated. A structured process is performed, aimed at getting an overall acceptable project definition for the innovation, based on the alignment opportunities. We will use a structured-disclosure technique to create a jointly supported strategy and make alignment between stakeholders’ value and collective actions happen.

By taking the complexity of the supply chain into consideration, the value case methodology facilitates the development of jointly developed market oriented solutions and business model scenarios. This can be a basis for the introduction of successful IT solutions, terminal models and cooperation models. In the Smart-Rail project, VCM will be applied in the Continuous Improvement Tracks in order to check if a scenario (future situation) is feasible for the involved stakeholders and suitable in the bigger picture.

2.2 Characteristics of the business model to be considered

2.2.1 Horizontal cooperation

2.2.1.1 Definition and characteristics

In the case of horizontal cooperation, collaboration occurs between companies of the same value chain. The products or services of the companies are at least similar (if not identical) or based on the same technology or the same basic skills. Therefore, horizontal cooperation in the rail sector is active cooperation between two or more firms that operate on the same level of the rail sector and perform comparable services in the value chain. This is illustrated exemplarily for some key players in the rail freight sector in the figure below, (even though the shipper is not a part of the business model, it presents an important part in the transport chain):

![Figure 2-2: Principle of horizontal cooperation in the rail sector](image)

In principle, horizontal cooperation within the rail sector is possible for all enterprises independent of their size. However, the analysis of past and present cooperation’s in the
rail sector, performed within deliverable 3.1, showed that horizontal cooperation is particularly important for small and medium enterprises in the starting phase of their business activities. This also becomes apparent when considering that most horizontal cooperation was established at the beginning of the liberalisation of the European railway market [1].

The common general characteristic of horizontal cooperation within the rail sector is the joint acting of weak partners to compete with stronger competitors. As cooperation is a dynamic process, in many cases horizontal cooperation are transferred to vertical cooperation. This occurs in particular, when the level of complexity increases, which requires changes in organisational structure, as well as controlling and managing. For this reason, vertical cooperation is currently more important as it better matches the market requirements than horizontal, although horizontal cooperation may be again important in new future markets [1].

2.2.1.2 Importance of horizontal cooperation

Horizontal cooperation is of particular importance for both cooperating partners and customers, offering significant benefits in terms of added value. Based on the analysis of examples as performed in D3.1 the following benefits for the railway undertakings are observed:

- **Extending geographical coverage and enabling cross-border traffic**: Even in the first years after the rail reforms, it was primarily the state-owned railways that could offer cross-border rail transports, due to numerous technical, financial, operational and administrative issues. This changed after private railway undertakings have been established in certain countries and cooperation between them has started with a goal to overcome these barriers, partially by very creative methods;
- **Strengthening of corridors**: By pooling activities and joined appearance on the market, strengthening of own transport could be achieved. This can lead to very affordable (or even first-time) deals for the customers;
- **Cooperation for special products, extension of the core business**, e.g. strengthening of single-wagon traffic: Through horizontal cooperation like X-Rail, but also more vertical cooperation, successful initial approaches could be executed for strengthening the single-wagon traffic. Despite progressive containerisation and the reduction of railway sidings, that have actually led to partial removal of single-wagon traffic in some countries in the European Union, this business field is of outstanding importance in the next year for parts of the manufacturing industry. Furthermore, the political objective to shift more goods from road to rails can only be implemented, if rail traffic is made more attractive for smaller shipments;
- **A common use of assets**: Most locomotives of the cooperating partners were used for cross border movements. In the case of European Bulls, also an own IT-solution was developed to allow disposition across borders.
- **Common sales activities, one face to the customer**: The joint appearance of different railway undertakings has simplified the process to order rail services for the customers. Through cooperation private railway undertakings overcame the initial disadvantages compared to state-owned railways and could extend their operating range significantly, in particular as regards services for heavy industry, relying on deliveries across the whole continent.
- **Information exchange**: It is known from the former cooperation of European Bulls that during Steering Committee’s characteristics of the respective partner countries have also been taken into consideration. The information exchange thus helped in the mutual transfer of knowledge about regional peculiarities, the respective customer structures and margin calculations, the marked-out routes and energy costs, the operation of feeder tracks, etc. This transferred knowledge
was, therefore, a cornerstone for marketing success in the marketing of the rails involved, as international competence could be established [1].

On the other hand, there has to be the view towards the customer. They are expecting, flexibility, reliability, short transit times and in general a good cost level. In the last year’s, costs for rail freight business were mostly increasing while costs for truck transport were decreasing. Beside the internal optimization of processes for railway undertakings, companies need to look for cooperation possibilities with other partners, based on the examples above.

These examples lead to operational optimization which means more flexibility for the customer (for example common use of assets which are available in more places) and reliability (for example partners can give back up solutions). The most important result is however the optimization of costs, which helps to railway undertakings to be more competitive and to the clients which have an alternative towards other transport modes.

In this sense, we can conclude that horizontal cooperation can provide valuable input to improve freight services regarding reliability, visibility, flexibility, costs and lead time. For this reason, it is important to define suitable, realistic and realisable business models within this task in order to increase the rail share in day-to-day logistics.

2.2.1.3 Transferability of aspects from horizontal cooperation in other sectors and countries

Within the scope of D3.1 cooperation models of US Railroads, Road Freight Forwarders and Maritime Container Transport were benchmarked, in order to identify suitable aspects respectively approaches for developing business models for horizontal cooperation within the rail sector. The benchmarks with freight forwarders and maritime transport offer some general aspects that can be transferred to Smart-Rail, serving as input for the new business model for horizontal cooperation.

Like for rail and maritime transport, road freight forwarders aim to fulfil their customer requests in cost efficient way and to make sure that the customer requirements on service quality are met. Besides the options to perform the operation by themselves and subcontracting (i.e. vertical cooperation), building up horizontal coalitions with other forwarders for exchanging transport requests is seen as appropriate option to meet the service requirements of the customer. The motivation considering this option lies in the cost-saving potential embedded in horizontal cooperation on one hand, but also with the aim to improve shorten lead times, offer higher frequency of reliable services and consequently higher flexibility. Through request exchange, forwarders can consolidate complementary requests off different coalition members and construct more efficient vehicle routes to reduce the total costs of the entire coalition. The obtained cost savings and other service level improvements present the joint benefits of the horizontal coalition that cannot be achieved by forwarders individually. The profitability of participating forwarders can then be further improved by acquiring their shares of the joint benefits [1].

In addition, the following most important barriers to horizontal cooperation identified for the freight forwarders sectors apply also to the rail sector:

- Difficulties in finding a trusted party to lead the cooperation;
- Difficulties in finding partners;
- Difficulties in guaranteeing a fair mechanism for allocation savings for the participants;
- Difficulties in the estimation of the savings of the cooperation in advance [1].

In maritime transport, modern alliances in container shipping are a widely-used form of cooperation. By extension of frequencies, port coverage as well as new services, alliances can generally improve their service quality. In principle, the existing alliances have
proved their efficiency and operational capability over several years (if measured by the
duration of the contract period), although there were slight movements among each
other in the meantime. There were decisions by consensus when frequencies were
changed, routes suspended or slot capacity was reduced by removing ships temporarily.
Obviously, communication between the partners within the installed Operating and
Coordinating Offices has extremely well worked [1].

As already indicated in D3.1 the concept of shipping alliances may be taken as blueprint
for the envisaged cooperation within the rail sector as the following characteristics are
comparable:

- Carriers $\triangleq$ Railway undertakings;
- Container vessels $\triangleq$ Container wagons;
- Given slot capacity in the ports;
- Port to port destinations $\triangleq$ port to inland terminal destinations;
- Timetables [1].

However, it needs to be pointed out that rail services are much more sensitive to any
disturbances between end nodes, then this is the case for the maritime transport.
Potential disturbances can influence on the reliability of rail transport services in certain
points. The operational capability of shipping alliances could also be transferred to the
rail sector by defining a 'neutral body’ that controls the basic rules and a centralized
Operating and Coordinating Office, which is responsible for the allocation of slots. An
imperative precondition is, however, that the operators/stakeholders are willing to take
part with their competencies from operational and marketing point, as well as with their
own resources.

2.2.1.4 Today’s situation as regards horizontal cooperation in the rail sector

Due to market requirements, existing cooperation in today’s rail sector is mainly based
on vertical cooperation. However, horizontal cooperation is still existing and is highly
important to serve some market segments. This applies in particular to Single Wagon
Load (SWL) which requires more efficient cooperation, than for example block trains,
therefore the focus of this chapter and future proposed business models is based on this
market segment, where the biggest need for improvements in cooperation has been
recognised.

SWL is suited to transport chemicals, grain, steel, paper, pulp, and similar commodities. An
example of cooperation in the SWL business is X-Rail, a cooperation of state owned
railway undertakings (incumbents) aiming to render international wagonload traffic by
rail more customer-friendly and efficiently. As single-wagon or wagonload traffic is still an
unchallenged business field, there is, besides the RETRACK system, almost no alternative
in the rail sector from the private sector. However, cooperation within RETRACK is today
no longer horizontal, since partners are now sub-contractors of the rail freight forwarding
company VTG Rail Logistics (formerly Transpetrol). RETRACK is now based on a vertical
cooperation model (see also chapter 2.3). Hence, the SWL market may be an option for
expanding horizontal cooperation of private railway undertakings in the future, but first
we need to create preconditions in order to make SWL efficient and possible to
consequently increase its market share in the rail sector.

2.2.2 Network cooperation

Besides horizontal cooperation aimed to reduce costs and/or to increase the quality of rail
freight transport, there are two other possible forms of cooperation which can positively
impact on competitive performances and business results of rail freight transport:
• Vertical cooperation – between rail freight transport operators and other non-railway actors in transport chain.
• Mixed cooperation – combination of horizontal and vertical relationships between actors in transport chain.

Vertical cooperative partnerships exist in cases when companies from different stages of transport value chain are working together (Figure 2-3).

Vertical cooperation may lead to more intensive overcome of existing barriers to market entry for rail freight companies (interoperability, asset availability, financial strength, economies of scale, technical, legislative or cultural differences).

There are numerous examples of these types of synergies designed to lead to better position of rail freight transport sector. One of these cases is Cargonet (subsidiary from Swedish and Norwegian national railway companies established to make a successful transition from conventional rail wagon transport to intermodal rail shuttle services. Namely, Cargonet entered into partnership agreements with intermodal operators of continental rail shuttle services like Hupac and Kombiwerkeh and on that way created a wider network of rail shuttle services resulting in a commercially successful business network. Long term cooperation between Duferco (global steel company in Italy) and Trenitalia shows another good practice delivering numerous benefits and a successful business case.

Further quality improvements and cost reductions for rail freight transport operators and transport chain in general, may result from mixed horizontal and vertical arrangements between railway and non-railway related actors. It includes cooperation between vertical intermodal actors such as pre and end haulage, intermodal terminals, LSPs and rail transport companies, as well as horizontal cooperation between actors active in the same transport market segment, between two rail freight operators for example.

In general, cooperation may help rail freight transport market segments to improve their competitive position against a single mode road transport. Furthermore, several lighter initiatives (such as coordination) seek to realize improvements for railway transport. These “lighter” forms include indirect actors in value chain to be involved. These actors operate/function as “oil” to make the direct transport companies cooperate.

Improvement of the rail freight transport through more efficient cooperative relationships must be supported by various technological improvements and better terminal network design strategies. Namely, the basic problem of intermodal freight transport is its feeder hauls and transfers of cargo, which both generate high extra costs. Such detrimental effects cannot be avoided in today’s system of few and expensive freight terminals far away from each other. If intermodal freight is to succeed better, a larger number of smaller terminals with less expensive facilities must be set up, thereby improving
accessibility and thus also shortening feeder haul distances. A larger number of terminals could also help making rail alternative feasible to new customers and help cooperation with trucks on shorter distances.

One proposal from WP4, D4.1 [4] refers to intermodal virtual network as a possible cooperative tool which will improve position of rail freight sector. It is in essence a shared, cloud based multilingual virtual platform, held by a third entity which gathers and provides the fundamental shipment information along its passages from an actor to the following actor linked to a Unique Load Serial Number. Thus it can enable/improve or make it easier for any possible form of cooperation between the participants in transport chain.

In summary, participation in vertical/mixed cooperative forms may provide various benefits for rail related actors and transport chain in general:

- Increasing productivity for core activities resulting in decreased non productive part of the cycle/increased use of capacities.
- Decreased costs – through knowledge sharing and a better ability to control costs and reduce costs.
- Decreased environmental impact through increased productivity and decreased costs (less travelled distance and improved utilization rate with positive effects also for the environment).
- Service – broadening the service portfolio.
- Market position – In Schmoltzi / Wallenburg [30] the results of a survey are reported, according to which the second most important motive to cooperation is protecting or increasing market share.

However, there are some barriers which must be overcome in order to establish efficient and strategic cooperative relationships:

- Unequal distribution of costs and benefits. If one actor in the chain has to invest (in ICT systems for example) while other actors grasp the benefits, cooperation may not arise spontaneously. Gain in/of sharing mechanisms that redistribute benefits are feasible in theory, but may fail in practice due to high transaction costs and risk of free rider behaviour.
- Lack of resources or willingness to invest of at least one form in the transport chain. Even though all actors may agree on an arrangement to improve cooperation, this requires investments (financial and management involvement). Stakeholders in the transport chain may not be willing or able to make these investments. This reason is especially relevant for cooperation where relatively small stakeholders are involved.
- Strategic considerations can also impede cooperation. Stakeholders may be reluctant to cooperation if this also yields benefits for competitors.
- A final reason is risk-averse behaviour and a short term focus. If stakeholders expect that the process of establishing cooperation is difficult and time consuming and results are uncertain, they may be reluctant to put effort in this process.

2.2.3 Evaluation and conclusions from WP5 - Information availability

An important element that influences the cooperation within rail sector is also the availability of information for freight rail stakeholders in order to improve service quality, which is analysed in the WP5. The main connection between new business models and information availability is in information sharing from the virtual data space that interconnects different solutions between the involved stakeholders and consequently improves cooperation in the rail sector.

The efforts of WP5 are focused on a high-level integration of different data sources into one common system that can be used for different applications. To facilitate the information flows between the railway stakeholders, an information interoperability platform is suggested, called the “CT-Rail” (Control Tower – Rail). The CT architecture
represents the unified data exchange environment and data interfaces or user interfaces, as designed in a comprehensive and versatile way in WP5.

The following data areas were identified as essential for implementation:

- **Pre-trip information**: data and information for planning the train service (in cooperation with the RU), covered often by the reference files; these data change less frequently (several times a year)
- **Train path availability for ad hoc planning**: not considered in Smart-Rail
- **Real Time Information**: most notably the Train Position; multiple primary information sources are used; these data change on minute-to-minute basis
- **Location of the wagons, track & trace of individual wagons**
- **Estimated time of arrival (ETA), Estimated time of departure (ETD)** – the key data items for the operative planning

The LSPs and some other partners (operators, forwarders) are standing in the role of a customer in relation to a railway undertaking (RU). The RU obtains the data either from its own sources (as GPS tracking units, driver’s announcements, or independently driven messages), or from the infrastructure manager. All these data exchange requirements shall be solved by the Interoperability Platform developed within WP5.

Within WP5 and the Interoperability Platform, a logical database is to be designed (D5.1), consolidating the various data sources into interoperable and reusable data structures. Also, the ontology semantic model is to be developed (D5.3) [7], describing the data dictionary to be used in the Smart-Rail project, and consolidating the ontologies and data dictionaries from potentially diverse sources.

### 2.3 Experience from the project partners in the RETRACK-project

RETRACK has introduced a new rail freight service on the corridor between Cologne and Győr. Supplementing this service were further feeder services from the Benelux countries and the Ruhr Valley area responsible different destinations in South-Eastern European countries. This service is a SWL offered by private RU’s. A detailed description is made in D6.1 of Smart-Rail [8]. A question arises to what extent the results from it can provide input on the manner in which a business model can function on the basis of sustainability within the framework of a complex network structure.

The RETRACK-project is a very good example of a cooperation project which initially starts at a horizontal level and is continued as a vertical project during the course of its development. It makes sense to answer the question as to why the success of the project was possible only through change in this cooperation structure?

Besides having a research section, the RETRACK project had a very operational module in the design of a demonstrator on the Rotterdam – Constanta axis. These two port cities were initially synonyms for the connection between the North Sea and the Black Sea, i.e., the west and the east. It was clear from the beginning to the involved partners that a continuous traffic demand would be unlikely on this corridor. The involved rail transport companies (rail4chem (D), LTE (AT), CER (HU) and Servtrans Invest (RO)) planned to operate on the basis of a privately organized single-wagon transport to achieve a higher degree of reliability and faster transit times between Western and Eastern Europe.

Besides the economic crisis, which was characterized by difficult circumstances during the project period 2007 to 2012, it was mainly the inadequate experience and staffing of the railway transport companies which led to the situation that despite there being no dearth of common will, these four equally entitled partners were unable to agree on starting this transport. It was more or less incidental that there was a change in the German partners during the project period. While the rail transport company rail4chem (which was going through a sales process on this date) opted out of the group, the new company Transpetrol (VTV Rail Logistics today) was accepted as partner. The consortium therefore had a forwarding company for the first time, which had the resources that the
rest of rail transport companies could not offer, and which, after a brief period, created the foundations for the pilot train.

The basic load for the subsequently created initial transport was borne by a grain trader from the Netherlands, as a result of which the remaining space in the train could be sold to single wagon customers, and on 27.02.2010, the first train could run from Győr in Hungary to Cologne in Germany. The structure of this transport is a classical anchor-customer-model. [9]

The involved rail transport companies LTE and CER were no longer equal rights partners in this sense, but sub-contractors of the rail freight forwarding company Transpetrol, which accepted the financial utilization risk of the rail transport formally, and promoted the single wagon over other systems to the final customer.

**Figure 2-4: Anchor customer model**

For mutual settlement, the rail transport project partners agreed to involve a neutral third party who could control the financial transactions in the input and output area and distribute the required funds according to an agreed key. The maximum possible trust was be generated in this way. This neutral third party was financed through a jointly defined percentage margin.
After the expiry of the project, rail transport was continued under one’s own initiative for several years with the same partners. Project extensions were made simultaneously based on a similar model, especially in Poland, where the state branch of Transpetrol used the complete trains of the Polish private railway transport company LOTOS Kolej in order to promote individual wagons there.

Today, the RETRACK network is the biggest single wagon network of Middle Europe operated by non-state rail transport companies and can be seen as a basic model for the consideration of complex network structures in which the infrastructure, the wagon lessee, the workshops and IT must be considered besides the operator and the rail transport company.

Figure 2-5: Schematic sketch of “RETRACK”-clearing agency
Figure 2-6: Original “RETRACK”- corridor

Figure 2-7: Actual “RETRACK”-network [10]
2.4 The Business Model CANVAS (Osterwalder)

2.4.1 Business models

Business models are used to describe a series of components guiding companies in processes of value creation; that is the financial and organizational architecture of a business. The function of a business model in a company is primarily related to value creation in profit making organizations [11]. A business model explains how value is created for the customers and how value is captured for the company and its stakeholders.

Each stakeholder has its own role and stake in the value network and therefore its own business model.

A business model is composed of different elements like revenues and costs, resources, activities and internal and external relationships and networks, the value proposition to the customer, and mechanisms to capture value for the company. The business model CANVAS [Osterwalder, 2009] provides a simple and intuitive tool to describe and think through the different elements of a business model.

2.4.2 The business model CANVAS

The Business Model CANVAS consists of nine basic building blocks covering four main areas of a business: customer interface, value proposition, supply chain and financial model. This gives the company a simple and intuitive map to understand its business models, but also a way to challenge and find successful alternatives of doing business. In the same time, companies can look at other companies’ business models to be inspired to do similar changes to their own model or to design a completely new business model.

Its building blocks are the following:

- Key resources: specification of resources needed to create the value proposition;
- Key activities: specification of activities needed to create the value proposition;
- Key partners: specification of partners needed to create the value proposition;
- Value proposition: description of the value proposition (product, service, solution) offered;
- Target customer segments: specification of to whom the value proposition will be delivered;
- Customer relations: description of how customer relations will be maintained;
- Channels: specification of through which channels the value proposition will be distributed;
- Cost structure: specification of costs for resources and activities to deliver the product or service;
- Revenue streams: specification of the revenues for the product or service.

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1 Please note that with ‘supply chain’ we here mean the activities, resources and key partners of one company; not the logistics supply chain as a whole.
2.4.3 Business model innovation

Business model innovation is basically about improving the building blocks of the business model. Business models often change gradually and do not necessarily imply fundamental revisiting of value propositions, but of course the changes could also focus on improving production processes or reconfiguring organisational structures.

In order to distinguish the driving factors for business model innovation, we can combine the epicentres with the four areas of business [11]:

1. Supply chain – Resource driven innovation;
2. Customer interface – Customer driven innovation;
3. Financial model – Finance driven innovation;
4. Value proposition – Offer driven innovation.

Business model innovations in the category supply chain (resource driven) include changes in key activities and key resources and the structure and management of upstream relationships with suppliers (key partners). Innovations in the supply chain can for instance, lead to improved utilization of core resources, new partner networks resulting in eco-efficient production and reduction of the impact of production on the environment.
Business model innovation in the category *customer interface* (customer driven) comprises changes in structure and management of downstream relationships with customers. *Customer interface* business model innovations can for instance lead to induction of eco-friendly consumption behaviour and green product logistics.

Business model innovation in the category *financial model* (finance driven) contains changes in associated cost and revenue structures. Changes in the *financial model* can include revenue models that stimulate greener usage.

Business model innovation in the category *value proposition* (offer driven) consists of changes in the value embedded in the product/service offered to the customers. Innovation of the *value proposition* can lead to a new offer to customers, for instance delivering a – resource efficient – service to the customer instead of a just product.

### 2.4.4 Application of business the Business Model CANVAS in Smart-Rail project

In the Smart-Rail project, we will use the Business Model CANVAS for developing concepts of new business models supporting cooperation within the rail freight sector, along the nine building blocks of the Business Model CANVAS.
3 Identification of stakeholders involved and characteristics of their interactions

3.1 Stakeholders within the operational process and governance structure

3.1.1 Operators undertaking railway transportation

The second railway package of 2004 obliged all EU countries to fully open their rail freight transport markets by January 2007. The aim of this package was to raise the efficiency and effectiveness and therefore the market share of railway freight transport by increasing intra-modal and inter-modal competition. As a result in some countries the rail freight market has been significantly changed. Besides the large former monopolistic state railway enterprises or incumbents, new entrants – private rail freight operators - appeared on the market. The market share of new entrants on national rail freight markets substantially increased in the last years and reached more than 50% in some countries. According to the data from 2013 [12], the market share of incumbents has a decreasing trend and it was 68% of total tkm (Figure 3-1). This is a consequence, among the other factors, of raising competition driven by the expansion of foreign subsidiaries of state railways.

<table>
<thead>
<tr>
<th>Rail infrastructure [km]</th>
<th>265,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modal share rail (%)</td>
<td>18%</td>
</tr>
<tr>
<td>Market volume for rail freight transport [EUR million]</td>
<td>17,500</td>
</tr>
<tr>
<td>Transport volume [million t]</td>
<td>1,720</td>
</tr>
<tr>
<td>Transport performance [billion tkm]</td>
<td>440</td>
</tr>
<tr>
<td>Expected tkm growth (2014-2019 p.a.)</td>
<td>1.2%</td>
</tr>
<tr>
<td>Share of international rail freight transport [% of tkm]</td>
<td>51%</td>
</tr>
<tr>
<td>Incumbents' market share [% of tkm]</td>
<td>68%</td>
</tr>
</tbody>
</table>

Figure 3-1: Rail freight market in EU [12]

Figure 3-2 shows the relationship between incumbent and new entrant’s shares on rail freight market.
It has to be noticed that there are some changes in the market and owner structure during previous years – large logistic or shipping companies are trying to include railway in their supply chains. This is also a consequence of several limitations for freight traffic, such as transalpine road freight traffic. That is the case with Swiss company MSC Rail, which is the part of shipping company MSC (Mediterranean Shipping Company) that has received permission from the Portuguese competition authority to take over the freight rail operator CP Carga. [31] This action will enable MSC to cover the Portugal’ related hinterland part of their transport activities.

Historically, in all EU states, there was a single public railway enterprise which was responsible for managing the rail infrastructure and providing passenger and freight services. After the first railway package (2001) a certain separation between infrastructure and transport activities had to be undertaken. As a consequence two parties appeared – infrastructure managers and incumbent railway undertakings. Since the second railway packages, all states within the EU had to fully open their rail freight transport makers from 2007. Since then, the EU railway market is completely liberalised meaning that any licensed railway undertaking has been able to request access to rail infrastructure, apply for a path, and provide freight transport services in competition with incumbent freight operators as well as with other freight operators.

However, in practice national rail freight markets are still not fully liberalised, since no level playing field exists in the national rail freight markets. National incumbents are still using their size, which gives them advantages in economies of scale and consequently a competitive advantage which is hard to overcome by new entrants. Consequently, incumbent European freight railway operators have continued to dominate their markets since liberalization, although their shares have shown a steady decline. Incumbent shares now range from 50 to 75 percent in most countries (Figure 3-3); shares for full trainload traffic are much lower. [13] The market also has become increasingly diverse, with many different business designs claiming a role in rail transport – from corridor specialists and regional feeders to combined logistics operators and service companies (Figure 3-4).
The reasons for this situation can be found in some barriers to liberalisation of rail freight markets which can be seen from a number of examples where incumbent railway operators have priority against the new entrants, for example: [14]

- Prioritized access of incumbents to infrastructure facilities like terminals, yards and sidings. This is the situation in Poland for example. The Polish incumbent freight operator (PKP Cargo) owns via subsidiary companies most of the rail terminals, including also the border terminals. Terminal’s capacity which has to be available to all rail operators on fair and non-discriminatory basis is mostly booked by the incumbent freight operator. “Historically most terminals were connected with PKP Cargo, and run either directly or through joint ventures and subsidiaries.”
We have applied for access to intermodal terminals, to be told they can only handle five wagons on a Saturday. Even with a reach-stacker one can handle an average-length intermodal train in 6-8 hours, so it's hard to believe there was no spare capacity at a terminal handling a handful of trains per week.”— words of Mr Konstantin Skorik, Director of Freightliner Poland. [32]

- Incumbents in some cases have priority during the bidding for rail freight infrastructure. In France for example, Fret SNCF – a French incumbent rail freight operator - has been allocated fixed paths far more often than other operators. In 2014, about 80% of the total paths allocated to the incumbent freight operators were fixed, compared to 68% of those allocated to new entrants.

- Incumbent freight operators have the extensive fleet of locomotives and freight cars from the old integrated company and they are reluctant to rent or sell free rolling stock to new operators at a fair price. That is the current situation with Spanish incumbent freight operator, RENFE, which is the only operator with locomotives authorized to run freight trains in Spain. None of its excess locomotives or freight cars has been sold to other rail operators within the Spanish market. In April 2014 the Spanish government established a separate company, within the same business group as the incumbent, for renting out the rolling stock.

- The maintenance of rolling stock also represents an additional critical point where a dominant position of incumbents on the market can be realized. Namely, the maintenance facilities are still under the ownership of incumbent rail freight operators.

During the second half of 2014, ERFA (European Rail Freight Association) expressed a worry that the big incumbent rail operators in Europe (namely DB and FS) refused the need for greater diversification in the rail market. For that reason, smaller rail freight operators are on the receiving end of many discriminatory practices due to the market dominance of the incumbents. [33]

There are also other tendencies of incumbents which may potentially limit the market competition. Incumbent rail freight operators acquire other freight operators on national and also international markets and in that way the EU market may come to be dominated by a small number of freight companies. For example, DB Cargo (German incumbent freight operator) has become the main operator in Denmark (DB Cargo Scandinavia A/S) [34], Netherlands (DB Cargo Nederland N.V.) [38] and in the United Kingdom (DB Cargo U.K.) [39]. Many private operators have been acquired by incumbents. Germany’s TX Logistic is now majority owned by Italian incumbent Trenitalia. Rail4Chem, the private operator specialized in chemical transport was acquired by Veolia Cargo, which was acquired by Fret SNCF. These consolidation activities also have a positive side in raising the efficiency of incumbents. If a company, with inefficient labour regulation acquire one with efficient regulations, the general direction of the new company should move toward improving efficiency. This was the exact motive of Trenitalia, when it acquired TX Logistik, and also Fret SNCF and Veolia Cargo/Rail4Chem. [15] Specialized business designs, such as TX Logistik or HectorRail, are more profitable than the average freight railway operator.

Considering the business operations, it is known that rail cargo is most profitable when large volumes of goods are transported over long distances, and when the complexity of the transport process is relatively low (full trains vs. single wagon). However, in the EU, long distances in rail freight transportation, which mostly concerns international transport relations, are limited by a number of legal and technical reasons. Barriers to entry into other Member states can be significant in European rail freight markets. Different networks are often not interoperable due to differences in track width, electricity systems, signals, maximum train length, and types of wagons to be used. However, incumbents have a comparative advantage in entering foreign markets compared to private rail operators due to the following reasons. [16]
• Incumbents have long standing know-how and experience with rail freight business, which was established while being a state-owned company, i.e this is comparable with subsidising the start-up phase for new entrants.
• As incumbents usually already offer cross-border transport into the concerned territories via cooperation, they are often informed about the foreign business;
• Incumbents already possess large quantities of rolling stock, which is necessary for entry;
• Due to an existing client network in their national networks, incumbents can make better use of economies of scale and scope than a private entrant could.
• Incumbents are usually significantly bigger and to a larger extent vertically integrated than private operators, so they can offer more complex logistic solutions than could most private operators.

The single wagon business is considered as a legacy problem from ‘monopolistic’ era of rail companies, since this can be recognised as the most problematic part of the rail freight business. This segment mostly generates negative cash flows. Single wagonload transport is jeopardized in several countries where deindustrialisation or low density of the industrial web makes it difficult to sustain this business. [17] Wagon load service is mainly used in the central parts of Europe, where the industrial web is denser, and in Sweden where rail-infrastructure charges are the lowest. However, despite wagonload's woes, this is still big business for rail operators in a number of European countries. For example in Germany, Europe's largest rail freight market, wagonload still accounts for around 30% of volumes (by ton-km) while it represents 38% of the Swiss market. [40]

Single wagonload business represents a network business at the national and European level. Therefore, in order to gain substantial improvements in this business segment, there is a need for cooperation between network operators and freight rail feeder operations in order to secure customer commitment. Steel company Arcelor formed a joint venture with Luxembourg Railways - Chemins de Fer Luxembourgeois or CFL. [38] The other experiences oriented to increasing the efficiency of single wagons business include adding other business, like it is in the case of DB, SNCF and other that have added a general logistic business to their portfolios. This moving upstream in the value chain enables rail companies to develop synergies and have a direct contact with customers which could enable more client-centric solutions and therefore generate more demand for transport service. Intermodal cooperation – in addition to competition may strengthen the rail freight system in Europe (presented in the WP4) DB represents a frontrunner in acquiring freight subsidiaries all over Europe. After acquisitions of incumbent operations in Holland and Denmark, the takeover of smaller private companies in Switzerland and Italy, and some major deals in the UK and Spain, DB continued its acquisition in Eastern Europe (Poland and Romania). SNCF also acquired private operations of Veolia Cargo. Rail Cargo Austria has also to be mentioned as one of the most important players, incumbents, on the European rail freight transport market. It acquired MAV Cargo, Hungarian incumbent. Recently, RCA has acquired German private rail freight operator EBM Cargo as part of its strategy to expand its activities in Germany and the Benelux countries. RCA has already cooperated with other private freight operators in Germany including ERS Railways, Captrain, and Railtrax and it also has formed a joint venture with Belgium's Rail&Sea called RCA Benelux to improve logistics in the Benelux countries. [39]

### 3.1.1.1 Main reasons behind the current state of rail freight

According to the results of recent analysis [40], the average share of the railway freight sector at EU level has slightly declined since 2011, although in Austria, Germany and Sweden these results are slightly different. It is obvious that shippers do not choose the mode of transport according to EU policy priorities, but on business decisions based on performance and quality matching the cargo to be transported. Therefore, according to current findings in the EC’s “Transport 2050” plan, to shift half of all the medium- and long-distance goods transport off the roads and on to rail (or water) by 2050, will not be realized unless there are some big improvements in the future.
An important reason for this situation is lack of level playing field, as a consequence of partly developed market liberalization process. Consequently, the Single European railway Area (Directive 2012/34/EU) is still not achieved. Interoperability issues still exist and humper more efficient rail freight transport. As described in D3.1, these includes different safety rules, signaling systems and voltage (and the need to switch to diesel on non-electrified tracks), and differences in gauges. For example, a 1,577 km haul from Ljubljana to Istanbul involves five countries and eight changes of locomotives and only a small number of drivers is licensed for more than one country. Multi-system locomotives are expensive, costing up to €4m ($5.3m), making it hard for any firm other than subsidized operators (the incumbents) to afford them.

ERFA which represents small private rail freight operators suggests that all issues hindering the business of new entrants – private rail freight operators are known. Some parts of the rail freight sector still act with a lack of cooperation and they have not adapted their business models to customer needs. Additional findings are the lack of choice of operators in the rail freight sector which is a consequence of consolidation in the rail sector where incumbents acquire small private operators. It is obvious that a partial domination of some bigger freight operators is not a road to developing a sustainable rail freight system. Small rail operators contribute to competitiveness between rail and other modes by offering new and innovative services for customers, investing in rail network and generating jobs. It is also known that intramodal competition between incumbents and private rail operators increases the attractiveness of the railway market, brings creativity and dynamism. The U.S. and North American railway market represent an example of good practice, despite differences with an EU railway system. This most successful rail freight market is entirely private and composed from a mix of few large Classes I railways, smaller regional Class II railways and a large number of short lines. The big railways are happy to encourage the small ones as they feed traffic into the network and enable small shippers to be served efficiently at affordable prices. [41]

Retrack solution for more competitive freight transport, initially financed by the EU, had the aim to encourage some private companies and consultants to develop a freight route from Rotterdam to Hungary and beyond. Today Transpetrol, the rail tank car operator majority owned by VTG Lehnkering, runs up to five trains a week in co-operation with CER Hungary and LTE of Austria, another private firm—and it makes a profit. The idea provided flexibility in combining the composing of the trainloads from small groups of wagons, well-timed leasing of locomotives and rolling-stock, and negotiating good access rates. Transpetrol says it has also persuaded customers that they will not suffer any repercussions from the state-owned competition. [42]

For attracting new entrants to the market, it is also important to have adequate infrastructure, low access charges and interoperability improvements - “Rail freight has successfully developed in countries that have invested in rail, either by means of direct financing or low infrastructure charges. This is the basic requirement to foster competition in the railway market and to boost the development of rail freight,” said Antoine Hurel, CEO of private railway company Veolia.

3.1.2 Routing parties

3.1.2.1 Actors involved in organising of rail services

Transport chain consists of various different stakeholders, but in the rail transport the following stakeholders are of particular importance:
Due to the heterogeneous attributes and corresponding functions of the involved stakeholders, close interaction between all actors is required when it comes to organising concrete rail transportation. The main interactions between the most important actors in the rail freight transport are illustrated in the figure below.

Figure 3-5: Different types of stakeholders and the value provided

Figure above [1] shows that organising rail transport includes defining the particular roles and responsibilities of each partner, according to their individual competences. Without this framework, cooperation is not functional and transport cannot be executed.

3.1.2.2 Roles and responsibilities

As already mentioned, an interaction between partners is the vital element of cooperation. The table below illustrates different roles and responsibilities of each individual stakeholder.
<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Roles</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Forwarders</strong></td>
<td>Organisation of transports on engagement by shippers</td>
<td>Delegating transport-related tasks to respective stakeholders</td>
</tr>
<tr>
<td><strong>Railway Operators (RO)</strong></td>
<td>Organisation of rail transports, who do not necessarily undertake it themselves</td>
<td>Ensuring rail transport by delegating transport execution to RU</td>
</tr>
<tr>
<td><strong>Railway Undertakings (RU)</strong></td>
<td>Providing services for freight transport by rail</td>
<td>Ensuring physical transportation of goods</td>
</tr>
<tr>
<td><strong>Rolling Stock leasing companies (Traction Providers and Wagon Keepers) /Personnel leasing companies</strong></td>
<td>Leasing of locomotives and/or wagons respectively personnel</td>
<td>Ensuring the provision of adequate assets for the transport by rail for RU/RO</td>
</tr>
<tr>
<td><strong>Infrastructure Managers (IM)</strong></td>
<td>Establishing, managing and maintaining railway infrastructure, including allocating rail capacity</td>
<td>Ensuring the availability and accessibility of rail infrastructure for freight transport by rail</td>
</tr>
</tbody>
</table>

Table 3-1: Stakeholders’ roles and responsibilities in view of rail freight transports

In general, the main questions regarding the cooperation in the rail freight sector are:

- Who decides how to organise the transport?
- Who decides which actors are involved and how?
- How is communication between the partners organised?

Each of these questions is related to the governance structure that needs to be established within the cooperation. Cooperating partners have to decide upon leadership, empowered with the capability and competency to coordinate and control, to ensure a functioning and efficient working together. This is in particular important in the case of horizontal cooperation, where the risk of disturbed interactions is evident, as each partner within the cooperation tries to maximize their benefits, very likely at the expense of other partners. Therefore a governance structure is essential to coordinate the interest and actions of cooperation members.

One of the vital elements is that the governance structure offers a solution taking into account the individual interests of all participants, ensuring to utilize equipment and assets sufficiently. This can result in the targeted benefits of the cooperation. Nevertheless, a solution can only be achieved, if all stakeholders are prepared to resign autonomy e.g. in respect to having the power of control on own assets. Transferring power of control to a neutral institution, taking care of an efficient utilization of resources in view of volatile markets, may be a suitable option [1]. As options are always depending on concrete cases, a general solution does not exist.

This governance structure has to be part of the business model of the cooperation. Analysing and defining in depth what elements of governance will be analysed as a next step which will be reported in D3.4.
3.2 Assets and governance structure

This chapter is addressing the question: which market participants are active in connection with the railway freight transport and how are they connected to one another?

Each rail transport company requires infrastructure, which in the EU region is generally managed and operated by government authorities or administrations or which belong to the structures of a national railway undertaking. Things are however different in the operative area. Rail transport companies require partners, clients, sub-service providers. While in the block train area the companies frequently operate directly for end-customers, operators or forwarding companies are normally used as intermediaries in container and single wagon transport. A part of the assets in the company is available or is rented with the help of appropriate companies or leased (say locomotives, wagons, staff). Some companies operate a core business; others are active in several areas and therefore require smaller network structures.

To limit the scope of the question somewhat, the observation level has been reduced to the Rotterdam – North Rhine Westfalia corridor based on CIT 3 (WP 8). These are the most important axis points of railway freight movement, as the following graph illustrates.

![Number of freight trains via all Dutch border stations](image)

**Figure 3-6: Number of freight trains via all Dutch border stations [18]**

In the following, observation of companies involved in freight transport in the direction of Rotterdam, there is a selection of essential market participants to the extent this is possible due to the multiplicity of companies.

3.2.1 Operationally active companies

3.2.1.1 Railway undertakings operating in the Netherlands

Presently 36 railway undertakings have a license for the Dutch network. Twenty-one of them are operating in the freight business. Beside DB Cargo Nederland, which still has a major share at present, comparable undertakings are Captrain, ERS Railways, Locon Benelux, Rheincargo and Rurtalbahn Benelux.
Figure 3-7: Market shares of Dutch railway undertakings (estimation) [19]

A complete overview of the railway undertakings operating in the Netherlands is given below:

<table>
<thead>
<tr>
<th>Railway Undertaking</th>
<th>Based in</th>
<th>Main Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bentheimer Eisenbahn</td>
<td>D-Nordhorn</td>
<td>local business on own network</td>
</tr>
<tr>
<td>Captrain Netherlands</td>
<td>NL-Rotterdam</td>
<td>long distance trains and shunting</td>
</tr>
<tr>
<td>Crossrail Benelux</td>
<td>B-Deurne</td>
<td>long distance trains</td>
</tr>
<tr>
<td>DB Cargo Nederland</td>
<td>NL-Utrecht</td>
<td>long distance trains, local shunting activities</td>
</tr>
<tr>
<td>ERS Railways</td>
<td>NL-Rotterdam</td>
<td>long distance trains</td>
</tr>
<tr>
<td>HSL Logistik</td>
<td>NL-”s-Hertogenbosch</td>
<td>long distance trains</td>
</tr>
<tr>
<td>KombiRail Europe</td>
<td>NL-Pernis</td>
<td>long distance trains on behalf of combined transport group</td>
</tr>
<tr>
<td>Locon Benelux</td>
<td>NL-Zwolle</td>
<td>long distance trains</td>
</tr>
<tr>
<td>LTE Netherlands</td>
<td>NL-Rotterdam</td>
<td>long distance trains</td>
</tr>
<tr>
<td>OOC Rail</td>
<td>NL-Oss</td>
<td>local shunting activities</td>
</tr>
<tr>
<td>Rheincargo</td>
<td>D-Neuss</td>
<td>long distance trains</td>
</tr>
<tr>
<td>Rurtalbahn Rail Feeding</td>
<td>NL-Rotterdam</td>
<td>long distance trains</td>
</tr>
<tr>
<td>SBB-Cargo Deutschland</td>
<td>D-Duisburg</td>
<td>long distance trains</td>
</tr>
<tr>
<td>Shunter Tractie</td>
<td>NL-Rotterdam</td>
<td>working and maintenance trains</td>
</tr>
<tr>
<td>SNCB-Logistics</td>
<td>B-Bruxelles</td>
<td>long distance trains</td>
</tr>
<tr>
<td>Spitzke Spoorbouw</td>
<td>NL-De Meern</td>
<td>working and maintenance trains</td>
</tr>
<tr>
<td>Strukton Rail</td>
<td>NL-Maarssen</td>
<td>working and maintenance trains</td>
</tr>
<tr>
<td>Train Group</td>
<td>NL-Ridderkerk</td>
<td>local shunting activities</td>
</tr>
<tr>
<td>TX-Logistik</td>
<td>D-Troisdorf</td>
<td>long distance trains</td>
</tr>
<tr>
<td>Volker Rail Meterieel</td>
<td>NL-Dordrecht</td>
<td>local shunting activities, working and maintenance trains</td>
</tr>
</tbody>
</table>

Table 3-2: Overview of relevant railway undertakings in the Netherlands [20]
3.2.1.2 Intermodal operators

The following intermodal operators are active in the corridor, which offer the services mentioned below. Government as well as private railway networks are used here.

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Terminal</th>
<th>Website</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distri Rail B.V.</td>
<td>ECT Maasvlakte</td>
<td><a href="http://www.distirail.nl">www.distirail.nl</a></td>
<td>ECT Maasvlakte</td>
<td>Duisburg</td>
</tr>
<tr>
<td>Optimodal Nederlands B.V.</td>
<td>Rotterdam Euromax</td>
<td><a href="http://www.optimodal.nl">www.optimodal.nl</a></td>
<td>Rotterdam</td>
<td>Duisburg / Dortmund</td>
</tr>
<tr>
<td>Kombiverkehr Deutsche Gesellschaft für kombinierten Güterverkehr mbH &amp; Co KG</td>
<td>Rotterdam MVTE/RSC</td>
<td><a href="http://www.kombiverkehr.de">www.kombiverkehr.de</a></td>
<td>Rotterdam</td>
<td>Duisburg / Dortmund</td>
</tr>
<tr>
<td>HUPAC Intermodal AG</td>
<td>Rotterdam RSC</td>
<td><a href="http://www.hupac.com">www.hupac.com</a></td>
<td>Rotterdam</td>
<td>Duisburg</td>
</tr>
<tr>
<td>CTS Container-Terminal GmbH</td>
<td>Rotterdam Euromax Terminal</td>
<td><a href="http://www.container-terminal.de">www.container-terminal.de</a></td>
<td>Rotterdam</td>
<td>Cologne</td>
</tr>
<tr>
<td>Alcotrans Container Line</td>
<td>Rotterdam</td>
<td><a href="http://www.alcotrans.nl">www.alcotrans.nl</a></td>
<td>Rotterdam</td>
<td>Düsseldorf / Cologne</td>
</tr>
<tr>
<td>PCC Intermodal</td>
<td>CT Twente</td>
<td><a href="http://www.pccintermodal.pl">www.pccintermodal.pl</a></td>
<td>Rotterdam</td>
<td>Duisburg</td>
</tr>
</tbody>
</table>

Table 3-3: Overview of container shuttle services between the Netherlands and North Rhine Westphalia

3.2.1.3 Rail freight forwarding companies

Besides DB Cargo, there are essentially two companies that have large national networks. The first company is VTG Rail Logistics in Hamburg. In addition to forwarding and logistics solutions, the company also covers the areas of wagon leasing (VTG Wagon Hire), tank container logistics (VOTG) and rail transport companies (EVU Bräunert, only in Germany).

Another significant rail transport forwarding company in the Netherlands is Raillogix based in Rotterdam, which is also active as a wagon hire company through its subsidiary RailReLease.

3.2.2 Asset companies, workshops

3.2.2.1 Locomotive leasing companies

Meanwhile, a series of companies offer locomotives on lease or even on hire for shorter and longer periods of time. The biggest leasing companies Alpha Trains, ELL and MRCE call the shots in the market here; these two companies have several hundred highly-modern electric locomotives for international use.

Different medium-level companies that partially cover special niche segments also exist.

<table>
<thead>
<tr>
<th>Company</th>
<th>Based in</th>
<th>Diesel loco</th>
<th>Electric loco</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ajax-Loktechnik</td>
<td>Hamburg</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Akiem</td>
<td>Clichy (Paris)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Alpha Trains Group</td>
<td>Luxembourg</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Beacon Rail Leasing</td>
<td>London</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CZ-Loco</td>
<td>Nymburk</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>ELL European Locomotive Leasing</td>
<td>Vienna</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
### Table 3-4: Overview of locomotive hire and leasing companies

<table>
<thead>
<tr>
<th>Company</th>
<th>Based in</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEROS Helvetic Rolling Stock</td>
<td>Rheinfelden</td>
<td>X</td>
</tr>
<tr>
<td>MGW-Service</td>
<td>Kassel</td>
<td>X</td>
</tr>
<tr>
<td>MRCE Mitsui Rail Capital Europe</td>
<td>Amsterdam</td>
<td>X</td>
</tr>
<tr>
<td>Northrail</td>
<td>Hamburg</td>
<td>X</td>
</tr>
<tr>
<td>Railpool</td>
<td>Munich</td>
<td>X</td>
</tr>
<tr>
<td>Railtec-Eisenbahntechnik</td>
<td>Marl</td>
<td>X</td>
</tr>
<tr>
<td>SRI Rail-Invest</td>
<td>Günzburg</td>
<td>X</td>
</tr>
<tr>
<td>SVG Rail-Service</td>
<td>Stuttgart</td>
<td>X</td>
</tr>
</tbody>
</table>

*Only as a substitute in case of maintenance*

### 3.2.2.2 Wagon hire companies

Same as in the locomotive leasing, there are also many wagon hiring companies on the market, which is dominated by VTG AG, Hamburg. They offer approx. 80,000 wagons all over Europe. In addition, around 25 small and medium sized companies are present in the market. The Verband der Güterwagenhalter in Deutschland e.V. (VPI) (Association of freight wagon owners in Germany Inc.) lists the following members: [21]

<table>
<thead>
<tr>
<th>Company</th>
<th>Based in</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARETZ GmbH &amp; Co. KG</td>
<td>Krefeld</td>
<td>Germany</td>
</tr>
<tr>
<td>ATIR Rail</td>
<td>Paris</td>
<td>France</td>
</tr>
<tr>
<td>DAHER PROJECTS GmbH</td>
<td>Hanau</td>
<td>Germany</td>
</tr>
<tr>
<td>EAH Eisenbahn Anlagen Handel GmbH</td>
<td>Duisburg</td>
<td>Germany</td>
</tr>
<tr>
<td>ERMEWA SA</td>
<td>Geneve</td>
<td>Switzerland</td>
</tr>
<tr>
<td>ERMEWA S.A.</td>
<td>Puteaux Cedex</td>
<td>France</td>
</tr>
<tr>
<td>ERR European Rail Rent GmbH</td>
<td>Duisburg</td>
<td>Germany</td>
</tr>
<tr>
<td>GATX Rail Germany GmbH</td>
<td>Hamburg</td>
<td>Germany</td>
</tr>
<tr>
<td>GE Rail Services GmbH</td>
<td>Hamburg</td>
<td>Germany</td>
</tr>
<tr>
<td>ITG Transportmittel GmbH</td>
<td>Syke</td>
<td>Germany</td>
</tr>
<tr>
<td>Kurt Nitzer GmbH &amp; Co. KG</td>
<td>Hamburg</td>
<td>Germany</td>
</tr>
<tr>
<td>NACCO GmbH - A CIT Company</td>
<td>Hamburg</td>
<td>Germany</td>
</tr>
<tr>
<td>On Rail Gesellschaft für Eisenbahn 3ausrüstung und Zubehör mbH</td>
<td>Mettmann</td>
<td>Germany</td>
</tr>
<tr>
<td>ORV On Rail Ges. für Vermietung und Verwaltung von Eisenbahnwaggons mbH</td>
<td>Moers</td>
<td>Germany</td>
</tr>
<tr>
<td>RailReLease B.V.</td>
<td>Rotterdam</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Spoorijzer Materieel Management en Onderhoud B.V.</td>
<td>Rotterdam</td>
<td>Netherlands</td>
</tr>
<tr>
<td>TOUAX RAIL LTD</td>
<td>Puteaux - La Défense Cedex</td>
<td>France</td>
</tr>
<tr>
<td>TRANSWAGGON GmbH</td>
<td>Hamburg</td>
<td>Germany</td>
</tr>
<tr>
<td>Tyczka Gase GmbH</td>
<td>Geretsried</td>
<td>Germany</td>
</tr>
<tr>
<td>VTG Aktiengesellschaft</td>
<td>Hamburg</td>
<td>Germany</td>
</tr>
<tr>
<td>Wagon Care B.V.</td>
<td>Rotterdam</td>
<td>Netherlands</td>
</tr>
<tr>
<td>WASCOSA AG</td>
<td>Luzern</td>
<td>Switzerland</td>
</tr>
</tbody>
</table>

*Table 3-5: Overview of wagon hire companies*
A few other East-European vendors are also active in the market (e.g. AX-Benet), which however, are of subordinate importance for rail transport in the direction of Rotterdam, with the exception of a few cereal transports.

### 3.2.2.3 Workshops

On the whole, the list of VPI contains 178 member companies in 18 countries that offer maintenance of freight wagons, mobile services and other services. Unlike in locomotive- or wagon hire companies, it makes sense here to limit the consideration to the corridor mentioned above. The following 20 companies which offer corresponding services remain: [21]

<table>
<thead>
<tr>
<th>Company</th>
<th>Based in</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combo Wagnonservice BV</td>
<td>Born</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Dortmunder Eisenbahn GmbH</td>
<td>Dortmund</td>
<td>Germany</td>
</tr>
<tr>
<td>ETZ Betriebs GmbH (ETZ)</td>
<td>Herne</td>
<td>Germany</td>
</tr>
<tr>
<td>EVONIK Industries AG - Werk Infracor</td>
<td>Marl</td>
<td>Germany</td>
</tr>
<tr>
<td>Fahrzeugfabrik F. Kiffe Söhne GmbH &amp; Co. KG</td>
<td>Münster</td>
<td>Germany</td>
</tr>
<tr>
<td>Hafen Krefeld GmbH &amp; Co.KG</td>
<td>Krefeld</td>
<td>Germany</td>
</tr>
<tr>
<td>Häfen und Güterverkehr Köln AG</td>
<td>Brühl</td>
<td>Germany</td>
</tr>
<tr>
<td>Neuss-Düsseldorfer Häfen GmbH &amp; Co. KG</td>
<td>Neuss</td>
<td>Germany</td>
</tr>
<tr>
<td>Niederrheinische Verkehrsbetriebe Aktiengesellschaft NIAG Geschäftsbereich Fahrzeugwerkstatt</td>
<td>Moers</td>
<td>Germany</td>
</tr>
<tr>
<td>On track GmbH</td>
<td>Krefeld</td>
<td>Germany</td>
</tr>
<tr>
<td>RailMaint GmbH Werk Duisburg</td>
<td>Duisburg</td>
<td>Germany</td>
</tr>
<tr>
<td>RailMaint GmbH Werk Oberhausen</td>
<td>Oberhausen</td>
<td>Germany</td>
</tr>
<tr>
<td>Rurtalbahn GmbH</td>
<td>Düren</td>
<td>Germany</td>
</tr>
<tr>
<td>RWE Power AG Technikzentrum Tagebau/HW</td>
<td>Frechen</td>
<td>Germany</td>
</tr>
<tr>
<td>Shunter Wagons BV</td>
<td>Rotterdam</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Spoorijzer Materieel Management en Onderhoud B.V.</td>
<td>Roosendaal</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Thyssenkrupp Steel Europe AG Logistics Services, TechnikEisenbahnwagen Werkstätten</td>
<td>Duisburg</td>
<td>Germany</td>
</tr>
<tr>
<td>Waggonwerk Brühl GmbH</td>
<td>Wesseling</td>
<td>Germany</td>
</tr>
<tr>
<td>Westfälische Lokomotiv-Fabrik Reuschling GmbH &amp; Co. KG</td>
<td>Hattingen</td>
<td>Germany</td>
</tr>
<tr>
<td>WI-NEU Lökinstandsetzung</td>
<td>Moers</td>
<td>Germany</td>
</tr>
</tbody>
</table>

Table 3-6: Overview of workshops in the area Netherlands / North Rhine-Westphalia

### 3.2.3 Derivation of a cooperation model

If one evaluates the business relations of earlier described market participants, it can be observed that they are related to each other essentially at the client/contractor level. The less functions a company defines as its core business activity, the more other companies are commissioned to provide services. However, one recognizes the tendency to perform the maximum possible number of these tasks in-house, irrespective of whether this is financially attractive or improving the operations. An exception is the leasing or hiring of locomotives as well as renting of wagons because of required investments (millions of Euros), as well as the risks involved can be reduced here.
This situation can be compared to the behaviour pattern in inland waterways transport. Even, when collaboration with other companies is from financial and operational perspective more profitable, one’s own internal infrastructure would still be preferred.

It could be a matter of history, but perhaps also a matter of perspective, that to ward off the risk of losing market shares in a highly competitive market, the companies decided not to outsource a part of their work to external companies in a railway and inland waterways combination, f.e. in view of the construction work in the Duisburg – Rotterdam Corridor that has been going on for several years now. There is the fear that after the completion of these construction activities one may not get the order again.

This is more astonishing than is evident in connection with the WP 8 interviews, that the required extra costs for diversionary transport by the market participants will be estimated at up to 20%, which normally cannot be transferred to the end-customer. On the other side, the evaluations indicate that despite the construction works, the punctuality rates have improved. This is not just an observation in connection with WP 8; similar conditions were experienced also with respect to the Hamburg port for the reconstruction measures initiated there. The reason presumably lies in the more accurate planning and observation of the assigned slots.

**Figure 3-8: Network of relation in rail freight business**

It has to be pointed out that an idea for a new or an alternative business does not mean to create additional EU regulations, since the railway sector is more regulated than any other transport mode. This is understandable with regard to safety reasons, working conditions and environmental protection. More intensive regulation would further reduce independent economic decisions and lead to heavier burdens for railway undertakings. If we define a new business model as a support for railway undertakings and include the given circumstances, such as lack of infrastructure, highly frequented railway nodes and optimization of assets, it makes sense to have a look to the realized models in some European ports.

The evaluation of port-shuttle systems in Antwerp, Duisburg and Hamburg proves that at the local level, totally neutral systems or systems run by several market participants can
be implemented, which is also accepted by the market. This presupposes that at the vendor level (in this case the port), the port or a company assigned to it or a consortium of interested market participants can play a leading role in shaping and conceiving such a model. One must also discuss the question as to whether such a neutral system can relate to the purely shunting service or also to the operation of a heavily overloaded bottleneck. However, such neutral systems – regardless, if they are created based on commercial solutions from companies or as an operative lobbyism from authorities – will give a crucial support to the rail freight market.

3.3 Parameters relation to communication

To facilitate the business model described mainly in Chapter 2.2.1, based on the concept of the horizontal cooperation, a rather intensive information exchange has to take place between the stakeholders. Especially for SMEs, which are in focus of Smart-Rail (see Chapter 2.2.1.1) and which have often limited access to large-scale information systems, the functioning information exchange is essential to stay flexible, responsible and responsive on the market.

3.3.1 Data exchange requirements between the stakeholders

Considering the horizontal cooperation in the railway market, as suggested here in WP3, the railway undertakings (RUs) are the most important stakeholders. The information exchange then involves firstly their mutual cooperation (and the resulting mutual communication), secondly their separated or coordinated communication with the infrastructure managers (IMs) who are their partners for providing the train path and for managing the train operation.

Both the cooperation and the respective information exchange may be seen from the business point of view (settling on the transport, negotiating prices and conditions etc.), technical point of view (specifying the train path with timetable and transit times, determining the engine and rolling stock etc.), and the operational point of view (the departure and trip itself, tracking the train position, handling disruptions, communicating with the IM).

Obviously, these considerations hold true only if the bi- or multilateral cooperation is necessary; when one RU can, thanks to an interoperable engine, personnel and other technical equipment and regulatory issues, handle the whole transport by itself, it will then communicate only with the IMs. An example of such cooperation was also the association of the European Bulls – mentioned in Chapter 2.2.1.2 and ceased their active business around the turn of 2009/2010.
In accordance with the roles and responsibilities of these stakeholders, described in detail in Chapter 3.1.2.2, the necessary communication involves:

- Pre-trip arrangements, business agreements or other negotiations between the participating RUs, concerning the route, the intended path (or especially the departure, arrival, and handover times), and solving technical issues (as selecting the engine, the rolling stock, personnel)
- Path request(s) – upon settling on the train route and the train handover (when necessary, i.e. when any handover takes place), the following process takes place:
  - The leading RU (LRU) requests a train path within the territory of the corresponding IM, specifying also the cooperating RU.
  - The leading IM provides the train path with the assigned train number.
  - Each next RU requests then a train path on the territory of his respective IM, specifying the cooperating LRU.
  - Both neighbouring IMs communicate the assigned train paths and handle the train later in the traffic control processes.
- This communication and information exchange is nowadays largely replaced by the Path Coordination System (PCS) of RailNetEurope (RNE), in the process called a harmonisation (involving all the cooperating RUs and all the respective IMs).
- Getting the cargo information – information on the goods loaded on each wagon; generally based on the transport contract, then completed with the wagon numbers, NHM goods codes, and other data defined by the CIM consignment note
- Getting the train information – the engine number, wagon numbers (in the wagon list and braking sheet, as stated below in 3.3.4), list of UN codes of the dangerous goods, if any; this information is exchanged between the cooperating RUs and also communicated to the IMs (as mandatory)

Towards the IM, the necessary information (wagon list, braking sheet) is generally provided using his specific ICT system. The wagon list is defined by the TSI TAF message TrainCompositionMessage.

In most cases the information exchange between the cooperating RUs takes place via e-mail (especially between the smaller ones without any specialized ICT solution), as mentioned below in 3.3.2 the documents are handled and handed over either by electronic means (often by e-mail again), or in their paper form, as described in 3.3.4.
3.3.2 Existing IT-environment in the railway area

As the ICT environment, various solutions with varying degrees of automation and electronic data interchange are used in the railway sector. The intended information interoperability should overcome the differences; however, its scope is generally limited to the message formats and semantics by the data exchange.

The typical tools or solutions used by the railway sector include:

- Microsoft Excel. Especially for the smaller RUs, this “solution” is ideally suited, as it is quite sufficient, and also affordable, unlike the large industry solutions. An obvious disadvantage is, however, rather cumbersome operation and maintenance of the “system”, and also limited options when it comes to the further data processing (basically it needs to be done by hand).

- COTS solutions (Commercial off-the-shelf) – multiple specific types of ICT systems are used, as the following:
  - Customer relationship management (CRM) – generally these collect information on customers, their contact information, purchasing habits, preferences, marketing info, and history with the company etc. To an extent it can also be used for managing transports, and it can prove being cost-efficient and often is quite sufficient.
  - Enterprise Resource Planning (ERP) – used for the general control of the business processes in manufacturing or by providing services; also rather general for the use in the transport area
  - Transport management systems (TMS) – is a subset of supply chain management system, dealing specifically with the issues of transport. It may be also a part of the ERP system (Enterprise Resource Planning)

- In-house development or tailor-made solutions: used especially by the largest RUs and operators with complex and demanding ICT requirements. This means an advantage of a tailor-made solution, covering the specific requirements of the large organisation; on the other hand, it brings or can bring also complexity, incompatibility with the neighbourhood or with partners, rising costs and dependency on the vendor or developer.

As the “data exchange mechanism”, a plain, non-structured e-mail is often used, as mentioned above. Again this solution may be viable and reasonable only for the smallest RUs and operators; for mid-size companies (not mention the large ones), a suitable data interface should be considered.

Towards the IM, the necessary information (path requests, wagon list or train composition, Train Ready, dangerous goods info, other requests) is generally provided directly into his corresponding ICT system, either manually in the web-based user interface, or automatically via a data interface.

3.3.3 Foreseen and upcoming ICT solutions

The following trends are winning even bigger recognition in the railway sector, both in the area of “individual” ICT solutions and in the area of the data exchange:

- Web-based interface to the ICT with a public access. The versatile web-based technology allows easy and ubiquitous access to the ICT resources, including the TMS systems or other solutions for managing rail transports. This way, the data may be provided (and acquired) by the customer or cooperating partner at any time, just using a web browser (and on condition of the proper user rights). The customer or partner RU does not need any installation or investments into the ICT.
  Among such systems, examples both on the IM’s and RU’s side include:
- Czech IS KADR for requesting train paths – completely based on the web-based interface (however also with a data interface which can be accessed from the RUs' systems).
- Polish "System RAIL"; under the name System Logistyki Kolejowej (SLK, System for the rail logistics) it is used by Lotos Kolej, one of the largest private railway undertakings on the Polish market. [22]

- Ecosystem approach. A relatively new emerging trend in ICT is the ecosystem approach, meaning that the ICT system reflects the natural structure of the market and its collaborative nature, respecting and supporting roles and responsibilities of each stakeholder. An example is the ABIRUN solution, intended mostly for smaller, independent subjects and for their mutual cooperation.

![Figure 3-10: The “transport ecosystem” ABIRUN](image)

- Data exchange standards – TSI TAF. To facilitate and simplify the data exchange, and to allow the information interoperability and to overcome the differences in the ICT systems, various data exchange standards have been developed. In the railway sector the most important and influential ones are the TSI TAF – "Technical Specification for Interoperability relating to the Telematic Applications for Freight subsystem of the trans-European conventional rail system". It was published as a Commission Regulation (EC) 62/2006; therefore it is applicable in the EU member states in the same way as a law. The TSI TAF covers all the major transport processes, from creating a consignment note, to path request, to the train preparation before its departure, to tracking the train position (with forecasting), to handling disruptions, and more. The TSI TAF is mandatory for communication between a RU and IM; however, it defines also messages and processes which take place between the cooperating RUs or other subjects.

- International ICT systems. With a similar purpose to the data exchange standards (in a sense), i.e. to facilitate the seamless communication and data interoperability, the international ICT systems are in operation. These include:
  - "legacy" UIC or Hermes applications
RailData systems (including ORFEUS for the electronic CIM consignment note, ISR for wagon tracking, and UseIT)

RNE systems (RailNetEurope), facilitating the European border-crossing train traffic and being based on TSI TAF; these include Path Coordination System (PCS), Train Information System (TIS), Charging Information System (CIS), and Common Components System (CCS).

- In some cases, the international systems as PCS and TIS, also assume the role of national systems for requesting train paths or train positions (if the national system is missing).

Figure 3-11: Web-based interface of the Path Coordination System (PCS) of RNE, harmonising a train path request

3.3.4 Documentation on the transport processes

The three most important transport documents necessary in the freight train traffic are the following:

- Consignment note – the basic indispensable document defining the cargo transported by the wagons or a train. Any consignment must have one, i.e. any wagonload, any wagon group, or also any block train (which is formally also a consignment, for that matter). May be provided in a printed or electronic form (see figure 3-12).

The standard consignment note CIM used throughout Europe is defined by the organisation called Convention concerning International Carriage by Rail (COTIF, from the French denotation “Convention relative aux transports internationaux ferroviaires”), specifically by their Uniform Rules Concerning the Contract of International Carriage (CIM, from the French “Règles uniformes concernant le Contrat de transport international ferroviaire des marchandises”).

Towards the ex-soviet CIS states (including transports to/from the neighbouring countries), a different transport law SMGS is used (Agreement on Direct International Goods Transport by Rail, from Russian “Соглашению о международном железнодорожном грузовом сообщении”), defined by the Organization for Cooperation of Railways (OSJD).

For a wagon group or block train, the consignment note contains usually the wagon list (which defines the Train Composition).
Figure 3-12: The international CIM consignment note (software-based electronic form)

- Wagon list or train composition – defined by TSI TAF standard as the TrainCompositionMessage, including the UN codes of dangerous goods, if applicable.
  The message is sent from a RU to an IM and defines the composition of the proposed train. The structure, as defined in TSI TAF, contains the identifying section (including the operational train number or OTN), responsible subjects (i.e. the IM and RU), a section on the route section for which the train composition is valid, train running data, information on the dangerous goods (if applicable), activities done on the train, loco or engine identification, and then the wagon operational data themselves.
  Generally, the wagon list is mandatory to be provided to the infrastructure manager (IM) before the train departs. Some IMs require specifying the wagon list in the corresponding ICT system (either via web-based or data interface).
- Braking sheet (in German-speaking countries known as Bremszettel) – defined by the UIC Fiche/Leaflet 472; the train driver specifies in it the number of axes, train weight, and braking behaviour of the train and its vehicles. The braking behaviour or braking strength is stated in the “braking percent” as the unit, and the
minimum required braking percent is specified in the train timetable or train path. In case that the train underruns the required value, operational measures come to the play, i.e. the train must lower its speed, or must not take the scheduled route at all. The braking sheet contains also information on the brake types, i.e. single, dual, emergency brake, or electro-pneumatic brake. The braking percent is essential to maintain the train safety when running (as it reflects its ability to brake and stop safely).

Physical handover of a train may take place either on the state boundaries (or more precisely, at the IM boundaries), or at any place in the inland. Thanks to interoperable equipment (as the multi-system electric engines) and versatile personnel (with the knowledge of multiple languages, multiple railway infrastructure environments and regulations, and multiple route knowledge) it is by far not necessary.

When the handover is necessary, both parties (i.e. both IMs) agree on the specific handover point (station) and time. Besides the physical handover, i.e. either changing the train driver, or detaching and attaching the engine, or both, also the handover of the transport documentation needs to take place. The documents may be exchanged either in an electronic form (i.e. as a data file or alternately by e-mail as a scanned version of the printed documents), or in the “classical” printed form. The specific procedure, time and place for handing the documents is agreed by both cooperating parties. In the simplest transport cases often no structured documentation is necessary; however, it may be required as a proof of crossing the borders of the member states. Also outside the EU the consignment notes are mandatory, due to the customs clearance.

3.4 Value case analysis

3.4.1 Introduction

To define a governance model that becomes successful and to achieve scalable innovations, the Value Case Methodology can be used. The Value Case Methodology (VCM) aims to unite multiple stakeholders by creating a very broad set of values that are associated with the innovation, and to explicitly capture the motivations and wishes of all stakeholders involved (see Smart-Rail deliverable 4.2).

The Smart-Rail project will define different improvement scenarios (Figure 3-13) for railways to become more competitive to other transport modes and seek and offer high-quality, end-to-end services without being restricted by national borders. Different types of solutions are assessed data-based solutions; synchro-modal solutions; other technical and logistics related solutions; capacity related solutions. [23] The improvement scenarios will describe possible future situations. In order to develop general improvement scenarios, the Smart-Rail Continuous Improvement Tracks will be assessed as use cases.

Each improvement scenario will require changes. These changes have their impact on the different stakeholders. The impact of the resulting barriers and drivers on the different stakeholders will be assessed for each of the improvement scenarios (Figure 3-14).
The identified barriers and drivers for realising the improvement scenarios will be the basis for deriving business and policy interventions in a next step beyond this deliverable. In that stage interventions / measures will be defined that are required to make the step to the desired situation (business model / cooperation, governance model). Interventions can be both measures businesses can take and measures to be taken by government.

### 3.4.2 Cases: Continuous Improvement Tracks (CIT)

The Value Case analysis approach is used in the CIT’s in order to find roles, incentives, drivers, barriers and collective business goals for each of the stakeholders. The preferred future improvements in the CIT’s will often result in a change of business for the different stakeholders. For example, there will be different and more intensive communication with stakeholders for the terminal operator or a business process redesign is needed.

Based on the drivers and barriers, business and policy interventions can be derived for realising the improvement scenario. Since not all improvement scenarios have been defined yet in detail, this will be done at a later stage.

In addition to individual drivers and barriers, the power relations of the parties are important. Socio-grams are drawn to show the estimated power of the stakeholders on the innovation.

A socio-gram is a graphical representation of the range of influence of the concerned stakeholders. In the center of the socio-gram parties are placed that have full power to initiate the required changes for the innovation. One circle further, the parties are shown that may decide together about the changes. One further, parties can collaborate, and one further parties can think along with others that can initiate the changes. In the last circle parties are limited to just inform others. In Figure 3.15 the empty form that is used for the socio-gram is shown.
We will briefly describe the Continuous Improvement Tracks (CIT’s) and summarise overall results in this chapter. Specific results of the CIT’s can be found in Smart-Rail deliverables D6.4, D7.4 and D8.4. [24] [25] [26]

3.4.2.1 CIT 1: Wagonload train services

The preferred future improvement in CIT 1 is to strengthen a single wagonload (SWL) transport concept. The main stakeholders in CIT 1 have different interests and incentives for realising this improvement.

In Smart-Rail deliverable D6.4 (Alignment of the value case of involved stakeholders) [24] a detailed description of these stakeholders can be found. The main stakeholders developing improvements strived for in CIT’s are the railway undertakings, with as additional role the ‘Coordinator’. The SWL concept of CIT 1 relies on the supply of cargo from shippers.

3.4.2.2 CIT 2: Control tower for long distance rail freight transport

The preferred future improvement in CIT 2 is to improve the quality of rail services by reducing round-trip times, better rail capacity use, improving reliability and reducing transport costs by using the Control Tower.

The main stakeholder is the party that operates the Control Tower, in this case Seacon Logistics. The Control Tower provides information services to shippers, logistics service providers, railway undertakings and infrastructure managers.

The change in business could create positive as well as negative effects for the concerned stakeholder. Different drivers and barriers have to be overcome for each stakeholder, to
realise the future situation. In Smart-Rail deliverable D7.4 [25] the whole methodology is elaborated for CIT 2.

3.4.2.3 CIT 3: Reliability in case of (un)expected disruptions on the rail network

Pilot 1: Analysis of performance of rail freight service Rotterdam – Duisburg / Neuss

The preferred future improvement in this pilot is the performance (mainly in terms of reliability and flexibility) of rail freight services between Rotterdam (NL) and Duisburg / Neuss (D). For detailed information, see Smart-Rail deliverable D8.4. [26]

Parties that will exchange data in this pilot are the railway undertakings and infrastructure managers. In order to realise this improvement, measures/interventions have to be taken. These will be derived from the results of the pilot and are therefore not yet defined. Therefore, at this moment new business models and new ways of cooperation cannot be defined yet in detail.

Pilot 2: Hub concept terminal Rotterdam for exchange of containers between different rail services

The preferred future improvement in this pilot is to arrive at a new inter-organisational structure that will manage the handling and bundling of containers at Maasvlakte, through a hub concept.

Pilot 3: Pre-defined paths for short term slot allocation in Germany

The preferred future improvement in this pilot is to optimise capacity allocation and utilisation on the railway network and to make transport more efficient by employing an IT tool for short term slot allocation.

3.4.2.4 Overall goal and directions

The improvement scenarios of the Smart-Rail Continuous Improvement Tracks are aimed at the overall Smart-Rail goal and directed at the rail transport customers: improving rail freight services offered to the shippers. In order to realise the desired improvement, the following changes in service aspects are required: [23]

- **Reliability**: Reduction of delayed freight through better coordination between stakeholders both within the rail sector and other modes;
- **Lead time**: Reduction of waiting times along the routes by better coordination between different stakeholders (for example terminal connectivity and time slot exchange);
- **Costs**: Decrease of total shipment costs for freight switching from road to rail transport;
- **Flexibility**: Establish protocols for last minute switching between modes. Implementation of protocols in operators and logistics service providers;
- **Visibility**: Real-time information on the status of the order of rail freight along the corridor. This includes insight of possible delays and best alternative options in such cases.

Since the Smart-Rail goal is directed at improving rail freight services, it is clear that railway undertakings (RUs) are the appropriate stakeholders to take the lead in realising the improvement scenarios and business model innovations. They have the largest and common interest, together with the rail infrastructure managers (IMs).
General intervention directions have already been indicated in Smart-Rail deliverable D4.1: [4]

- **Better cooperation of stakeholders**: Interventions in willingness to invest and cost benefit distribution to support vertical cooperation, between different stakeholders; interventions to realise "mixed" vertical-horizontal cooperation by sharing assets; interventions to realise a shared virtual platform, held by a third party, which gathers and provides shipment information from actor to actor.

- **Improving customer visibility**: E.g. interventions to reach a standard load identification number in order to achieve a global track and trace.

### 3.4.2.5 Roles and interest of the stakeholders

Even though each process, area and added value is different, in general there are three main types of roles within the ecosystem. Those are the end customers, enablers and the parties that form the base chain process. Regarding the parties within the Smart Rail ecosystem the following roles can be identified:

#### End customer:

- **Shipper**: The Shipper could be seen as an end customer, as the service is chosen by them. He has an interest in the best service, for the best price. That means reliable, flexible and cost effective services by rail. Well loaded trains, optimization of modal choice and rail services for optimization could help in making the service more efficient and could lead to a more attractive service.

#### Enabler:

- **Railway infrastructure manager**: The railway infrastructure manager will strive for an effective utilisation of its available infrastructure capacity. This will be reached with a more attractive service product by rail.

#### Main parties forming the base chain process:

- **Logistics service provider / forwarder**: The logistics service provider or forwarder would like to ensure flexible and cost effective modes of transport. For this, it is of great importance to be able to be as dynamic as possible and hence be able to make real time decisions to cope with changing situations.

- **Terminal operator**: The terminal operator would like an efficient and effective use of its facilities and control over transports arriving and departing from the terminal. Since the visibility of rail shipments can contribute to his terminal throughput, exchanging this data can be of great importance.

- **Railway operator/railway undertaking/wagon keeper**: Those strive for a reliable form of transport, while keeping the use of assets as efficient as possible.

In the chain, logistic service providers, terminal operators and railway operators are the most likely parties to exchange data, since they form the base process on which the others operate. The parties that are within these three roles have the specific position to make the base process more effective by exchanging data. This might not only be the most immediate benefit, but would also allow the others to build upon.
3.4.2.6 Transition of changes

To create a transition, changes in business are inevitable. However, creating such a transition is not easy and requires a strong base of power within the ecosystem. However, each of the parties has its own capabilities and possibilities to achieve these changes. Changes could differ from one changing the mode of communication to (other) modes of cooperation or even methods for making decisions.

Parties with a lot of power to initiate changes are usually the parties that can take a new role in the chain, like a coordinator, and parties in the base process, such as the LSP and the railway operator.

Enabling parties, like infrastructure managers, have usually less power to change the practical way of doing, although they can collaborate and/or may be willing to think along.

Last but not least, there are facilitating parties like port authority, ministries, etc., who could inform or help to initiate the changes.

3.4.3 Conclusions on improvement scenarios and business model innovations

Regarding the Continuous Improvement Tracks, a few conclusions can be drawn, on the improvement scenario’s and business models, roles, cooperation and the incentives to make it work.

3.4.3.1 Continuous Improvement Track scenarios and business model innovations

The Smart-Rail Continuous Improvement Tracks (CIT’s) focus on different aspects of the improvements and business model changes: [24] [25] [26]

- **CIT 1: Wagonload train services**
  
  CIT 1 is explicitly focused on cooperation between RUs in order to enlarge the geographical coverage and with that the attractiveness for Shippers.

  In CIT 1 a new role in the value network is added: the Coordinator, a specific party to promote and execute the single wagon load transport concept on behalf of the cooperating railway undertakings (RUs).

  The focus of the improvement is with the RU’s. They set up a cooperation scheme through the Coordinator. The largest change and impact is therefore with these parties and also includes changes in the relationship with LSPs.

  The business model innovation is driven by a change in the supply chain (SC) and includes changes in the structure and management of relationships with key partners (RUs, Coordinators). This Business model innovation improves the value proposition (VP) to existing and new customers through the customer interface (CI). Since CIT 1 is focussed at new customers (Shippers), changes, or new activities, in the customer interface are needed in order to attract these new customers.

- **CIT 2: Control tower for long distance rail freight transport**

  CIT 2 is directed at improvement of reliability, lead time, flexibility and visibility) proceeding from the LSP on the basis of information exchange.

  Focus of the improvement scenario of CIT 2 is on improvements regarding information exchange at the LSP. The information exchange is initiated and coordinated by the LSP. Besides impact at the LSP, improvements for the RUs are foreseen. Cooperation is required in order to realise the exchange of information,
mainly between LSP, RUs end IMs. The driver for the improvement scenario is the LSP. Besides the LSP, shippers, RUs and IMs provide the most value (see D7.4 [25], Section 3.2 and Chapter 3).

Although the improvements scenario is mainly directed on information exchange between different stakeholders, the business model innovation can also be regarded as a change in the supply chain (SC), resulting in an improved value proposition (VP) to the customers (shippers).

- **CIT 3: Reliability in case of (un)expected disruptions on the rail network**

The three pilots / measures of CIT 3 are focused on operational improvements in the reliability and flexibility of transport over the rail network, on the basis of existing business relations.

The focus of the improvements and impact in pilot 1 “Analysis of performance of rail freight service Rotterdam – Duisburg / Neuss”, lies with the RUs/ROs (inclusive Forwarder). For pilot 2 “Hub concept terminal Rotterdam for exchange of containers between different rail services” the focus of the improvements is on RUs and Terminal operator. The focus of the improvements in pilot 3 “Pre-defined paths for short term slot allocation in Germany” is with the IM and RU’s.

These improvement scenarios do not entail a real change in business models. The aim is to improve the product (value proposition) to the customers, that can be realised within the existing business model structures. However, in order to realise the required information exchange in CIT 3, a coordinator role could be necessary (in the case of pilots 1 and 2, this role could for instance be executed by the Terminal operator or a third party as an independent body).

### 3.4.3.2 Coordinator role required

In general, it can be concluded that in order to improve rail freight services offered to the shippers, a coordinating role is necessary. This role is needed to bundle the propositions of different RUs into a new proposition with added value for the customers and/or to enable information exchange between different stakeholders. The coordinating role can contain one or more of the following functions:

- **Realise the customer interface to the shippers**: E.g. the Coordinator in CIT 1 and the LSP in CIT 2.
- **Govern the cooperation between stakeholders**: E.g. the Coordinator for the single wagon load transport concept in CIT 1.
- **Realise an information exchange platform**: E.g. the Control Tower function performed by the LSP in CIT 2 and the necessary coordinator role for information exchange in CIT 3. (E.g. an ‘Information Value Provider’ [27]).

In order to realise such a coordinator role, the party that executes this function should be seen as trusted and independent party by the different stakeholders.

### 3.4.3.3 Vertical and horizontal cooperation for improvement

As discussed before, the desired improvements include vertical and horizontal cooperation in the value chain. From the improvement scenarios in the CIT’s it can be seen that this can involve different subsets of stakeholders in the value network. In general cooperation in a vertical sense (Shipper – LSP – RO/RU – IM), seems to be most beneficial to improve rail freight services offered to the shippers. For instance in CIT 1 the cooperation between RU and LSP (through the Coordinator), and in a lesser sense in CIT 2 the cooperation between LSP, RU and IM and in CIT 3 the cooperation between RU
and Terminal operator. The examples of the Continuous Improvement Tracks also include cooperation in the horizontal sense, mainly between different RU’s.

In general, it can be concluded that vertical cooperation between RUs, LSPs and Shippers is the basis for improving rail freight services offered to the shippers (with possibly new roles or stakeholders in between). With respect to geographical coverage and efficient use of infrastructure and assets, vertical cooperation between RUs and IMs is vital.

### 3.4.3.4 Barriers and drivers to be tackled by business and policy interventions

Different barriers and drivers for realising the improvement scenarios haven been listed [24] [25] [26]. In general, the most important drivers and barriers (improvements in market and investments in cooperation and information exchange) are with the RUs/ROs regarding improvement in cooperation and business model innovations, interventions are needed to overcome the following barriers:

- **Culture**: mental shift required.
- **Trust**: insufficient trust in partners to cooperate (make less decisions on your own, lose your exclusivity, share information) and to realise a (independent, neutral) coordinating function.
- **Knowledge**: no knowledge yet available.
- **Cost-benefit**: unclear insight in the balance between cost (investments and operational costs) and the benefits that will result from the investments.
- **Critical mass**: insufficient partners and mass to realise impact in the market;
- **Redesign of processes**: required changes in existing processes;
- **Market engagement**: required activities to attract new customers (Shippers) and innovate the customer interface.
- **Investments**: investment, e.g. in additional activities and information exchange systems (see below).

Regarding improvement in information exchange, interventions are needed to overcome the following barriers [4]:

- **User-related barriers**: economic (investment, implementation and maintenance), operational, managerial barriers.
- **Operation-related barriers**: human capital issues such as difficulty in employing qualified personnel, lack of ICT specialists and personnel skill shortage to operate new applications.
- **Technology-related barriers**: technological constraints that prevent operators making full utilisation of ICT applications, from time slot system to real time rail traffic management, including the issues such as interoperability of systems, ICT integration, standardisation, security and data protection.
- **Policy-related barriers**: different legal requirements and customs regulations in different countries; various regulations for every transport mode; different safety and security standards or regulations between transport modes as well as countries; different legal frameworks according to cargo category; different administrative procedures and standards between countries; and insufficient harmonisation of national and European policies between transport modes.

The identified barriers and drivers for realising the improvement scenarios form the basis for deriving business and policy interventions in a next step in the Smart-Rail project [D3.6 and D3.7 to be published].
4 Characteristics of a new business model supporting cooperation within the rail freight sector

4.1 Description of the new business model

4.1.1 Preliminary remarks

The new business model is determined by the examinations and results of the work packages and continuous Improvement Tracks. In particular, the guidelines according to the Smart-Rail manual (page 28f.), as well as WP3 concerning (horizontal) cooperation within the rail sector and WP4 examining (vertical) cooperation in the supply chain, and furthermore the elaboration on control tower for long distance rail freight transport (WP7), corresponding to the Value Case methodology undertaken in CIT2. Finally, the evaluation of the new business model will be carried out according to the CANVAS business model.

![Diagram of influences from Smart-Rail project affecting the new business model](image)

**Figure 4-1: Influences from Smart-Rail project affecting the new business model**

The figure implicates a synthesis of the respective work packages, in coincidence with the ‘philosophy’ of the Smart-Rail project.

A second preliminary remark refers to a meta-level: It means, the new business model determines conditions, which may not be in compliance with a common understanding of business like maximizing profits by minimized costs and pursuing the own advantage irrespective of interests of the partners involved. Sharing resources – an essential requirement of the new business model – means bowing out of the common business culture and turning towards a new culture in interactions between stakeholders, when, for example, resources are ‘neutralized’ and transportation chains are decoupled. So to say, the requirement for abandoning conventional interactions between stakeholders in their principal-agent-roles reflects to some extent a ‘paradigm shift’.

Furthermore, the new business model does not work without defining a communication structure. In the moment, the protagonists are on a par with each other; it needs someone who takes over the role ‘in driver’s seat’ and who coordinates the communication henceforth. Such a role is usually predestined to a Fourth-Party-Logistics service provider (4PL), but can also depend on the objectives of the cooperation. Asset-
free, his outstanding characteristics are neutrality, independency, transparency – all these are presumptions which allow him to emphasize on best-in-class solutions in designing and completing supply chains.

As already mentioned earlier infrastructure as a separate ‘production factor’ beside equipment, IT and governance have to be taken into account when designing the new business model. That leads to below sketch of the essential elements of the new business model in a nutshell:

![Figure 4-2: Essential elements of a new business model](image)

4.1.2 Preliminary remarks

It was mentioned before that a new business model should primarily support the rail freight market. The merge of the findings of the three Continuous Improvement Tracks (CIT’s) has shown that the principle of the process is nearly always the same and can be defined as optimization of processes which means a higher level of coordination. Therefore, the key factor will be to go deeper into cooperation. We need to find structures that will enable cooperation and will fulfil the customers need of more flexibility and reliability and for railway undertakings as well as for the clients a more attractive cost structure.

The results of these considerations are shown in the Figure 4-3. These interactions between stakeholders are similar in the most cases of the rail freight business. The suggestion is to install a neutral level in the process chain, which means a Fourth-Party-Logistics service provider (4PL) in his central role as an organizer of the entire process, having access to a data platform, where all necessary information to process a transport order is compiled. It may be remarkable, that there is no direct link between data platform and involved parties on the second, third or fourth level of the process-‘hierarchy’ (see socio-gram) - their data are already processed on the value-added step before, as they are mandatory to identify an order.

In some cases, the function of a 4PL can be in a transposed sense another institution, as mentioned for example for the ports - a local authority. It needs to be pointed out that the given structure is working in all actual CIT’s, as well as in the different cooperation models described in chapter 4.3.1.
Figure 4-3: Relationships in a preferred business model

Both Figures (4-3 and 4-4) are corresponding with each other and show the relationship between the different parties involved. Based on the question of data, this platform unifies:

- Train traction related data (locomotive, wagons, paths)
- Shipper's order related data (product, lead time, etc.),

each provided by the particular interacting party, such as for instance:

- IM -> RU/RO
- LSP -> RU/RO
- Shipper -> LSP
- LSP -> IO

Again, the data platform is in fact separated in different tuples, each tuple filled with the data appendant to a particular stakeholder. At the end, there is a given status of data provided by shippers, LSP’s and operators (including data from IM’s). Now, the 4PL enters the stage and task is to manage and allocate orders and available resources.
It might be a task close to OR (Operations Research) or Linear Programming to find an optimum in that allocation process. Operationally, it requires resources in infrastructure, where trains, wagon groups and even single wagons can be handled. The cooperation requires governance rules, regulations and agreements between the participating parties to steer a type of process, where each participant renders his direct involvement at an early stage.

An automatic feedback on the present status of an order to the parties concerned is a crucial requirement of the 4PL. Transparency is necessary for all of them to intervene depending on their individual agreements with their service provider or client (principal-agent-relation). This is based on the value case methodology which will be analysed in the following chapter.

### 4.1.3 Influence on the bottlenecks

Coming back to the initial situation of this chapter, the question has to be answered, what kind of problems or bottlenecks defined in the D3.1, can a suggested business model solve or try to bypass? Based on the exposed bottlenecks in Chapter 2.1.1 these are primarily the operational and partly the infrastructural problems that can be influenced by our recommendations. It is difficult for a business model to solve or strongly influence on regulatory bottlenecks or barriers in accessing the infrastructure, which are mainly in the domain of effects of rail policy and national legislations.

From the operational point of view, the suggested solutions of a proposed business model can work especially in the field of “Capacity and traffic” which represents one of the major operational bottlenecks for train operators (Chapter 5.2.2 in D3.1). The recommended solutions can work in the sense of:
- Optimization of available paths through common use of RU’s
- Optimization of assets (common use) in highly frequented areas, such as ports, railway nodes, lines with a high density of trains, etc.
- Building up back-up solutions especially in times of reconstruction periods

From the perspective of “infrastructure bottlenecks” (Chapter 5.1.1 in D3.1) similar results can be expected. Especially in case of track maintenance, cooperation can avoid additional costs for the railway undertakings involved along these lines. Additionally, the geographical coverage can be expanded.

4.2 Structure according to CANVAS

So far, the description hitherto has been focusing on an operational and a commercial respectively communicative perception, but also a third variable has to be taken into account: since we are dealing with a transportation service a requirement is that suitable infrastructure is available and otherwise should be regarded as a factor limiting the possibilities. Infrastructure, therefore, could be regarded as a separate third production factor beside next to the more operational factors equipment and people.

It’s a clear will and ambition of the participating companies to collaborate. But how do you come up joint plans, operations, objectives and requirements? It still proves to be a difficult question what to reach exactly in the collaboration. What does the collaboration precisely offer in the end to the customers? Who are these customers? Is there a common goal? What can be done by their own organization, when do they have to find a partner for certain parts? What benefits can we see in the collaboration and how do we get it out? A solid business model serves to provide answers to these questions and to set a clear concept for the partnership.

Based on the CIT 2 (Control Tower concept) a business model CANVAS is used to make clear the value proposition, the customers and how to reach them, the process to provide the value proposition and the corresponding business case. Each stakeholder will have its own business model. We elaborated the business model of the 4PL, since its special position in this CIT (see Figure 4.1).

<table>
<thead>
<tr>
<th>Key partners</th>
<th>Key assets</th>
<th>Value proposition</th>
<th>Customer relationships</th>
<th>Customer segments</th>
</tr>
</thead>
<tbody>
<tr>
<td>None, 4PL is independent and does not have any directly linked partners (only buying services)</td>
<td>An IT system 4PL does not have any other assets, and thus the freedom to choose for the best solution.</td>
<td>‘best in class solutions’  Owns an IT system to negotiate the best rates on behalf of shipper  Total service for the shipper: 4PL acts on behalf of the shipper  Suggestions for improvements by logistic analysis  Controls data distributed by the parties involved</td>
<td>The relationship is formalized by an outsourcing contract</td>
<td>Most important customer is the shipper</td>
</tr>
<tr>
<td>The only may need a host to handle the data.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Key resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st class experts (qualification)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Channels
Often the shipper contacts the 4PL, but the 4PL also organizes its contacts and creates appointments.
### Revenue streams
Gain sharing with shipper. 4PL might achieve savings up to 20%, by professional purchasing freight and having a fabulous tendering and network.

### Cost structure
Quantification experts, purchasing freight, maintain a network and of course maintain the IT system will induce the most important costs.

#### Table 4-1: Business model 4PL

### 4.3 Organizational characteristics and governance model

#### 4.3.1 Underlying scenarios

Like in other sectors cooperation within the rail freight sector evolves in the course of time. Hence three different steps – use of idle capacity, cooperation between existing trains, new train – will be considered in the sections below. For each of these steps, different attribute levels of economic success are possible. For this reason three scenarios – worst, average and best case – will be defined for each step to cover these differences and to show and describe the variety of possibilities taking into account both risks and opportunities. For each of the three steps the most likely scenario will be determined.

The economic success of the business models is the most important aspect to be considered in the scenarios. Without economic hedging, both in case of loses and profits, no actor will be willing to cooperate. This leads to the following questions to be answered:

- What happens in case of losses and how will they be covered (worst case)?
- What measures have to be taken to avoid change for the worse and which options exist for change for the better (average case)?
- How are profits allotted (best case)?

Inherent risks respectively opportunities affecting the economic viability of the new rail freight services to be developed are regarding payload, cost/revenue ratio and business stability. These are affected by external market-related factors, but can be influenced to a certain extent by an appropriate governance model. As these external factors are partly unpredictable and can occur at any time special attention is required, in particular with regard to negative effects to the business. For this reason the measures that are to be taken to achieve the optimum must be defined in the governance model. Managing these risks respectively opportunities in a proper way is vital for the success of the cooperation, the economic viability of the service and provides the framework for the organisational models described in section 4.3.2 to section 4.3.4.

Considering the focuses and objectives of CITs 1-3 and the three steps named above the highest potential for horizontal cooperation within the rail sector is for SWL services (CIT 1), but also for collaboration of RU in case of (un)expected disruptions on the rail network (CIT 3). Both CITs can serve as input for all three steps and will be used for developing the organisation models.

The cooperation structure in place within CIT 1 for SWL is detailed in Figure 4-5 and described in detail in D6.2 – “Report on the impact of the concept”. This will serve as basis for step by step approach within this deliverable.
To summarise this – when a shipper wishes to utilise the Smart-Rail offer he engages the services of a forwarder who is in charge of overseeing the whole transportation chain, and ensuring the efficient completion of the process. This function of the forwarder can be carried out by either:

- A rail forwarder,
- A rail/road operator,
- A railway undertaking,
- A coordinator.

The coordination of flows from various shippers and requests from various forwarders is managed by one or more coordinators depending on the geographical scope in which they operate. According to the geographical coverage CIT 1 aims to have one coordinator with responsibility for France/Belgium and a further coordinator with responsibility for Germany. This system allows for the addition of further coordinators if the geographical range spreads. The coordinator will then focus on matching the flows between various terminals and RUs in their geographical region. [28]

With this model, all parties have to become active partners in the network and as a result, each takes a proportion of the financial risk. The division of roles and financial benefits is based on a set of priorities that focus on the geographical area, the technical aspects of the operation and the risk as to which each participant takes. [28]

This concept, depicting a new way of cooperation in order to effectively build up a SWL network, includes important aspects for both the new business model for horizontal cooperation presented in Chapter 4.1 and the three organisational models presented in the following sections.

### 4.3.2 Management of idle capacity risk

The basic assumption for this case is that an already existing long-distance train has an idle capacity that is offered by the operator to other interested customers either for the entire distance or for certain sections. In order to enable using this idle capacity designated stations for feeding respectively distributing have to be defined. In addition, cooperation between RUs is required to guarantee smooth operations. As the rail cooperation models identified and described in detail in D3.1 focus on cross-border long distance rail services without taking into account local shunting operations at origin or destination respectively at intermediate stations, these models do provide limited input.
to a case-related organisational model. For the organisational model for using idle capacity, last mile shunting operations have to be taken into consideration, too.

The cooperation model of CIT 1 for SWL services offers links to the new business model presented in chapter 4.1. Both concepts require a ‘coordinator’, a neutral body who manages the flows respectively the requests from different actors in order to organize a goal-oriented transport solution. Depending on the number of actors involved and the geographical coverage different sub-coordinators may be required.

These models served as a basis for the new cooperation model for the use of the idle capacity of an existing train presented in the figure below.

![Figure 4-6: Cooperation Model for using idle capacity](image)

The request for available idle capacity is placed by shippers who address the coordinator (4PL), who carries out the function of the forwarder (see CIT 1 model). The coordinator is in charge of organising suitable idle capacity on existing trains and has to have an overview of the entire transport chain. For this purpose, he has access to an overall data platform, compiling all data and information of one or more regional data platforms, depending on the geographical coverage and managed by sub-coordinators, who provide all necessary data and information on idle train capacities. These data and information are provided by the RU’s. This also requires specific IT tools to cope with growing customer numbers, standardised definitions, and standardised formats for information sharing. The overall responsibility for managing all data and information falls to the 4PL, i.e. he has the lead compared to the sub-coordinators.

In a first step, the coordinator checks the data and information and decides which idle train capacities are best suited to fulfil the requirements of the shipper’s request(s). Subsequent to this, he initiates further steps to organise the respective transport, including determining the stations for loading and unloading and informing the RU’s involved (long haul and local shunters). Depending on the number of requests placed simultaneously this may be a very complex task. Fulfilling this task properly is important to meet the shipper’s requirements and to ensure the reliability of the service.

In addition to managing the available capacities of different RU’s the coordinator needs also to be aware of disruptions in the transport chain that can occur expected (e.g.
planned construction works on railway lines or planned closures) or unexpected (e.g. technical difficulties on the line, accidents or damage to rolling stock). Handling these plannable and unplannable occurrences in an adequate manner is important to avoid inconveniences for all partners. Therefore, taking reasonable precautions is another important task of the coordinator.

As the acceptance of the offer and the reliability of the service determine the functionality and suitability of the cooperation model as well as its economic viability, the governance model needs to cover all relevant aspects related to these points. The roles and interests of all actors as well as their individual motivation for collaborating (i.e. the assessment of barriers and drivers) have to be clear. Discrepancies have to be minimised in order not to endanger the cooperation. As all parties have to become active partners of the network, each takes a proportion of the financial risk associated with the activities. This further means that a partner can assume different roles in the network but each function is contracted separately. Managing the financial risk belongs to the tasks of the coordinator.

The general functioning of the cooperation model depends on the number of partners involved and their willingness to collaborate. In order to bring potential partner companies (forwarders, coordinators, RU’s, operators) on board they have to be made aware of the functionalities of this new model, which is different to previous efforts, and how they stand to benefit when cooperating with this model. Most importantly it has to be seen to be an effective model. This might not happen in the first iteration but can be developed in the course of time.

In order for this new model to be a success, all participants have to be fully engaged. They have to have a full understanding of the various roles, responsibilities, and requirements as well as what their contribution to each of these will be. The cost sharing of this, as well as the relationship of this to the risk they are willing to take also needs to be understood by all parties. The interrelationships between the various levels within the model and the different priorities applied to those all need to be clearly defined.

Key partners of the 4PL in this cooperation model are the RUs collaborating to organise rail freight transports for the shipper’s request. Key activities include organising the flow of data and information between all actors, compiling these and identifying the best suited matches of offered idle capacity to meet the requirements of the shipper’s request. Key resources are the overall and regional data platforms enabling the 4PL to fulfil his activities and to deliver value to the customer. Main customers are shippers with whom the 4PL communicates directly.

### 4.3.3 Bundling of existing trains for better capacity sharing higher payload

The idea behind this case is that existing long distance rail freight trains interchange wagon groups at certain intermediate stations to open up a larger network with several destinations. Like organising the use of idle capacity, organising the cooperation between existing trains is very complex, requiring numerous different bi-/multilateral agreements between the actors involved. For this reason, a coordinator is considered as mandatory.

Based on the new business model and the cooperation concept of CIT1 an organisational structure has been developed and is detailed in the figure below.
Figure 4-7: Cooperation Model for existing trains

Under this cooperation model when a shipper is willing to utilise the interchange of wagon groups between two or more long distance trains for a shipment, he addresses the coordinator. This function is carried out by a 4PL. The responsibility for managing the end to end transportation of the shipment falls to the coordinator. This is in the case of domestic traffic as well as international traffic.

Under this model the shipper enters in the network only via the coordinator in charge of overseeing the whole transportation chain and ensuring the efficient completion of the process. For this reason, the coordinator has access to an overall data platform compiling the data and information of one or more regional data platform(s) depending on the geographical scope within which he operates. These data platforms, managed by sub-coordinators, include all relevant data and information regarding trains, wagon groups, slots, marshalling yards, terminals, disruptions etc. required to organise smooth and efficient services. The information and data required are provided by RUs, IMs and terminal operators. To ensure that the coordinator has all information to organise the transport, there is a reconciliation of information respectively data between all data platforms. This is of particular importance in the case of (un)expected disruptions, where the coordinator in charge has to decide in short term respectively with some lead time how to cope with the situation. As the coordinator has to ensure that the impact on the transport chain is as minimal as possible, alternatives have to be identified quickly and measures e.g. re-routing of transports implemented as fast as possible. This requires extensive knowledge and understanding of all transport-related aspects. Keeping the overview is crucial and is the main task of the coordinator.

Based on the data and information the coordinator first decides which trains are best suited to fulfil the requirements of the shipper’s request(s). Secondly he initiates further steps to organise the respective transport, including determining the stations for loading/unloading and interchanging wagons as well as informing the RUs involved (long haul and local shunters). Depending on the number of requests by shippers and the number of stakeholders involved in the transport chain this may be a complex task. For this reason, the governance model shall foresee different bi- and multilateral agreements between partners to ensure smooth and efficient collaboration.

The governance model is identical with the one described above for the cooperation model for the use of idle capacity (see chapter 4.3.2). To ensure the willingness of
stakeholders to collaborate, making them aware of the functionalities and the benefits of the new model is essential.

Key partners of the 4PL in this cooperation model are the RUs collaborating to organise rail freight transports for the shipper’s request, IMs providing the required train paths and rail infrastructure for exchanging wagon groups as well as terminals offering transshipment facilities for goods. Key activities are organising the flow of data and information between all actors as well as compiling these and identifying the best suited matches of offered idle capacity to meet the requirements of the shipper’s request. The key resources are the overall and regional data platforms enabling the 4PL to fulfil his activities and to deliver value to the customer. Communication with shippers, who are the main customers, takes place directly.

4.3.4 Organization for new train-service

This case focuses on a new long distance train especially for less than trainload services, i.e. SWL. To cover a wider geographical area a feeder and distribution system is created involving regional and last mile operators.

Due to the large number of stakeholders involved and the interactions between them, the organisational concept is again complex. The key elements are the same as for organising idle capacity and cooperation between existing trains. This follows the step by step approach that was already mentioned in chapter 2.1.1 considering that the organisational model is geared to the evolution of cooperation within the rail sector over time. The organisational model is presented below.

![Cooperation Model for new train](image)

Figure 4-8: Cooperation Model for new train

The request for a transport is placed by shippers, who address the coordinator (4PL) being in charge of organising the rail transport. The coordinator is responsible for checking, how the shipper’s request can be fulfilled best, taking into account the whole transport chain. This includes checking if a new train service is required or if the request can be served by existing services and cooperation models for idle capacity or existing trains as described above.
As the information and data needs are higher compared to the other cooperation models, the concept of coordinated regional data platforms is extended by adding data and information from intermodal operators. The other sources remain unchanged, i.e. RU, IM and terminals.

First of all, the coordinator matches the requirements of the shipper’s request(s) with the data and information on available transport resources. Depending on the result, the coordinator secondly initiates further steps to organise the respective transport. Ideally there is enough cargo that can be bundled for operating a new train economically viable. If not, alternatives have to be defined, taking into account one of the other cooperation models described above. This includes considering the lead time determined by the requirements of the shipper respectively their customers in order to decide if it is possible to delay the transport until there is enough volume for a new train. Another option is to operate the new train despite the lacking cargo and economic viability. In this case financial losses have to be borne by the involved partners. This again highlights the importance of a well-structured governance model defining the distribution of losses.

Having high impact on bundling cargo for the new train, special attention again has to be paid to (un)expected disruptions hindering smooth transport. A set of general measures to be taken in these cases should be defined, including a structured implementation plan to avoid losing time to switch to alternatives. Losing time in providing suitable target-oriented alternatives results in higher costs for the collaborating partners and implies customer dissatisfaction due to delays. This can mean additional negative effects for the cooperation. As customer satisfaction is highly important for the overall acceptance of the service, all actions should be taken to avoid such situation. A customer once lost is difficult to regain. Hence special care has to be taken to avoid a vicious circle, in the worst case resulting finally in a collapse of the cooperation.

In this cooperation model the 4PL has numerous different key partners: RUs collaborating to organise rail freight transports for the shipper’s request, IMs providing the required train paths as well as rail infrastructure for exchanging wagon groups, terminals offering transhipment facilities for goods and intermodal operators providing transport services. Like in the two previous models key activities of the 4PL include organising the flow of data and information between all actors, compiling these and identifying the best suited matches of offered idle capacity to meet the requirements of the shipper’s request. 4PL’s key resources are the overall and regional data platforms enabling him to fulfil his activities and to deliver value to the customer, while main customers are shippers with whom the 4PL communicates directly.

4.4 Operational structure

In this section, the described new business models are related to each of the identified organizational models. Following the structure, below a single-wagon-case, an existing block train and a new block train model will be considered according to:

- Equipment and assets
- Processes
- IT structures and data exchange

The following simulations act on the assumption that each involved stakeholder is represented by at least two protagonists, so there is a situation simulated where the interests of at least two participants have to be coordinated - respectively negotiated. At the same time it can also mean to solve a situation of conflict of interests, if there is no understanding between the partners.

Concerning the interaction between the participating stakeholders within the following simulation basically three states are thinkable:
• Principal-agent-relationship
• Unlimited access to resources
• Scarcity of resources – limited access.

4.4.1 Equipment of assets

As the necessary equipment and assets, locos or engines, wagons, and in a broader sense also shunting facilities are to be considered, as detailed in Section “3.2 Assets and governance structure”.

In the case of a single-wagon requirement, there are three ways of providing special wagons for the transportation of goods according to shipper’s needs.

• The shipper disposes of the wagon(s) needed
• The railway undertaking/railway operator disposes of the wagons
• None of them disposes of the wagons; either shipper or RU/RO has to take care of providing the equipment

It is referred to the respective lists of suppliers and the stakeholders in question in respect to the case now to be constructed.

In the case of a block train – both an existing one and a new one – the wagons necessary for the transportation are generally provided already (under similar models to the aforementioned ones, i.e. provided by the shipper, RU, or leased).

A very important asset (and at the same time, often the most scarce and/or the most costly one) is also the loco or engine. It is generally provided by the RU responsible for the specific part of the trip, i.e. for the specific train as requested from the IM in the corresponding Path Request. However, the RU does not need either to own or even to dispose the loco himself; it can be leased from a leasing company or “Lokpool” (see 3.2.2.1), optionally also from another RU, which may cooperate directly in the transport chain, but does not necessarily need to.

The shunting facilities constitute a shunting yard or a suitable major railway station, which is operated generally by an IM (or by a large RU, large industry facility, or a terminal operator in some cases), and a shunting loco, which is provided either by a member RU of the transport chain, or by a specific last mile operator or shunting operator (see 4.3.4).

4.4.2 Processes

The construction of the transport-chain and all related processes starts with an inquiry of a shipper (Shipper₁) – or a LSP (LSP₁) on behalf of a shipper (Shipper₂); following both strings, they simultaneously illustrate the different characteristics of logistical processes. As to the purpose of this exercise it will be shown that in the course of the process the strings intersect operationally – and at these interfaces there occurs the option for exchanging data, utilizing idle resources, generally spoken: for optimization of the process by interacting between the protagonists.

The shipper’s infrastructure disposes of a siding or even a public track for direct access by rail – otherwise a single-wagon-transport would not work. Disposability of a single wagon – or wagon-group – either owned or leased given, the collection of the wagon(s) has to be organized. The details of the process depend on the particular principal-agent-relationship, so the railway undertaking either carries out the shunting-service on its own to collect the wagons or subcontracts a local (railway-)operator. Now, the next operational interface is an interesting one:

In the marshalling yard which is normally linked with more than one siding, there is a first interface where several transport chains cross. Traditionally incumbents are used to compose their block trains, each incumbent taking care of himself. In the simulated case
two railway operators – the first one directly contracted by shipper\textsubscript{1}, the second contracted by the LSP, who acts on behalf of shipper\textsubscript{2} – now have the option to cooperate and jointly organize the ongoing traction of their group of wagons to a shunting yard to be agreed upon.

In the new business model latest at that point (presumably earlier) transport data from both sources of shipment are transmitted to a CT, where they are likely combined with data from other shippers and LSP’s concerning the ongoing common destination. Those data are visible for a neutral coordinator usually called 4PL, who is in the position to supervise more than one similar process, to evaluate them according to efficiency and to intervene in order to optimize the further steps. Such an intervention may refer to a third or fourth shipper or LSP, whose orders overlap with the ones already known. Now, the option is to spread the information and to offer a bundled, optimized alternative for undertaking the next operational steps.

A precondition is that all participants agree on sharing their data. They will agree if the risk of sharing data is less than the benefit of sharing them.

In that context the option for existing block trains only varies with respect to the point of origin. For the sake of completeness once again referring to single-wagon transports it should be mentioned, that a marshalling yard is the chance to add one or two wagons to block trains unless there is any idle capacity. The main concern, however, relates to block trains meeting in shunting yards.

To cut trains in half at shunting yards and put them together could be a situational advantage, but that would only be a certain characteristic of groupage or single-wagon transportation. The new business model much more refers to a situation where two or more railway undertakings meet at shunting yards and pass on the responsibility for the on-carriage on the last mile. Such a constellation is called ‘encountering traffic (‘Begegnungsverkehr’).

Analogue to the single-wagon process the data of the block trains concerned are compiled in the CT; the 4PL again evaluates the data and matches them with data from railway undertakings and operators connected to the respective shunting yards and capable to take over trains (or wagon groups) to final destinations.

Creating new block trains as a third type of organizational model seems to be the least complicated case, as that would be restricted to the 4PL following the logic of the new business model. A train is composed exclusively according to efficiency: Demand for transporting goods from more than one shipper is collected by the 4PL and documented in a control tower/data warehouse. Subsequently, the 4PL, now sitting in driver’s seat, requests offers from the specific service providers – railway undertakings, railway operators, intermodal operators – and designs a ‘best-in-class’ solution, where all the participating shippers profit from.

### 4.4.3 ICT structures

To facilitate any cooperation or a cooperative business model, as suggested in this work package, a corresponding data exchange is necessary to take place between the involved stakeholders. More specifically, all the major processes of the business model(s) used need to be reflected in the corresponding controlling ICT system for processing digital-based information.

These processes include the business cooperation, physical handover, physical cooperation, and often also handling and assigning contracts and revenues (in the sense of customer relationships management or CRM). For every RU, operator, forwarder, agent or other stakeholder it is essential to manage the assets in every moment (locos, wagons, personnel, and other resources), to be as efficient as possible. All these aspects are suggested in the section 3.3.2.
During the train trip, itself, the necessary transport documents need also to be handled properly (most notably the consignment notes, customs, wagon list, braking sheet, as detailed in 3.3.4). To facilitate the data exchange, various data exchange standards are used in the railway industry, most notably the TSI TAF, as detailed in 3.3.3. Usage of these standards is often a mandatory prerequisite for the data exchange to take place with specific stakeholders, especially in the case of the international bodies (RNE, RailData, UIC/Hermes etc.) and their operational ICT systems.

The ICT solutions, systems or applications used in the railway sector or in transportation in general (as described in the section 3.3.2), may also employ different levels of sophistication, depending on the specific stakeholder or user (i.e. on his or her needs) and on the specific vendor (i.e. on his or her competencies and maturity of the software and its development). Neither this WP nor this deliverable aim for any detailed analysis of the available systems and solutions; however, we can at least roughly characterise the available and upcoming solutions in the following categories:

1. Simple recording of data and events. In the simplest case (i.e. in the “least sophisticated” one) the ICT solution or application just records the data on customers, transports, etc. The rudimentary “solution” based on Microsoft Excel being a typical example of this category, these tools do not offer much comfort and much automation – even such features as data validation, interconnection, or propagation may be challenging in them.

2. Standard database solutions with semi-automated features. The typical “mainstream” solutions (either COTS, or tailor-made) include rather sophisticated database structures, merging and relating data from various sources, and featuring inherently data validation, verification, and automated data exchange with the neighbouring or partners’ systems. More often than not, they also launch specific suitable or logically expected actions automatically or semi-automatically based on specific events received from the environment (i.e. from the vehicles in the field, for example), or from other ICT components or systems (examples may include e-mail advice on arrival, or an alert in an emergency case, or also call to action for the user upon unhandled requests).

3. Optimised and other sophisticated tools. The most sophisticated systems, tools and applications often use proactive control, suggest suitable transport solutions automatically, or employ optimisation to achieve higher efficiency in the resource utilisation. The latter feature (optimisation) typically involves highly elaborated mathematical methods, modelling algorithms, methods or procedures of the operational research, or so-called heuristic algorithms (based on “practical” calculations of a higher number of feasible solutions and on a near-to-human type of decisions). All these application or system components compute and/or select such a solution which is the most suitable in the sense of costs, lead time, or other criteria defined either intrinsically by the system or application, or by the user. Often also multi-criteria decision support algorithms are used, to achieve even better results. Typical example of optimising functionalities may be assigning engines and personnel to a specific train based on time or costs criteria, or pure cost-based optimisation of repositioning empty wagons after a loaded run (as the empty trips mean just idle runs and pure costs with no revenues and are therefore to be avoided as much as possible).

The suggested levels of sophistication can be seen as a feature or property of any ICT system or solution used by the stakeholders – whether a ERP solution used by a shipper, or a CRM solution of a forwarder or agent, or a TMS system of a RU or LSP, or even
sophisticated tools and applications for planning engines, wagons, personnel, and transport as a whole.

A more detailed description or analysis of each approach or that of specific solutions available on the market is out of the scope of this deliverable.

These considerations on ICT structures or systems and on the assets or data objects being managed hold true for any stakeholder and essentially also for any transport, regardless whether a single-wagon case, an existing block train, or a new block train is affected. For these purposes, any type of the existing ICT environments, systems or solutions may be used, as described in more detail in Section 3.3.2 (including the most rudimentary “solutions” as Microsoft Excel).
5 Conclusions and recommendations

This deliverable merges the theoretical Work Packages 3 – 5 with the practical Work Packages 6 – 8 (CIT’s 1-3) within the Smart Rail Project. The lessons learnt until now have been collected, analysed and a model based on them developed, which contribute to support the future collaborations in Europe’s rail freight market.

Suggestions for a business model for the rail freight market have to meet the customer requirements to improve rail freight services for shippers, but should also include solutions for the operational needs of a railway undertaking to be competitive.

This means that beside the five Smart-Rail goals:

- **Reliability**: increase of punctuality through better coordination of the parties involved;
- **Lead time**: reduction of transit time and avoiding waiting times in highly frequented nodes and ports as well along lines with high density of trains;
- **Costs**: general reduction of costs through optimisation of processes;
- **Flexibility**: shorter registration deadlines and flexible choice of transport modes;
- **Visibility**: borderless real time information of customer and partners involved in the transport chain.

The needs of a railway undertaking to be competitive in terms of price has to be considered. The key factor is deeper cooperation. Structures that will enable cooperation and will fulfil the customer’s needs for more flexibility and reliability need to be found. For both Railway Undertakings as well as for the clients a more attractive cost structure is required. Realised examples have shown that this is possible without additional regulations. In the railway sector within EU, there should be more level playing field between state owned and smaller private operators.

Collaborations are not a sign of weakness but a targeted opportunity to save resources and thereby optimise costs. All actors should bear this in mind as so far this opportunity is not perceived as an option to strengthen the performance of rail freight transport.

Taking into account the Smart-Rail objectives, the optimisation of processes should also help to raise today’s weak margins in such a way that a satisfactory position for RU’s is provided for continuing existence for the companies. On the other hand the improvement of the quality of services is essential to be attractive for the market while competing with other modes of transport, particularly truck and barge.

In D3.1 the main bottlenecks in the rail freight sector were defined and described. Business model can solve primarily the operative and partly the infrastructural problems (in terms of hitting limits in terms of weight or length). A business model cannot in particular influence or solve regulatory bottlenecks or barriers in accessing the infrastructure. In the two sectors “Operation” and “Infrastructure” the suggested business model will work in the sense of:

- Optimisation of available paths through common use of RU’s
- Optimisation of assets (common use) in highly frequented areas, such as ports, railway nodes, lines with high density of trains, etc.
- Building back-up solutions especially during periods of construction and maintenance
- Geographical coverage.

It was mentioned before that a new business model should primarily be a support for the rail freight market. The merge of the findings of the three Continuous Improvement Tracks (CIT’s) has shown that the principle of the process is nearly always the same and can be defined as optimisation of processes which means a higher level of coordination.

So the key factor will be to go deeper into cooperation. Ultimately, the development shows that railways are integrated preferably by the development of structures where a neutral unit is interposed in the processes.
The suggestion is to install a neutral level in the process chain, which means a Fourth-Party-Logistics service provider (4PL) in a central role as an organiser of the entire process, having access to a data platform, where all necessary information to process a transport order is compiled. It may be remarkable, that there is no direct link between data platform and involved parties on the second, third or fourth level of the process-‘hierarchy’ (see socio-gram). Their data are already processed on the value-added step before, as they are mandatory to identify an order.

In some cases the function of a 4PL can be in a transposed sense another institution, as mentioned for example in the ports a local authority. The given structure is working in all actual CIT’s as well as in the different cooperation models described in chapter 4.3.1.

An external data platform, accessible to all parties involved in one or more transport processes, is the central instrument of a control tower and thereby is an indispensable component of the new business model.

These findings are to be reflected further over the course of the project in the Continuous Improvement Tracks. Despite - or perhaps because of - their different orientation to the themes - “wagonload freight”, “control tower” or “dealing with operational difficulties”, the suggestions made in this deliverable are a good basis for further elaboration in the project.
References


[26] Smart-Rail consortium, „D8.4 Alignment of value cases for involved stakeholders needed for cooperation,“ 2016.


