Deliverable D 5.2
Business Case Study for Selected Use Cases

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1. Executive Summary

Within the scope of Pods4Rail, advances in connectivity and automation as well as the existing rail infrastructure are to be utilised in order to embrace and expand the concept of intermodality throughout the transport and logistics sector. As such, the Pod System represents an autonomous, electric vehicle consisting of a transport unit for passengers and goods and a separate specific carrier unit. [1] In order to implement the Pods4Rail vision and expand the concept of intermodality in the freight and mobility sector, it is crucial to formulate clear economic and strategic arguments by means of Business Cases. Thereby, Business Cases are a key tool used by companies to analyse the economic and strategical significance of a planned investment or project.

As part of Work Package 5 (WP5), Business Cases are to be developed and analysed with the aim to examine the economic feasibility of selected Business Cases both for passenger and freight transport. The developed Business Cases will highlight the potential benefits of deploying the innovative technology and leverage the existing rail infrastructure for autonomous, electric vehicles such as the Pod System. This will include an assessment of costs and benefits, as well as a strategic focus on long-term profitability and improving railway efficiency.

In Task 5.2 of WP5, a comprehensive Business Case study of different transportation and mobility services for Pod Systems was conducted. Based on a selection of Business Cases, the Business Case Study covers a wide range of scenarios from manufacturing to service deployment and thereby covers different Business Models within the public transport sector. The aim of the study is to evaluate a variety of specific Pods4Rail Business Cases for target customer markets with regards to Use Cases in order to increase efficiency and sustainability in the mobility sector. The methodology comprises systematic methods for data collection and analysis, including detailed Business Analysis using Fact Sheets and Business Model Canvas, as well as benchmark for comparative analysis of sector standards.

This document describes an attempt to evaluate assumptions regarding the economic viability of new or not yet operational vehicle concepts, called Pods. The underlying comparative values were collected as part of a literature search and do not represent a connection with current prices and costs of railway technology. In the following, the connection between the available values, in particular the costs, should be considered with regard to the cost structure of automotive series production and under no circumstances should a direct derivation be made for railway technology. Also, it should be noted, that, only a few selected Business Cases (BC) can be examined in more detail and not all of the possible business cases shown in D5.1. In addition, due to the technical content of the project, it was not yet possible to estimate quantifiable information for the cost blocks of individual components or the overall system, which are necessary for a quantitative representation of a BC. Hence, it is highly recommended to do this in a later stage of the project.

A revision of a business case study for selected Use Cases will be carried out in subsequent work package (WP6) based on the information gained from the pod system development work packages considering the proposed issue such as vehicle design details, induced infrastructure requirements, partial cost estimation and local transport capacity estimation.

2. Abbreviations and acronyms

Abbreviation / Acronym	*Description*
AMR	Autonomous Mobile Robot
AGV	Automated Guided Vehicle
BC	Business Case
BMC	Business Model Canvas
CAGR	Compound Annual Growth Rate
CBA	Cost-Benefit-Analysis
C3X	Connected Car Customer Experience
DaaS	Data as a Service
Dx.x	Deliverable x.x
GA	Grant Agreement
GDP	Gross domestic product
IM	Infrastructure Management
JU	Joint Undertaking
KPI	Key Performance Indicator
LCC	Life Cycle Cost
NGO	Non-Governmental Organisations
OC	Operating Cost
PIS	Passenger Information Services
PRM	People with Reduced Mobility
RIM	Railway Infrastructure Manager
ROI	Return of Investment
Tx.x	Task x.x
TSO	Transport System Operator
TU	Transport Unit
WP	Work Package
WS	Work Stream

3. Background

The present document constitutes the Deliverable D5.2 “Business Case Study for Selected Use Cases” in the framework of the Flagship Project Pods4Rail as described in the EU-RAIL MAWP.

The Pods4Rail Flagship Project is clustered into three Work Streams (WS). The WS1 contains of five WPs dealing with the “Identification of use Cases, Business Cases/CBA, operating concept.” The WS2 also contains of five WPs dealing with the "Moving Infrastructure vessel and operation System". Finally, the WS3 comprises three WPs dealing with "Moving infrastructure carrier incl. Locking System and handling System". The overview of the overall Pods4Rail Structure can be found in the D5.1.

The work reported in this Deliverable has been performed within Work Package 5 “Business Case Development” as part of WS1 “Identification of use Cases, Business Cases/CBA, operating concept. WP5 is divided into two Tasks as shown in Figure 1. Task 5.1 deals with the Development of Generic Business Cases, while Task 5.2 deals with the development of specific Business Cases. The result of WP5 will be a “Business Case Study for Selected use Cases” (D5.2), based on a report on a “Generic Business Case Elements” (D5.1). Accordingly, this Deliverable D5.2 will show the results of the Task 5.2, which are based on the outcomes from Task 5.1 described in Deliverable D5.1 [2].

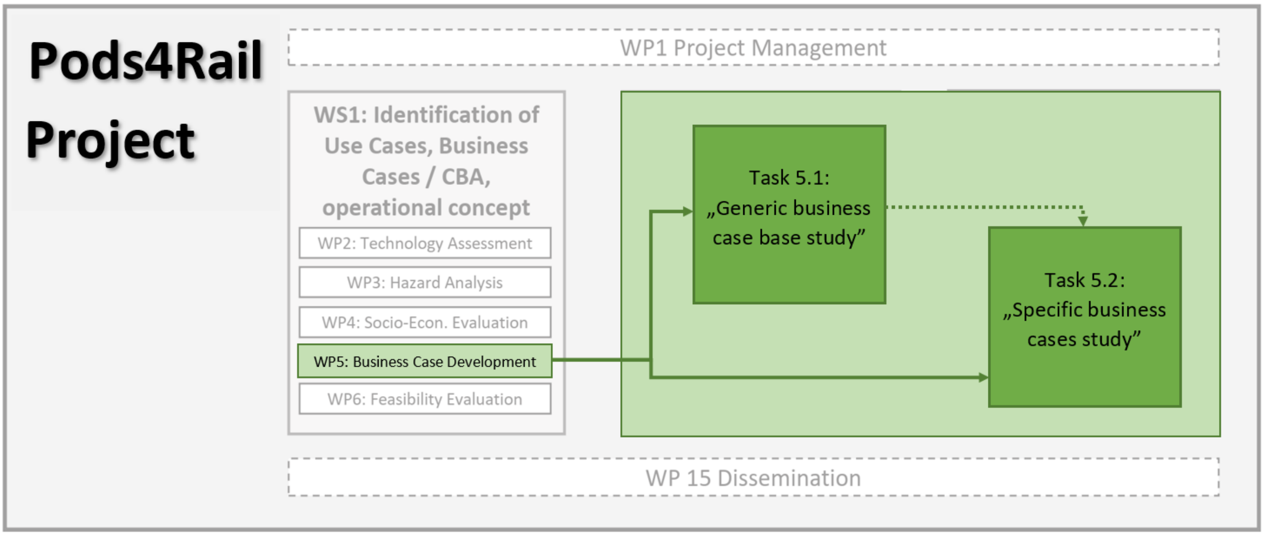

Figure 1: Overview of Pods4Rail Work Package 5

4. Objective/Aim

The Work Package Description according to the Grant Agreement (GA) is as follows:

"Development of (a) Business Case/s including a qualitative Cost Business Analysis (CBA) for the different stakeholders and for the different use Cases. The approach has two steps: in the first step in task 5.1 the conditions, which are the same for all Business Cases are identified and then in the second step in task 5.2 are different Business Cases individually detailed and analysed."

However, a slightly adapted approach to the one described in the GA was chosen. The decision to adopt the new approach was driven by the need to respond more flexibly to the specific requirements and conditions of the different specific Business Cases, within the limits of what can be analysed in the current project phase. In this context, it was ensured that the new approach fulfils both the overall objectives of the WP5 as well as the requirements for Tasks T5.1 and T5.2. Additional information for this deviation can be found in detail in D5.1.

As part of the new approach, the analysis of the specific Business Cases is performed through a business analysis that allows a qualitative assessment of the cost values for the selected Pods4Rail Business Cases in order to evaluate their economic feasibility. A general overview of the objective, content and structure of WP5 according to the adjusted WP Description is presented in Figure 2.

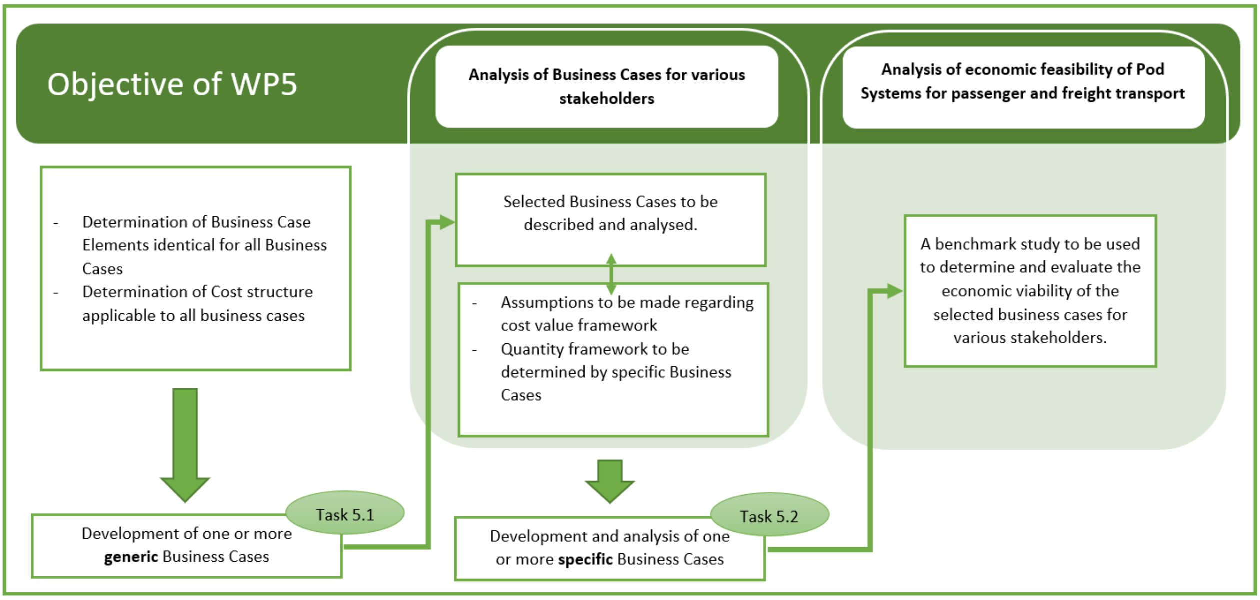

Figure 2: Objective, Content and Structure of WP5

5. Methodology

5.1. Methodological Approach

In order to gain a detailed understanding of the methodological approach, the work in WP5 was divided into four steps (see also D5.1): While the first two steps of the methodological approach covered the framework for Task 5.1 "Development of generic Business Cases", the next Steps 3 and 4 constitute the framework for Task 5.2 “Development and Analysis of specific Business Cases”. Thereby, the Business Cases to be specified in Task 5.2 are based on the generic Business Cases developed in Task 5.1. As the focus of this Deliverable D5.2 is on Task 5.2, only Steps 3 and 4 of the methodological approach will be described in more detail in the following chapters, referring basically to a Business Analysis (Step 3) and a Benchmark (Step 4).

As a basic understanding of Business Concepts is required for the development of specific Business Cases, reference must be made at this point to the terminological definitions of Business Models, Business Owners and Business Cases. However, as the terminology of Business Concepts have already been described in detail in D5.1, this will not be repeated in this Deliverable D5.2. Also, it must be noted that the work in WP5 is linked to the knowledge gained in the previous WPs, in particular of WP4. The references are given in the corresponding chapters.

5.2. Business Analysis

Based on the results of Task 5.1, selected Business Cases are specified and analysed according to the objectives of WP5 as described in GA. By the specification of selected Pods4Rail Business Cases by means of Fact Sheets and the consecutive analysis by means of the Business Model Canvas a comprehensive impression of the capabilities and potentials of Pod Systems can be provided under consideration of the specific Business Case. Based on the results of this business analysis, a Benchmark can then be carried out to evaluate the overall picture of the feasibility of the Pods4Rail Business Cases for various stakeholders. However, in order to ensure that the analysis also includes the description of potential customers, the Use Cases to which the respective Business Cases may be applicable will be stated below, see Fact Sheets ‘Related Use Cases’. So as not to exceed the scope of this paper, additional information on the Use Cases i.e. the specific target customer is not included here, as these can be found in more detail in D4.1. [3]

5.2.1. Fact Sheets

A Business Fact Sheet, also known as a business profile, is a compact representation of the essential information about a Business. It includes basic information such as name, legal form, location and a brief description of the Company's products and services. Innovations, target markets and the Company's market position are also key elements of Business profiles. Its purpose is to provide a valuable source of information as well as serving as a marketing tool in order to ensure transparency and strengthen customer and stakeholder confidence for the offered product or service. [4]

In the framework of WP5, Business Fact Sheets are used to provide a comprehensive specification of selected Pods4Rails Business Cases. The Fact Sheets serve not only as a brief introduction to the following analyses, but also as a justification of how the specific Business Case offers great potential for achieving strategic European traffic targets and ensures sustainable success for a Business. Figure 3 shows the Fact Sheet template used for all WP5 Business Cases.

Business Case Title: *Name of your selected Business Case*	
Brief summary/Short description of the Business Case: *What is the business case about?* *Who is the business owner?* *What is his service portfolio?* *Who are the customers?*	
Why was this business case selected?	
Operational scope:	*Which traffic is addressed in the business case:* *Passenger transport, freight transport, both? Public/Private?*
Transport mode:	*Which transport modes will be covered in the business case:* *Road, rail, air, water?*
Technology:	*Which innovative technologies of Pod System will be highlighted in the business case?*
Related Use Case:	*Which vehicle types/variants of the carrier are planned in the business case?* *What equipment/features are planned for the TU in the business case?* *(see D4.1 "Use Cases")*
Implementation:	*How is it planned to implement/integrate the pod system of the business case on the current market?*
Benefits:	*What are the advantages of the business case?* *(see also D4.2 "SWOT analysis")*
Challenges:	*What are the challenges of the business case?* *(see also D4.2 "SWOT analysis")*

Figure 3: Fact Sheets for the Specification of the Pods4Rail Business Cases

As an introduction, the Fact Sheet commences with a brief description of the Business Case. Subsequently, the operational scope (e.g. passenger transport, freight transport, both? Public transport or private transport?) as well as the transport mode of the Business Case (e.g. road, rail, air, water) are described to encompass the specific range of the Business Case. In order to emphasise the transformative potential of the Business Case for the economy and society, the innovative aspect of the Business Case is then described based on its most important Pod System technologies, e.g. autonomous driving, integration of different transport modes, Door2Door service, assistance systems, battery-powered driving, sharing concepts, digital (booking) platforms etc. Furthermore, the specification of Use Cases related to the Business Case emphasises the practical application and the benefits of the technologies from the customer perspective, as described in D4.1 [3]. In this context, the Use Cases not only provide an overview of possible target groups, but also of the way in which the Pod System in the Business Case is characterised, e.g. size of the Pod, equipment of the Pod, etc. Finally, based on the Use Cases from D4.1 as well as the

SWOT analysis from D4.2 [5], the potential challenges and benefits of the specific Business Case will be described briefly, providing an initial approach to the implementation of the company's products and services as defined in the specific Business Case. Following the compact overview of the selected specific Business Cases by means of the Fact Sheets, the Business Cases can then be analysed on the basis of a Business Model Canvas.

5.2.2. Business Model Canvas

For the analysis of the specific Pods4Rail Business Cases, the so-called Business Model Canvas (BMC) was applied in order to ensure a standardised approach for all the specific Business Cases. The basic BMC represents a strategic management tool for the definition and documentation of Business Cases. [6] In particular in WP5, the BMC was used to analyse the specific Pods4Rail Business Cases in order to gain specific insights into the economic, sustainable, technological and social assessment of Pod Systems. Thereby, the BMC utilises a visual diagram divided into nine basic elements: Key Partners, Key Activities, Key Resources, Value Propositions, Customer Relationships, Channels, Customer Segments, Cost Structure and Revenue Streams. Not only do these elements represent the generic Business Case elements as described in D5.1, but also enable a structured analysis of a company's business model. As a practice-orientated communication tool, it serves the purpose of persuading stakeholders of the feasibility and value of a project and of establishing a clearer picture of the company's vision. [7] However, it should be noted, that the Business Model Canvas exclusively focuses on the perspective of a company or entrepreneur. [8]

During the preparation for analysing the Pods4Rail Business Cases, adapted approaches to the classic Business Model Canvas were identified that were even better suited to the structures of the specific Pods4Rail Business Cases. Specifically, the Lean Model Canvas [8] was applied, providing essentially the same results as the classic Business Model Canvas, but offering a more specific problem-solution-oriented approach for the analysis. As such, the modified version of the BMC enabled to analyse and validate the potential and success of new business ideas at a very early stage with a structured approach based on the following nine key elements: Problem, Solution, Key Metrics, Unique Selling Point, Unfair Advantage, Channels, Customer Segments, Cost Structure and Revenue Stream. In addition to the nine elements of the Lean Model Canvas further elements were included to the Canvas Model to ensure that also sustainability and societal aspects were covered in the Pods4Rail Business Case Analysis. These resulting 13 elements of the extended Sustainable Lean Model Canvas used within Pods4Rail are described as follows:

- Problem: Identification of the most important problems the product or service is intended to solve.
- Solution: Description of the key characteristics of the product or service that address the identified problems.
- Unique Selling Point: Explanation of the specific benefit that the product or service offers in order to differentiate itself from the competition.
- Unfair advantage: Highlighting unique characteristics or features that cannot be easily reproduced that provide the company with a competitive advantage.

- Key Metrics: Identification of the most important indicators measuring the success of the Business Model.
- Market/Alternatives: Analysing the current market situation and identifying existing alternatives or competitors.
- Channels: Definition of the ways to reach potential customers in order to promote the product or service.
- Customer Segments: Description of the different target groups of people or organisations that are expected to consume the product or service.
- Cost Structure: Description of costs that will be incurred in operating the Business.
- Revenue Stream: Description of how the Business will generate revenue.
- Eco-Social Cost: Determination of the environmental and social costs associated with the product or service. The Eco-Social Costs summarise both environmental and social costs as well as their interactions.
- Eco-Social Benefit: Determination of the environmental and social benefits offered by the product or service. Focus is on environment and society, particularly where these are interlinked.
- Societal Benefits: Analysis of the societal benefits that the product or service will contribute to. Focus is on the general benefits for society as a whole, without considering necessarily ecological components.

Figure 4 presents the project-specific version of the extended Sustainable Lean Model Canvas. Detailed instructions on how to fill out the Sustainable Lean Model Canvas can be found in the appendix.

<table>
<tr><td colspan="3">Perspective:</td><td colspan="3">Business Case:</td></tr>
<tr><td>Problem</td><td>Solution</td><td colspan="2">Unique Selling Point:</td><td>Unfair Advantage</td><td rowspan="2">Societal Benefits</td></tr>
<tr><td>Key Metrics</td><td>Market & Alternatives</td><td colspan="2">Channels</td><td>Customer Segments</td></tr>
<tr><td colspan="3">Cost Structure</td><td colspan="3">Revenue Stream</td></tr>
<tr><td colspan="3">Eco-Social Cost</td><td colspan="3">Eco-Social Benefit</td></tr>
</table>

Figure 4: The adjusted Pods4Rail Version of a Sustainable Lean Model Canvas

5.3. Benchmark

A benchmark is a methodology in which a company's products, services, processes and methods are compared with those of leading companies or established industrial standards. The aim of such a comparison is to identify best practices, analyse differences in product and service performance and determine areas of potential improvement. By collecting and analysing data from various sources, a Benchmark enables companies to better understand their position in the current market, to close any performance deficits and to optimise their processes. In order to gather data, companies can access publicly available databases, industry reports, market research studies or publicised annual reports. Another method is to collect data through surveys and interviews with customers, suppliers or other stakeholders. Lastly, companies can also access internal data sources such as sales figures, production reports and customer satisfaction surveys. [9]

As part of WP5, the Benchmark serves to investigate the economic feasibility of the potential companies resulting from the specific Business Cases. By conducting research, the aim of the Benchmark is to find benchmark systems that are comparable to the respective selected Business Case but already exist on the current market. Future market developments were not considered, as they were not within the scope of the task. In order to gain the overall picture of the feasibility of the Business Cases not only the costs but also the benefits are included in the analysis. Hence, the research focuses on finding cost values and revenue figures of the benchmark systems in order to enable the estimation of possible financial outcomes of the Pod System Deployment as outlined in the specific Business Cases, which in turn enables to address the question of the feasibility of the specific Business Cases as best as it is possible at the current stage of the project. The aim of this task is ultimately to provide an overall assessment of the specific Business Case as to whether the Pod System has a realistic chance of being introduced into the current market.

However, when reading the results described in the following chapter 6, it is crucial to take note of the following instructions according to D5.1:

- Statements regarding the specific Business Cases can only be made within a narrow local context. Generalization for all EU member states is not possible. Results of the Business Cases always refer to a very specific setting.
- The majority of the Pods4Rail Business Cases can only provide a qualitative assessment of costs/benefits. Under certain conditions, it may be possible to predict potential target costs and revenues for some of the Business Cases.
- Any assessment of financial outcomes of the Pod System (whether qualitative or quantitative) is based solely on a rough estimation.

6. Procedure and Results of the Business Case Study

For this document eight Business Cases were selected in order to provide a variation of possible Business Cases without exceeding the scope of this document. The justification for the selection of the specific Business Cases is given in the Fact Sheets. The results of the specific Business Case Study for selected Use Cases are described in the following chapters. Each specific Business Case refers to a single company that offers its product or services to various customers as defined in the Use Case description of D4.1. For the sake of simplicity, interactions between the Business Cases have been excluded, hence any commonalities between the Business Cases may be repeated. In this regard, each Business Case follows the same procedure: First the Business Case is specified by means of Fact Sheets, then the specific Business Case is analysed using the sustainable Lean Model Canvas to determine the potential of the Business Case and finally the Benchmark is carried out to validate the results. Specific conclusions are given at the end of each subsections.

6.1. Manufacturing of Transport Units

6.1.1. Fact Sheet

Business Case Title: Manufacturing of Transport Units	
Brief summary/Short description of the Business Case: The Business Case is about the Manufacturing of innovative modular and flexible Transport Units (TU) for passengers and freight with a sustainable performance-based approach (Industry 5.0, Remanufacturing, Recycling). The Business Owners are Manufacturer such as railway manufacturer, container manufacturer, caravan manufacturer, automotive manufacturer, etc. The service portfolio contains the manufacturing and remanufacturing of car bodies (clean) and parts recovery, specific interior design required by customer, service and maintenance of TU, battery-abo (battery recycling) as well as financing services. Customers are Rolling stock leasing companies, car rental companies, railway undertaking, transport and logistics companies, bus companies, public transport companies, retail companies, catering and hospitality companies and waste management companies	
Why was this Business Case selected? This business case is a prerequisite for all Business Cases that operate with Transport Units.	
Operational scope:	Passenger transport, combined transport, freight transport (but no container production)
Transport mode:	Rail, road, air, (water)
Technology:	e.g. modularity: “one size fits” all concept for mobility; multifunctionality: configurable high-quality cabin design sets; sustainable performance-based manufacturing approach: harmonized standard TU platform for different customer requirements, highly automated flexible production; resource-efficiency; customer support system
Related Use	The use cases (D4.1) applicable are the following:

Case:	UC1: Basic Public Passenger UC2: Premium Public Passenger UC3: First Class Public Passenger UC4: Mass Public Passenger UC5: Basic Private Passenger UC6: Premium Private Passenger UC7: Luxury Private Passenger UC8: PRM Application UC10: Tourism Application UC11: Transport Service UC12: Shop floor UC13: Rescue UC14: Housing Application UC15: Event Application UC16: Parcel Delivery UC17: Night Logistics
Implementation:	• Go2Market – with cutting-edge technology and cost-competitive pricing model • Incentive programs • Ecosystem partnerships (technology partners, ...) • Operator networks • Investment partners • Sales • Digital marketing, public relation, events/trade shows (demonstrations) • Community engagement
Potential Benefits:	• Affordable high-end customized Transport Units • Robust production capacities • Shorter delivery times of Transport Units (24/7) “ready to use anytime, anywhere” • Customer support system • Higher profit margins • Second-hand market
Challenges:	• High capital requirements (Gigafactory vs. micro factory approach) • Supply chain development • Remanufacturing and recycling strategy • Market penetration and long-term contracts

6.1.2. Canvas Model

<table>
<tr><td colspan="4">Business Case: Manufacturing of Transport Units</td><td colspan="2">Perspective: Industry</td></tr>
<tr><td>Problem
• High cost due to specific of operators</td><td>Solution
• Harmonised standard TU platform for different customer requirements</td><td colspan="2">Unique Selling Point
• Manufacturing of car bodies (clean)
• Specific interior design required by customer.
• “One size fit all” concept for mobility</td><td>Unfair advantage
• Deep Knowledge in Railway industry
• In place sales organization
• No additional personal required</td><td>Societal Benefits
• Fast and experienced stuff
• Access to railway operators
• Due to standard platforms costs of mobility units will decrease</td></tr>
<tr><td>Key Metrics
• Prize / Passenger km
• Cost per TU</td><td>Market & Alternatives
• Conventional operators in Europe for Passenger
• NAM for cargo
• AFRICA passenger & cargo
• (world-wide-market)</td><td colspan="2">Channels
• Social media, newspaper etc. for advertising or pinpointing attractiveness of the Pod Systems
• Web pages of the manufacturers
• European organization(s) of Pods Operator network managing companies (expected to be established).</td><td>Customer Segments
• Operators global
• Investments private PPP
• World bank</td><td></td></tr>
<tr><td colspan="3">Cost Structure
• Materials and Stuff
• Sales
• Service
→ Conventional sales to costumer approach.</td><td colspan="3">Revenue Stream
• Sale of the TU e.g. 10.000 units per year (mass production to keep manufacturing costs low)
• Renting out the TU
• Further income from e.g. repair and maintenance of TU e.g. for 15 yrs.
•</td></tr>
<tr><td colspan="3">Eco-Social Cost
• Higher raw material cost/kg</td><td colspan="3">Eco-Social Benefit
• Less carbon footprint</td></tr>
</table>

6.1.3. Benchmark

The Business Case of "Manufacturing of Transport Units" focuses on the manufacturing of innovative modular and flexible Transport Units (TU) by railway manufacturers, container manufacturers, caravan manufacturers, car manufacturers, etc. on behalf of passengers and freight. Regardless of the sector in which the manufacturer operates, the service portfolio comprises the production and refurbishment of car bodies (clean) and the recycling of components, customised interior fittings, service and maintenance of TU battery recycling and financing services.

In order to conduct a specific target cost estimation, it is necessary to consider precise dimensions of the TU as well as the technical and constructive requirements for the design of the Transport Units. However, these are not available at the current stage of the project. For this reason, benchmarks are made with existing, comparable transport vehicles in order to enable a target cost estimation as good as currently possible.

However, it should also be noted that only assumptions can be made with regard to the manufacturing costs for TU, which are essentially based on manufacturing costs of the automotive industry due to the planned lightweight design of the TU [5]. Furthermore, it should also be noted that the TU has no drive and no chassis. As per D5.1 [2], the assumptions for calculating the target cost for the manufacture of the Transport Units are as follows:

- Construction of the TU based on components from the automotive sector
- Large-scale production: Production in large quantities due to the planned systems design and the standardisation of TU
- Production facilities with a high degree of automation based on new construction principles foreseen in 2040 resp. 2050 (planned implementation of Pod Systems)

As the potential Target Cost for the manufacturing of Transport Units has already been determined in the context of the Cost Value Framework in D5.1 [2], the following Table 1 refers to the Target Cost's values provided there. Further information on the calculation of the Target Cost for the Manufacturing of TU can be found in D5.1.

Table 1: Target Costs for Manufacturing of Transport Units [2]

Cost factor	Costs in 2030 acc. [10] [EUR]	Target Costs for Transport Units [EUR]
Car body	1,800	2,600
Interior	3,000	6,000
Manufacturing	1,300	2,600
Others	2,000	4,000
Total		15,200

For the description of the benefits, only the qualitative approach is applicable for this Business Case. For the manufacture of TU, it can be assumed that the costs for TU will decrease in the long term due to the standardised platforms. Assuming that 10,000 TU are sold/rented per year, significant profits can be achieved. It is also likely that manufacturers will be able to generate long-term customer loyalty by providing maintenance services and component orders, thus generating additional revenue. As personnel will be required for customer service and inspection of the manufacturing facility, additional jobs can be created, which will have a positive impact on the economy as well as society.

6.1.4. Conclusion

As a conclusion, it can be said that this Business Case is crucial for the implementation of Pod Systems, as it represents a general estimate of the probable Target Costs for the manufacture of Transport Units. Depending on the market situation, manufacturers may also add a profit margin to sell the TU to stakeholders. Generally seen, the production of TU would appear to be cheaper compared to other means of transport such as taxis, buses, trains, etc. In this regard, it can be assumed that the production of TU could be of interest to the relevant manufacturers. Depending on the acceptance of the relevant stakeholders, the implementation of Pod Systems on the European market may be successful if the prerequisite for manufacturing TU is met.

6.2. Pod Network Capacity Service for Transport Service Operators

6.2.1. Fact Sheet

Business Case Title: Pod Network Capacity Service for Transport Service Operators	
Short description of the Business Case: The capacity management of a Pods rail network includes offering, allocating, selling and operating the capacity of a given rail network. This includes all functions required for make a rail network available for Pods usage for the time of duration of a management contract to be applied for, offered and signed in the assumed case of a public rail infrastructure network. The business owner/-s is public and/or private entity/-is being in charge of the capacity management of a rail network by signing such a contract. The service portfolio comprises: Availability of rail network capacity for TSOs, Availability of facilities (incl. handling systems and energy) for TSOs, Capacity (incl. facility usage) offers and allocation / ordering through e.g., web portals or apps used by TSOs, Operational information services for TSOs and end-customers and Consulting services.	
Why was this Business Case selected? The BC addresses the main aspect of planning and operation allowing competition of multiple TSOs on one and the same network infrastructure.	
Operational scope:	Public/Private Passenger, Combined and Freight Transport
Transport mode:	Rail
Technology:	Rail network-wide track and facility offering, allocation and ordering system supporting the competitive sales process. Apps or Web-portal application and client devices (mobile phones or other web client devices) Modularity of the Pods and ability to combine both, freight and passenger Transport Units on one and the same Carrier. ATO, Moving Block and Virtual Coupling capability of Pods operations
Related Use Case:	Relevant for all types of usage of the Pod Systems (as stated in D4.1) requiring availability of rail infrastructure capacity including the linked facilities e.g., handling systems, energy.
Implementation:	Co-existence with the current transport modes is possible with fulfilling several safety and logistic conditions.
Potential Benefits:	Modal shift from road to rail. Efficient use of the rail infrastructure capacity. Allows for demand responsive trip/capacity booking. Cost efficiency due to competition.
Challenges:	Capacity of existing (legacy) lines. Criticism towards service due to demand inadequacy Resolution of capacity conflicts. Consideration of temporary restrictions of the rail infrastructure, e.g., track blockage or reduction of speed. Capacity pricing strategy and User acceptance

6.2.2. Canvas Model

Business Case: Pod Network Capacity Service for Transport Service Operators			Perspective: Rail Infrastructure Managers / System operators	
Problem • The rail track network as a resource is limited and thus, the allocation of the resource required for Pods trips need to be managed and made available for a competing group of TSOs being interested in accessing the network. • The track capacity required for Pods trips needs to be offered to TSOs and capacity orderings to be managed. • At the same time capacity restrictions, caused e.g., by track maintenance or weather restrictions need to be considered. • Penalty payments will need to be paid if ordered trips will result in relevant delays for the end user of the Pods.	Solution • The Pods planning and operation system provides the capability for offering and ordering of track capacity for Pods trips and track maintenance. • The capacity allocation is performed ensuring a smooth overall operation by at any time providing an operational plan free of resource conflicts. • Capacity pricing models is suggested to be a mixed fixed and flexible pricing model ensuring a best trade-off between capacity availability e.g., for longer term orderings and attractive prices for trips with less demand especially at short demand timescales.	Unique Selling Point • Dynamic, demand oriented capacity allocation of rail network capacity. • Rail network capacity allocation considering new operational technologies like virtual coupling, ATO, Moving Block. • Integration with other operational status and forecast information of other transport modes.	Unfair advantage • Existing legacy rail network infrastructure and its limitations. • Existing European legal regulations for rail network management. • Information and communication security standards. • Competing ecosystem of existing railway networks and rail infrastructure managers / train operators with a long history of providing public transport service.	Societal Benefits • Due to the more effective and demand responsive capacity allocation process the use of existing rail network is increased, hence more people use the eco-friendly Pods transport mode supporting sustainability. • Reduced prices due to competition on the rail network • Demand driven capacity allocation and booking increases end customer comfort. • Efficient timetabling considering moving block and optimising the use of virtual coupling maximizing the transport capacity in accordance with the

				transport demand. This leads to a maximum of compliance between trip request of end users and the related capacity offer.
Key Metrics • Rail capacity costs including infrastructure lifecycle costs (LCC) and operational costs (OC). • Rail capacity usage i.e., accumulated occupation times of track sections as per line section / time / TSO /… • Effective revenue of capacity selling. • Capacity efficiency i.e., number of transported passengers or amount of goods (in t) which have been transported using a given allocated and booked capacity including time interval and track length. • Operators/customers opinions and feedback	Market & Alternatives • TSOs are the primary customers to request and book the capacity. • A market of capacity managing and operating companies could be established allowing a license-based management of the public rail network. • Neighbouring rail network capacity managing companies may cooperate to provide smooth interchange of Pods crossing different networks and allowing for economical and societal synergies.	Channels • Social media, newspaper etc. for advertising or pinpointing attractiveness of the managed network and operation or relevant news. • Web pages of the capacity managing companies. • European organization(s) of Pods network managing companies (expected to be established).	Customer Segments • TSOs for freight and passenger transports. • End customers requesting trips for passenger or freight transport (indirectly; being addressed to increase attractiveness and demand)	

Cost Structure • Infrastructure asset lifecycle costs • Pods system operational costs • Staff costs • Software development • Software maintenance • Data management • Server infrastructure/hosting costs • Advertising • Legal compliance • Benchmark models	Revenue Stream • Revenue from capacity sales • Revenue from usage of facilities (including handling systems and energy) • Consulting services
Eco-Social Cost • Concerns of TSOs and end customers about how their data is being used • Environmental impact of associated technology • Environmental impact of hosting of software • Automation of processes and use of AI might lead to reduction of jobs	Eco-Social Benefit • Sustainability – efficient use of low emissions transport modes • Moving more passengers to public transport, making it more accessible, attractive • Reduction of personal vehicle use – less CO_2 emissions, less noise, better air quality • Best performance and price for end customers through competition of o Multiple TSOs on a rail network and o Multiple capacity managing companies applying for a rail network to be managed.

6.2.3. Benchmark

This Benchmark aims to evaluate the target cost for performing the capacity management of the rail network used with the proposed Pod System by finding cost examples of existing, similar systems of today. For the cost estimation, similar processes at today's Railway Infrastructure Managers (RIM) in Europe have been considered. This was seen as being of importance in the light of expected competition between the 'classically operated' railways and the new Pods transport system.

Since detailed costs or revenue figures are not available from public sources, the idea is to make use of available statistics for RIM operational costs and track access charges published by the RIM in Europe. Using these sources is deemed to be valid since the RIM in Europe are public bodies without intentions gaining high profits. So, the track access charges may be used as a benchmark criterion for covering RIM' costs for capacity management including infrastructure asset Life-Cycle-Cost (LCC) and Operating Cost (OC) but excluding the Train Operators' (i.e., TSO-) LCC and OC. However, it needs to be considered that RIM in Europe, as non-commercial institutions, are usually receiving subsidies from the state authorities to provide rail network capacity at reasonable prices. In the following Figure 5, the development of the charges throughout the years 2011 to 2019 is shown. The charges vary significantly throughout the European countries with a slight increase over the years.

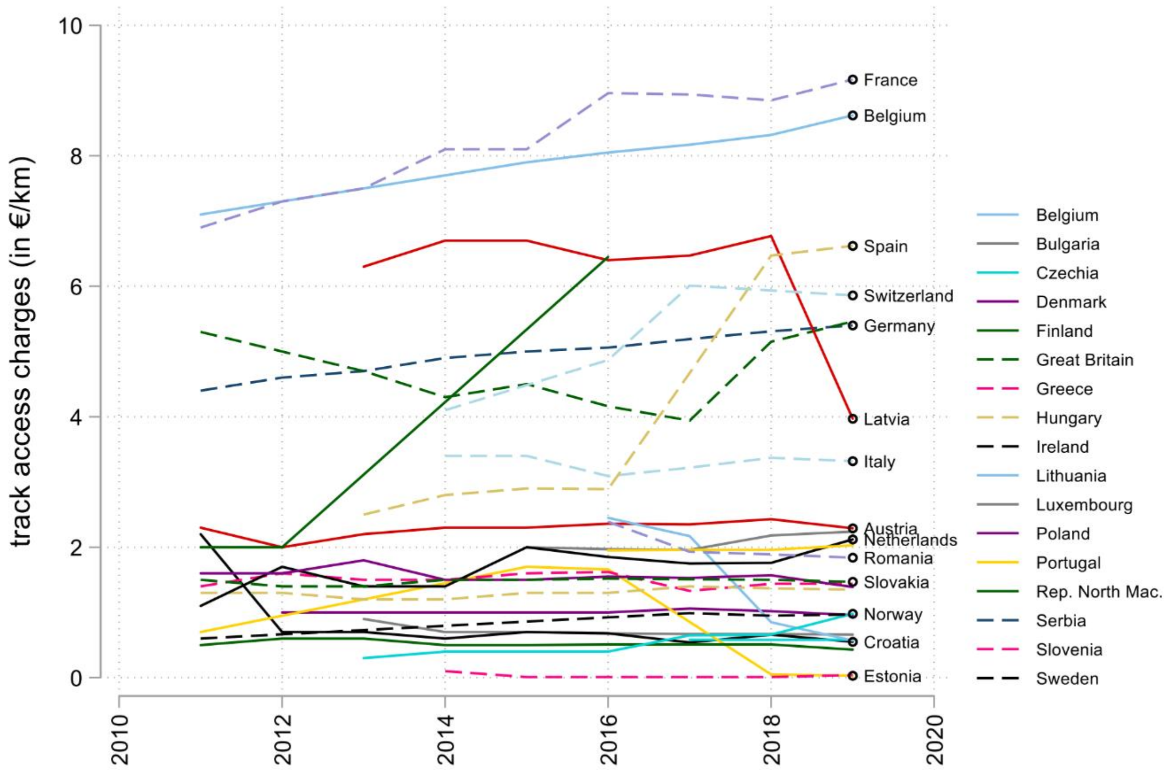

Figure 5: Track access charge revenue of the railroad infrastructure managers 2011-2019 for the minimum access package in Euro per train-kilometre [11]

Assuming extrapolated development of the charges towards 2025, an average charge of 2 € per train-km can be expected, see calculation below. Due to the virtual coupling capability of the Pods, multiple Pods running virtually coupled would be fitting to the same capacity as consumed today by one train expecting the same underlying transport demand.

It can be expected that the Life-Cycle-Costs and Operating Costs for the Pods infrastructure is lower than for classical railways due to missing signalling asset and ATO operation. However, we expect other cost effects which we are not able to assess today so that an overall relative target cost value can be given by 2,50 € per train-km which can be used to calculate target costs for any size of a Pods network without considering the increase of demand e.g., due to higher attractiveness.

For calculating the expected IM Operating Costs, the operating costs of Infrastructure Managers of relevant railway systems have been used by applying results of a study of the European Commission from the year 2015. Based on this study, existing European railway systems with a similar transport productivity as expected from a future Pod Systems can be identified to restrict the cost calculation above to relevant systems only.

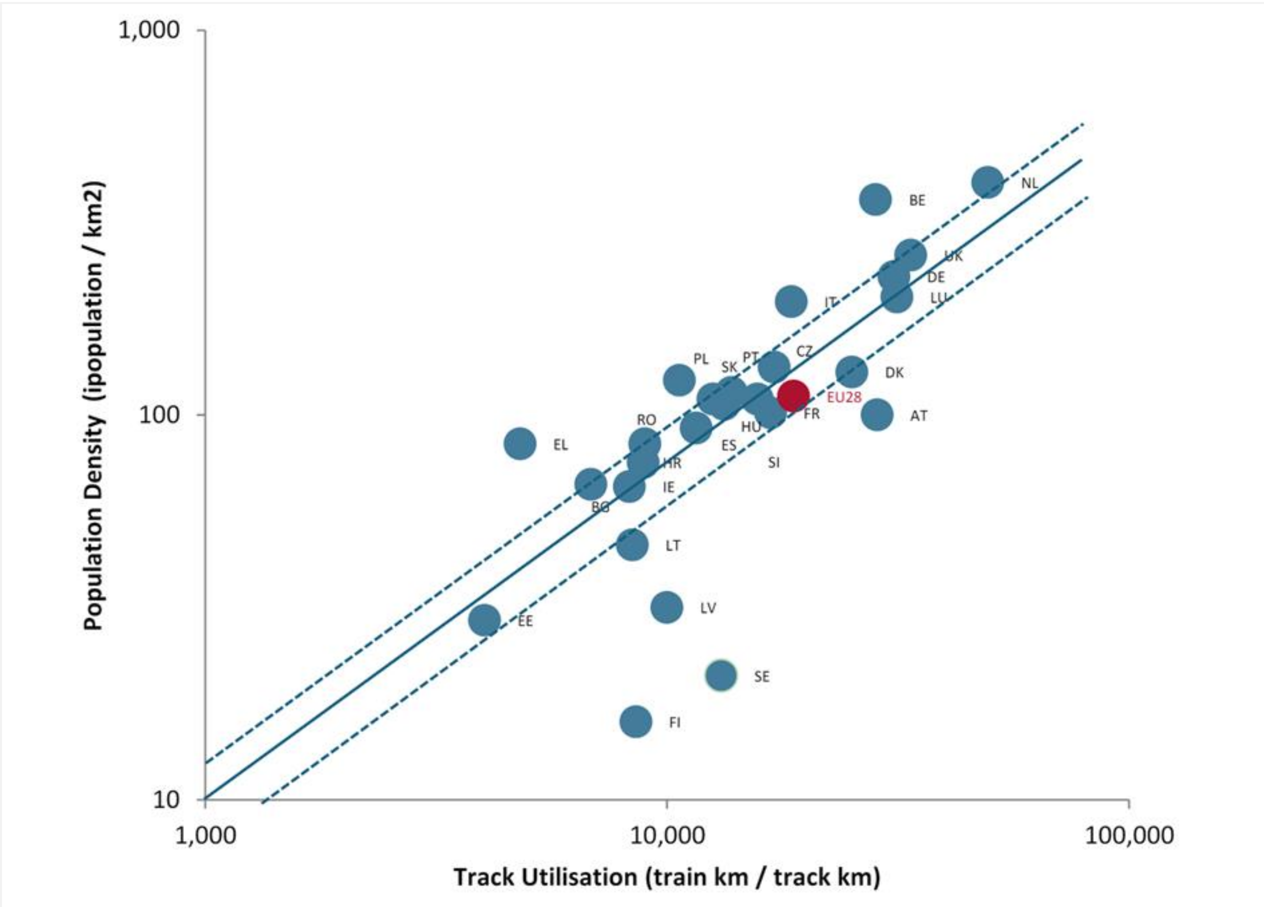

Figure 6: Track utilisation and population density (2012) - logarithmic scale [12, p. 34]

Since it is not expected that Pod Systems will be used for rail networks with a strong footprint in (long distance) freight transit as e.g., in Finland, the relation of population density and track utilization of the Pods can be expected as being more or less constant when looking at different future Pod networks. Thus, the idea is to identify existing railway systems behaving in the same manner as indicated in the diagram above (see Figure 6).

The identified relevant systems are: EE, BS, IE, HR, ES, SK, HU, PT, CZ, FR, DK, LU, DE, UK NL and these are seen as representative for the implementation of Pod Systems as described in this Business Case. However, it should be noted, that 'EU28' is not a relevant system but another indicator used by the EC study which is not relevant for this benchmark.

As shown in Figure 4 of D5.1, the following IM Operating Cost percentages based on total Operating Cost have been identified:

- EE: Estonian Railways (16,0/26,0) =61,5%
- BS=BG: Bulgarian Railways (5,5/13,0) =42,3%
- IE: Irish Railways (7,5/19,5) = 38,5%
- ES: Spanish Railways (12,5/25,0) =50%
- SK: UIC database 2007 (11,5/28,0) =41,1%
- HU: Hungarian Railways (5,0/15,0) =33,3%
- PT: Portuguese Railways (14,0/30,0) =46,7%
- CZ: Czech Railways (6,8/17,0) =40%
- FR: French Railways (10,0/62,0) =16,1%
- DK: Danish Railways (10,0/25,8) =38,8%
- LU: Luxemburg Railways (19,0/52,0) =36,5%
- DE: German Railways (5,0/15,2) =32,9%
- UK: UK Railways (13,0/28,0) =46,4%
- NL: Dutch Railways(13,0/38,0) =34,2%

The railway systems FR and EE (see marked ones above) can be seen as atypical giving the extreme values calculated for them. These two systems are decided to be not considered for the refinement of the IM Operating Costs indicated for years 2012 and 2019 in € per train km including calculated average annual increase (AAI) and extrapolated 2025 target values, see Table 2:

Table 2: Operating costs of infrastructure management for state railways for 2012 and 2019 in € per train kilometre

State railways	2012	2019	AAI	2025
Bulgarian Railways	1,050	0,700	-0,050	0,450
Irish Railways	0,750	1,070	0,046	1,299
Spanish Railways	2,250	6,700	0,636	9,879
Hungarian Railways	1,450	1,450	0,000	1,450
Portuguese Railways	1,000	0,000	0,000	0,000
Czech Railways	0,200	0,700	0,071	1,057

Danish Railways	1,650	1,250	-0,057	0,964
Luxemburg Railways	2,000	2,200	0,029	2,343
German Railways	4,600	5,400	0,114	5,971
UK Railways	5,000	5,450	0,064	5,771
Dutch Railways	1,000	1,090	0,013	1,154
			AVG	2,758

The calculation table shown in Table 2 reveals extrapolated average IM operating costs of 2,758 € per train km for the year 2025. Thus, we may assume 2,80 € as an appropriate value for the expected revenue per train km in the year 2025.

For the selected Business Case, the cost components to be covered by the total cost target derived for a given system are:

- Capacity Management IT System procurement, installation and maintenance cost
- Rail infrastructure asset LCC
- Rail infrastructure asset OC
- Staff costs
- Administrative costs including e.g., advertising, staff recruiting, management.

Initial one-off costs are to be considered:

- Development of the system
- Project management
- Delivery, testing and roll-out of the solution

Regarding the determination of Target Benefits only qualitative statements were possible for this specific Business Case: A direct benefit is the revenue received by selling the rail network capacity to the TSO. Additional revenue could be obtained by allowing a flexible, demand-based pricing e.g., by making use of an auction-based model which would need to be publicly accepted in case of state-owned RIM.

Besides, there are societal benefits by allowing competition between TSO in getting hold of the capacity sought for which would lead to better quality and attractiveness of the offered services and the rolling stock asset used for performing them.

Also, environmental benefits can be expected as a consequence because this new type of public transport system may become the preferred transport system in the future. This would lead to a reduction of CO_2 emissions and increase of air quality.

Another economic benefit may be seen in creation of new jobs to support and perform the capacity offering and selling process and maintain it on the long run.

6.2.4. Conclusion

A simple calculation based on publicly available network reports of European RIM reveal a statistical average of roughly 22.000 train km annual train performance in the EU for one km of a national rail network. Assuming a Pod network size of e.g., 5.000 km, this would mean an annual performance of 110 Mio train km and an associated total Target Cost value of 303,4 Mio € and 308 Mio € expected revenue per year unless the RIM is a private company or a flexible pricing model is used.

A distinction between fixed and variable costs is not applicable but also not reasonable in this context since we may expect a long-term obligation for managing an existing rail network for the Pods so that all costs are finally to be covered by the revenue gained from capacity sales. Building a rail new network or providing extensions to an existing rail network for establishing a Pod transportation system will have to be calculated separately.

It is to be noted that in this selected Business Cases, we are just addressing a part of the overall costs for using the Pods transport infrastructure since we are just focusing on the rail network rather than looking at different other transport modes and their transport infrastructure which are expected to be involved in a future Pod System.

Besides the revenue, there are other benefits that should be considered. Especially the societal aspects leading to better quality and attractiveness of a Pod System are to mention as well as a positive impact on CO_2emissions from the environmental point of view supporting sustainability targets decided on European level.

6.3. Freight Transport Service for Cities

6.3.1. Fact Sheet

Business Case Title: Freight Transport Service for Cities	
Short description of the Business Case: The Business Case is about using autonomous mobile robots (AMR) on already existing stop trains during off/low-peak hours in urban areas. The Pods automatically enter and exit the trains at train stations and find their way to their destinations inside the train stations and in the immediate vicinity of the train stations. The main goal is to lessen the congestion on the roads near the train stations that is caused by trucks and freight transport. The business owner(s) are logistics companies such as e.g., DB Schenker, for roads, and train service operators, such as e.g., the Dutch Railways (NS). The service portfolio is the logistics services, where goods are transported to busy rail related hubs (train stations), and goods delivery (including planning and organizing) to retail facilities inside the rail related hubs. The customers are the stores inside and in the direct vicinities of the train stations.	
Why was this Business Case selected? This Business Case was selected because there is a potential for the reduction of congestion in larger cities, by using already existing infrastructures. That means that the carriers do not need a separate infrastructure to transport goods from one location to another and thus be an alternative or addition to the transportation of goods to stores inside and in the close vicinity to train stations. The technology of the Pods already exists inside warehouses which means that the time and resources that would have been spent on inventing the technology, can instead be used on the implementation and streamlining of the Pod System. This fact enables the Pods to be implemented as soon as the decision of doing so is made.	
Operational scope:	The traffic addressed are the train stations, the stop trains (regional and local trains), and (freight truck) logistics companies (e.g., DB Schenker). The owners of the Pods are (freight truck) private logistics companies (e.g., DB Schenker).
Transport mode:	The Business Case focuses on rails (trains) and roads (freight trucks).
Technology:	The innovative element to this Business Case is the use of AMRs to reduce congestion of roads, and to replace the need for manpower to deliver store items inside train stations. The AMR are fully automated and can navigate through train stations without the need for custom made pathways that they can follow. AMR navigate from one destination to another automatically and will move around any obstacles that appear in their way. When the AMRs have reached their destinations and are emptied by the staff in the store, they find their way back again to the correct train.
Related Use Case:	UC1: Basic passenger transport UC11: Transport services UC12: Shop floor UC16: Parcel delivery

Implementation:	The primary customers (station managers, logistics companies, transport companies) and secondary customers (mother company station shops, franchise station shops, other shops) must come together to figure out what each party wants from the service and how that can be done. The Pods need a system in place (i.e., technology and infrastructures) that allow them to enter and exit trains autonomously, as well as freely move around inside the (entirety) of each train station in question. There needs to be a group of people who can coordinate and organize the delivery of goods, to ensure that the goods are delivered when needed.
Potential Benefits:	The advantages of this Business Case are that the congestion on the roads inside cities and city cores (where train stations are typically located), can be reduced. The AMR Pods will use the trains during off-peak hours, which means that it will not likely affect travellers on the trains, i.e., take up too much room. The AMRs are fully autonomous, and enter and exit trains before proceeding to navigate through train stations to their destinations. This means that they are suitable for already existing infrastructures. Their carrying capacity ranges from 100-600 kilos and take up approximately the same space as one seated person, per AMR unit. Due to their simple design (low and flat, and carries the cargo un top), they are easy to load on and off of.
Challenges:	In this Business Case, it was decided to only focus on the aspects of the AMR that are factually true, as presented by the manufacturers of the robots, to reduce the amount of assumptions about the implementation and use of the AMR. However, there are a number of aspects to the AMR and the implementation of them outside of warehouses that are still unclear, which are important to have accurate information about before one can present a case that representative to a real-world scenario. Such information is listed below: • Technology needed for the robot of enter/exit the train • Possible need for platforms and elevators, depending on the layout of each station • Noise emission • Safety • Level of complexity in handling the robot • The level of training needed to operate the robot • Battery capacity • Charging stations • Frequency of goods delivery • How far away from the train station the AMR can go

6.3.2. Canvas Model

Business Case: Freight Transport Service for Cities			Perspective: Service Provider	
Problem • Trucks around busy train stations (congestion) • Cramped station halls • Unused capacity on trains during off-peak hours	Solution • "Off-peak Pods" • Use off-peak train capacity to transport and deliver goods from less congested with Pods being a mix between a "roll container" and an Amazon Titan. The service to take over truck trips to heavily congested urban areas is offered to logistics companies and or their clients in and around stations.	Unique Selling Point • Using infrastructure (rails and trains) that is already available. • Reduces the amount of people and trucks around train stations.	Unfair advantage • Changing the train hardware • Must use trains with a floor level of the same height as to the station platform • Adding new infrastructures inside an already cramped/busy train station	Societal Benefits • Less traffic around stations • Less trucks on the roads inside the city • improved urban mobility and infrastructure • Potentially less congestion inside the train station due to less personnel working with delivery
Key Metrics • Navigation accuracy • Operating time and energy consumption • Maximum speed and ease of manoeuvring • Maximum payload and payload capacity	Market & Alternatives • Trucks deliver goods to train stations, and delivery workers manually move the goods from the trucks to the station stores.	Channels There are three different channels that can be explored: • Truck stream • Shop streams • Station stream	Customer Segments Primary customers: • Station manager (like NS stations) • Logistics company (like DB Schenker) • Transport company (like DB Schenker)	

<table>
<tr>
<td colspan="2">• Connectivity and data transfer rate
• Mean Time Between Failures (MTBF)
• Mean Time to Repair (MTTR)</td>
<td></td>
<td></td>
<td colspan="2">Secondary customers:
• Mother company station shop (like Burger King)
• Franchise station shop (like the Burger King franchise)</td>
<td></td>
</tr>
<tr>
<td colspan="3">Cost Structure
• Acquisition Cost for the Pods (e.g. Amazon Titans)
• Costs for Pod Development
• Costs for Pod Operation
• Costs for Pod Routes
• Costs for Pod infrastructure
• Costs for Pods control centre
• Costs for Energy usage
• Maintenance Cost</td>
<td colspan="4">Revenue Stream
• Rental/Leasing of the Pods to
o Transport companies
o Shops inside train stations</td>
</tr>
<tr>
<td colspan="3">Eco-Social Cost
• Jobs in traditional industries may be replaced, leading to increased social disparities.
• Manufacturing and disposal of the Freight Pods cause pollution, whereas their utilisation in logistics has the potential to improve resource efficiency.
• Privacy and security issues represent significant social costs due to the extensive data monitoring required for the use of these Pods.</td>
<td colspan="4">Eco-Social Benefit
• The reduction of truck traffic near the train stations will lead to improved air quality as fewer pollutants are emitted and reduced Noise pollution
• As a result, residents will enjoy a healthier environment (e.g. respiratory diseases may be reduced), which will improve the quality of life in the affected areas.
• Improved efficiency and increased productivity for various business sectors, leading to economic growth and cost reductions.
• Optimising processes in logistics can reduce energy consumption. This contributes to a reduction in environmental pollution and the CO_2 footprint.</td>
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6.3.3. Benchmark

The aim of this benchmark is to compare already existing cases that are similar to the chosen Business Case, with the goal of making an estimation on the costs of implementing the Business Case in a real-world scenario. In this chapter different companies are presented that already offer the types of Pods that are consider in this specific Business Case: Using autonomous mobile robots (AMRs) on already existing stop trains during off/low-peak hours in urban areas. The Pods automatically enter and exit the trains at train stations and find their way to their destinations inside the train stations and in the immediate vicinity of the train stations. The purpose of the Pods is to autonomously deliver goods to train station shops.

The value of this Business Case can be seen in the reduction of congestion on the roads that positively affects municipalities and logistics companies. Less traffic on the roads leads to less deterioration of the infrastructure and vehicles. By using trains during low-peak hours, the AMRs can use already existing infrastructures to move from train station to train station.

The innovative element of this Business Case is the use of Pods (robots) to reduce the congestion on the roads, and to replace the need for manpower to deliver store items inside train stations. The Pods are fully automated and can navigate through train stations without the need for custom made pathways. The Pods navigate from one destination to another automatically and will move around any obstacles that appear in their way. When the Pods have reached their destinations, they wait until they are emptied by the staff in the store, before they find their way back again to the correct train.

Two types of robots exist for similar purposes already. The autonomous mobile robot (AMR) *"[…] is a type of robot that can understand and move through its environment independently"* [13]. AMRs use a sophisticated set of sensors, artificial intelligence, machine learning, and compute for path planning to interpret and navigate through their environment, untethered from wired power. Because AMRs are equipped with cameras and sensors, if they experience an unexpected obstacle while navigating their environments, such as a fallen box or a crowd of people, they will use a navigation technique like collision avoidance to slow, stop, or reroute their path around the object and then continue with their task.". [13]

The second type of robot that exists today is the automated guided vehicle (AGV). *"AGVs are driverless vehicles. Onboard software guides their movement, helping them move along predefined paths and avoid obstacles, ensuring safety. There are many ways AGVs navigate through a site, but the two most efficient are reflector navigation and natural navigation:*

- *In the reflector navigation method, reflectors are installed on-site and scanned by each automated vehicle, allowing it to define its position based on the distance to the reflectors. This navigation method has been noted for its high accuracy and robustness.*
- *Using natural navigation, an automated truck will use reference points, such as walls, racking and fixed objects to calculate location. This is a common navigation method for warehouses or distribution centres where the internal setup and landmarks remain constant"*. [14]

In the framework of Task 5.2 the focus was set on the AMR, as they can navigate their surroundings without the need for technology to guide them along permanent pathways, and they do not typically require operator oversight. [14] This is a logical option, seeing that the robot will have to navigate its way through train stations and trains where there are constant (moving) obstacles along the way to their destinations (e.g., people, luggage, other cargo, transport units like bikes, wheelchairs, strollers, etc.).

In the following Benchmark Systems will be presented, based on already existing AMR robots such as Mecalux. [15]: *"Autonomous mobile robots (AMR) are designed to transport loads between two points completely independently. They move freely through the warehouse, following dynamic routes calculated by intelligent software to optimize their movements and follow the perfect trajectory for each task. Using state-of-the-art sensors and scanners, they are able to detect and avoid obstacles and work safely in an environment where people and other machines work together. Mecalux's AMR are highly versatile robots that can be easily integrated into all types of warehouses, as they do not require any adjustments to the existing infrastructure. The range consists of different models that complement each other and are therefore suitable for handling a wide variety of loads, from boxes, totes and parcels to racks and pallets"*. [15]

The second Benchmark System for this specific Business Case is based on the AMR of Jungheinrich, which are described as follows: *"Autonomous mobile robots (AMR) navigate freely within defined areas, avoid obstacles, and can pick up load carriers of different sizes and weight. The AMR are even smaller and more agile than manual forklifts."* [16]

Finally, as a third Benchmark System the AMR of Dematic was determined: *"Autonomous mobile robots (AMRs) sense their environment and adapt just like you do. AMRs are industrial robots that lift and transport materials within your company. They safely navigate around people, equipment and inventory by reading QR codes on the facility floor or using Light Detection and Ranging (LiDAR) to sense surroundings and obstructions"* [17]

Based on the Calculation of Total Cost of Ownerships for AMR as described in D5.1 [2] and presented in the following Table 3 it was possible to estimate Target Cost for this specific Business Case. However, it should be noted, that the figures in Table 5 only show the initial purchasing price of an autonomous mobile robot (AMR), as well as estimates of operational costs and additional costs over five years, when used inside a warehouse. Thus, the total cost of $ 77.000 does not represent the total cost of an AMR, as it does not consider variables that could potentially lower or increase the final costs over the same five-year period.

Table 3: Estimation of the total cost of ownership of an AMR

Expenses	Costs (USD)
Initial purchase of AMR	50,000
Operational (over 5 years) • Maintenance • Software updates • Staff training	 2,000/year = 10,000 1,000/year = 5,000 3,000/one-time = 3,000

Additional costs (over 5 years) • System reconfiguration • Additional equipment	 5,000 4,000
Total cost over 5 years, for one AMR	77,000

When implementing AMR for use on trains and inside train stations, there will have to be a system in place (i.e., technology, infrastructure, equipment, personnel) on the trains and train stations, that allows for the continued use of multiple AMR. Navigating onto trains and inside train stations, is a more complex task for the AMR than working inside a warehouse. *"The more specialized the tasks, the higher the cost. This is because more sophisticated technology and programming are required to meet these specific needs."* [18] The costs can also change based on the model of the AMR and the tasks that the robot needs to perform, as well as possible discounts when purchasing multiple AMR.

Additionally, the cost of a single AMR ranges from $ 10,000 to $ 100,000 [18]. Thereby, the focus is on robots that range from small to medium, with a carrying capacity from 100kg-600 kg [15] [19], dimensions of approximately 80cm x 62cm x 33cm (L x W x H) [8] and has a (single) unit price range from $ 10,000 to $ 50,000 [19] [20]. To conclude, it was not possible to provide concrete numbers that represent the complete costs of implementing AMR, but it is as close as it can be calculated at this stage of the project. The following Table 4 summarise the calculated target costs for this specific Business Case based on the estimates made through the Benchmark. Empty slots indicate that numbers have not been found.

Table 4: Estimated Target Costs for Freight Transport Service

Cost Type	Cost Segment	Cost Sub-Segment	Estimation of Target Costs for the specific Business Case
Acquisition costs	Manufacturing	Transport unit	50,000 USD/ AMR
		Carrier	n/a
	Equipment	Interior fittings, entertainment systems, etc.	n/a
	Research and development (R&D)	Software development	
		Sensor technology	
Operating Costs	Energy consumption	Costs for electricity, depending on the frequency of use and energy prices.	
	Operation, maintenance and repairs	Regular maintenance, software updates, etc.	Maintenance: 2,000 USD/ year Software updates: 1,000 USD/ year

	Insurance	Insurance costs for autonomous driving and liability insurance.	
Infrastructure Costs	Charging points	Construction and maintenance of charging stations, especially in holiday regions and heavily frequented areas.	
	IT infrastructure	Costs for networking, data transmission and ensuring cyber security.	
	Swap Body infrastructure	Construction and maintenance of Swap Bodies for transfer to other modes of transport	n/a
Other Costs	Personnel costs	Personnel are required for monitoring operations, technical support and customer care. Training required for maintenance and operation.	3,000 USD/ one-time
	Regulatory costs	Costs for authorizations and compliance with legal regulations.	
	Other Cost		System reconfiguration: 5,000 USD/ over 5 years Additional equipment: 4,000 USD/ over 5 years

6.3.4. Conclusion

Accurate costs are seemingly only available to those who engage with the manufacturers directly, with the intent of purchasing robots [15] [16] [17]. An additional element to this Business Case is to figure out the costs for implementing the use of the Pods on trains, as well as possible costs for ensuring that the Pods can do their tasks autonomously in (and around) the train stations (i.e., technology, infrastructures, access points to shops, organization of the delivery, safety aspects, etc.)

The determined costs are based on calculations made by the Robotics Marketplace, Qviro [18]. These numbers were the only ones found that somewhat accurately depict the five-year cost to be expected for one AMR. Before making a more accurate estimation of the implementation of the Pods, it is essential to first figure out the costs for implementing the use of the Pods on trains, as well as possible costs for ensuring that the Pods can do their tasks autonomously in (and around) the train stations (i.e., technology, infrastructures, access points to shops, organization of the delivery, safety aspects, etc.). Another element to consider is the price reduction that one can get when purchasing multiple AMR. Any of these calculations are not available at this moment, thus the numbers shown in the tables above are the best to offer at this stage of the project. There are some numbers available from other Pod Systems but they do not compare adequately to this Business Case and are therefore assumptions at best. To avoid assumptions, it was chosen to leave the areas for some cost elements blank until accurate numbers are available.

In conclusion, it is not possible to make accurate cost estimations for the implementation and use of this type of Pods in this Business Case, at this moment. There are many more variables than the purchasing and operation of the Pods. At best, an estimation can be made when the variables and the full overview of the necessary elements of implementing this Pod System are uncovered, but it will remain an estimate.

For the description of the benefits no numbers that can represent the possible benefits of this specific Business Case were found. Hence, it was not possible to provide quantitative statements regarding Target Benefits. However, as described in the Canvas Model relevant elements of the benefits of this Business Case are worth mentioning to gain a realistic view of what needs to be considered when implementing the Urban Goods Rail Pod System.

Depending on the number of Pods deployed and the way that the Pods and the goods are organized, the number of trucks driving into and inside cities and near train station can be reduced. The Pods are autonomous and should not be a nuisance to passengers on the trains or people inside the train stations. Because of the current technology of the Pods, they can detect obstacles in their path, navigate around and find their way to their destination, and back to where they need to go, or alternatively go to a charging station.

Hence, the benefits of the Pod System in this Business Case lie with the reduction of congestion on the roads near train stations, and the potential for a tailored delivery system to shops inside and around train stations. The Pods can move between stations and the goods terminals where they pick up the goods for delivery, multiple times a day, depending on the distance that they need to travel, and thus make for a resource efficient way of moving goods. The Pods can carry up to 600 kg of goods in a compacted way on already existing electrical trains, compared to potentially half-full freight trucks on the roads. That also means that there is a potential for the reduction in emissions related to the transportation of the goods.

However, the economic success of this Business Case is dependent on how the stakeholders collaborate with each other, and the level of acceptance by the end users. All stakeholders should be involved in the process and have the opportunity to share their interests before implementing the Urban Goods Rail Pod System.

6.4. Ride-Sharing Service for Private Passenger Transport (Franchise)

6.4.1. Fact Sheet

Business Case Title: Ride-Sharing Service for Private Passenger Transport	
Short description of the Business Case: This Business Case is focusing on the provision of a user-friendly mobile application that facilitates the integration of Pods into existing mobility solutions. The application would help making day-to-day travel more sustainable and would ensure the efficient use of existing rail infrastructure. The business owner is the developer of the application – a software company. The software company has experience in developing sophisticated software solutions for travel planning, which includes multimodal journey planning, booking and ticketing of journeys. The customers of the business owner are mostly mobility providers who purchase the software and applications to service the users of their mobility offers. They could also be investors and fleet operators. Hence, Investors can purchase Pods and contribute them to the company's network to benefit from the revenue generated from the journeys. The revenue from the ride-sharing services is split between the investors and the ride-sharing company according to a pre-agreed arrangement. This can be based on various metrics, such as the number of journeys, turnover or another agreed measure.	
Why was this Business Case selected? This Business Case was selected, because it covers all Use Cases related to passenger transport. Easy usability and connectivity with other transport modes are essential to make the Pods a viable and attractive mode of transportation. Consequently, an App would be a solution to support the use of Pods for travellers in the already existing mobility network.	
Operational scope:	This Business Case addresses public and private transportation of passengers
Transport mode:	The transport modes covered are rail in combination with road travel, as well as any kind of mobility provider that could use Pods for their services.
Technology:	The innovative technologies of Pod System highlighted in the Business Case are: The integration of different transport modes, Door2Door service, digital (booking) platforms as well as options for People with Reduced Mobility (PRM)
Related Use Case:	The use cases (D4.1) applicable are the following: UC1: Basic passenger transport UC2: Premium passenger transport UC3: First class passenger transport UC4: Mass passenger transport UC5: Basic passenger transport UC6: Premium passenger transport UC7: Luxury passenger transport UC8: PRM application

	UC9: Ambulance application UC10: Tourism application
Implementation:	The implementation of the proposed system can be achieved through targeted partnerships with mobility providers (as well as infrastructure companies). Former and existing customers who are interested in including a Pod system into their mobility offers could be great partners for an implementation.
Potential Benefits:	The benefits of this Business Case are sustainability, mostly through the efficient use of low emissions transport modes; moving more passengers to public transport, making it more accessible, attractive. The solution is user friendly and makes it easy to use public transport. Another benefit is the reduction of personal vehicle use – less CO_2 emissions, less noise, better air quality; there might also be more space if less single personal vehicles are being used. the integration of PRM, inclusive mode of transport.
Challenges:	Regarding the challenges of the Business Case, there might be concerns in society about privacy and how the users' data is being processed and used. Data exchange may be a challenge, as well as the definition of operating areas. Furthermore, the automation of processes and use of AI might lead to reduction of jobs.

6.4.2. Canvas Model

Business Case: Ride-Sharing for Private Passenger Transport			Perspective: Software Provider	
Problem • Integration of Pods into existing mobility solutions for users; facilitating multimodality is required • Easy merging of new system into existing infrastructure required • Efficient on-demand transport solutions required • One-stop-shop solution for users/travellers required	Solution • Mobile application • User friendly app • Providing Real-time information • Disruption management • Potential booking and ticketing solution	Unique Selling Point • Making day-to-day travel more efficient and sustainable • Great usability • Most efficient usage of existing rail-infrastructure, facilitated by smart and sophisticated software	Unfair advantage • Similar app solutions already exist on the market	Societal Benefits • Public Transport Evolution - Making day-to-day travel more efficient and sustainable • Accessible solutions • Most efficient usage of existing rail-infrastructure, facilitated by smart and sophisticated software. • PRM information included – accessibility and support
Key Metrics • Data quality and accuracy (timetable data, static/realtime), infrastructure, topographical data • Regulatory compliance metrics • Passengers' opinions and feedback • Operators/customers opinions and feedback	Market & Alternatives • Other software providers • Start-ups • Competitors	Channels • Traditional advertising methods (e.g. social media, newspapers) • Former and existing customers recommendations (not only for Pods Systems but for similar systems as railways and trams) • Partnerships with railway operators and other	Customer Segments • Pods owners • Public transport companies / service providers	

<table>
<tr><td>• Passenger Information Services metrics (accuracy and quickness) compared to other transport modes
• Monthly revenues
• PRM metrics (Station information, accessibility information)</td><td></td><td>mobility providers, software providers, etc
• Rail-infrastructure companies</td><td></td><td></td></tr>
<tr><td colspan="2">Cost Structure
• App development
• App maintenance
• Data management
• Server infrastructure/hosting costs
• Advertising
• Legal compliance</td><td colspan="3">Revenue Stream
• Revenue from app sales
• First time sale and set-up, recurring service fees revenue
• Consulting services</td></tr>
<tr><td colspan="2">Eco-Social Cost
• Concerns in society about their privacy and how their data is being used
• Environmental impact of associated technology
• Environmental impact of hosting of software
• Automation of processes and use of AI might lead to reduction of jobs</td><td colspan="3">Eco-Social Benefit
• Sustainability – efficient use of low emissions transport modes
• Moving more passengers to public transport, making it more accessible, attractive
• Reduction of personal vehicle use – less CO_2 emissions, less noise, better air quality
• Integration of PRM, inclusive mode of transport</td></tr>
</table>

6.4.3. Benchmark

This Benchmark on Ridesharing for Private Passenger Transport aims to evaluate the target cost for the proposed Pods system by finding cost examples of existing, similar systems. For the cost estimation of the proposed Pods system, a similar software solution has been considered. The solution has the same or similar functionality and requires a similar amount of expected maintenance. The location of the Pods or size of the Pods fleet do not have an impact on the suggestion solution and cost. The area of operation could add more cost, especially if the Pods follow a cross-border approach. In this case standardisation of data and data sharing between countries and providers can be challenging and add complexity.

Due to the competitiveness of similar service providers on the market, providers are not disclosing the costs for their systems. Therefore, it was not possible to find information about costs from more than one system provider. It is expected that the costs for the system will be comprised of two factors: the initial cost for setting up and developing the system and the recurring cost of hosting the system, as well as maintenance and support. The functionalities and components required for the selected Business Case are:

- Backend system
- Information management system
- Data management system
- Hosting of the backend system
- Mobile frontend system
- Interface management system
- System for booking and ticketing

Furthermore, there will be costs for the development of the system, for the project management and for delivery, testing and roll-out of the solution. The following Benchmark system is based on a central European medium-sized enterprise [21] that is specialized in journey planning software. The costs are for a solution that is provided as Software as a Service (SaaS), see Table 5.

Table 5: Estimated Target Cost for Ride-Sharing Service for Private Passenger Transport

Cost creating component	Initial price of product	Recurring costs per year
Backend System (general)	30,000€	40,000€
Backend System: Information management	30,000€	50,000€
Backend System: Data management	80,000€	48,000€
Hosting		250,000€
Mobile frontend	100,000€	200,000€
System for booking and ticketing	250,000€	250,000€
Software development, testing, rollout of software	100,000€	
Project management	150,000€	
Integration of Services/Interfaces. DRT	300,000€	60,000€

Total	1,040,000€	898,000€

Regarding the determination of Target Benefits only qualitative statements were possible for this specific Business Case:

First of all, direct Benefit is the revenue received by selling of the App, this includes one time and re-occurring revenue per customer. Additional revenue could be obtained by adding new features (based on ongoing developments within the market) or adding data from other Mobility Providers to the system (due to extension of the area of operation).

In addition, there are societal benefits by having an App that connects different types of transportation and provides easy and supported Journey Planning with a door-to-door approach, live information on connection and information in case of disruptions and one stop shop for tickets. This approach increases the attractiveness of public transport and makes it easier and more likely to be used. By taking customer needs into account (e.g. needs for persons with reduced mobility, children, women) this Business Case can lead to better support and inclusion of a variety of user groups and allow better connectivity of these people to or within a city or area.

Consequently, this will lead to environmental benefits, as public transport may become the preferred method of transport in the future. This would lead to a reduction of CO_2 emissions and increase of air quality. The economic benefit may be creation of new jobs to support the development and operation of such systems. By pushing this approach further, collaboration and standardization cross-border will become increasingly important and will have significant impact on the success and the implementation of such systems.

6.4.4. Conclusion

The target cost for the proposed Pods system is divided into two segments: the expected initial cost of setting up a system to provide the Pods service can be expected to be around 1.000.000 €. Depending on the functionalities, efforts and technical requirements implemented, the price may vary. The recurring cost of such a system can be estimated at around 900.000 € per year. This amount also depends on the level of maintenance required, as well as the scope of the system, which influences the hosting cost that will occur.

Besides the revenue there are other benefits that should be considered as described in the Fact Sheet. Especially the societal aspects, such as connecting people, inclusion of different user groups (with differences in age, sex, special needs, location, technical affinity), and specific user demand are considered and supported. This may lead to an increase of attractiveness of public transport in general, which will have a positive impact on CO_2 emissions and pushes climate-friendly mobility forward in alignment with the sustainable development goals but also ongoing climate actions in Europe.

6.5. Data Services Company for Pod Systems

6.5.1. Fact Sheet

Business Case Title: Data Services Company for Pods Systems
Short description of the Business Case: Overview: The use of data in the global transport industry has become increasingly important in recent years. Although the exact value of vehicle data is difficult to estimate, there is a consensus that vehicle data has great potential value for a range of related products and services. Vehicle data consists of a large number of data points from a variety of sources. Monitoring is an essential part of any management system; the results of the analysis should be used to improve the business and its characteristics. Monitoring requires the collection of data, its processing and transformation into information, the final information being an important input for the decision-making process. The type of data services according to monitoring as an essential part already exists and is used not only in railway transport, but it is also available for other transport modes (mainly road and air transport). The Pod manufacturer or provider, which is the main actor in this BC, has the objective of not only competing with the existing organisations that provide this type of service, but also of implementing it in a new transport concept (Pod System) in a smooth way and with the degree of innovation and efficiency that the novelty of this transport concept will require. The Pod manufacturer enables Pod System operators to access a wide range of real-time data generated by the autonomous Pods (e.g. data from the Pod currently in operation). This data will be used to optimise operational efficiency, improve safety (e.g. studying past accidents and predicting future accidents), gain a better understanding of the traffic environment and provide high quality services to Pod users to enhance their travel experience. Services may include, among others, travel information services, data storage/cloud provisioning or CCTV services, digital experience monitoring, asset management and data communication services, including passenger services. Data can be used for several goals: • Data services—such as predictive maintenance and data-powered asset management, where value is created through the processing and use of vehicle data. • Connected services—such as entertainment services, where value is created by allowing devices and systems within a vehicle to connect with one another (e.g., smartphone, another vehicle) • Vehicle-based services—such as autonomous driving and digital keys, where value is created through interactions with the vehicle itself The expected business owners will be private companies providing a comprehensive data service for the operation of Pods systems. The service portfolio may include a wide range of services: Real-time data collection through smart sensors and other technologies, real-time monitoring of infrastructure and equipment (railway components and assets), data analysis for predictive maintenance, AI data analysis for

decision making, operational optimisation - traffic management, data storage, CCTV services, Passenger Information Services (PIS), train delay analysis, intelligent driver assistance.
The expected customers are operators (initially focused on rail), infrastructure managers, Pod owners, governments, logistics companies (freight focused) and maintenance companies.

Business owner: Private company providing a comprehensive data service for the operation of Pods systems.

Service portfolio: Real-time data collection through smart sensors and other technologies, real-time monitoring of infrastructure and equipment (railway components and assets), data analysis for predictive maintenance, AI data analysis for decision making, operational optimisation - traffic management, data storage, CCTV services, Passenger Information Services (PIS), train delay analysis, intelligent driver assistance.

Customers: Operators (initially focused on rail), infrastructure managers, Pod owners, governments, logistics companies (freight focused) and maintenance companies.

Why was this Business Case selected?
The primary business focus is not fully clear yet, and the reason why is that the purpose of the Pod System is not given at the current stage of the project. Also, most of the Pods4Rail Business Cases identified do not explicitly refer to the use of railway systems (trains) but show holistic possibilities for the Utilisation of Pod Systems. Also, as many of the determined Pods4Rail Business Cases focus on derived demands that shall be addressed not now but when the Pods system is already implemented (e.g. warehouse storage, entertainment services, cleaning services businesses), a Business Case that was considered important for the construction and implementation of the system was chosen, i.e. for Data Services.

The concept of Data Services includes the main components 1 (Planning), 2 (Operation), 5 (PIS), 6 (Incident Management) that were discussed in D4.4 (even when, in reality, all the components of the system are involved in these services in one way or another). In that sense, we consider this BC as principal between the listed ones to figure out how to implement the Pod System in the future.

Some data that can give an idea of the volume of business are given below.

- The value of vehicle generated data is estimated to be USD 450 to 750 billion by 2030 [22]
- The global market of digital services is expected to more than triple by 2030, to more than US$12 billion [23]
- Automotive Data Service Market size was valued at USD 100 Billion in 2023 and is expected to reach USD 185 Billion by the end of 2030 with a CAGR (Compound Annual Growth Rate) of 9.91% during the forecast period 2024-2030 [23]
- 60 to 70 percent of new vehicles sold in North America and Europe reaching Connected Car Customer Experience (C3X) Level 3 or above by 2030 [24]
- On a per-vehicle level, this equates to up to $310 in revenue and $180 in cost savings per year, on average, in 2030 [24]

Operational scope:	This Business Case addresses both passenger and freight transport. However, the main focus is passenger transport since the necessity of data collection and analysis, and information towards users can be considered, at first steps, higher in this type of traffic. For both of traffics, public and private services are taken in consideration with changes in the different requirements that each of them will demand from the business owner.
Transport mode:	This Business Case focuses on rail transport mode; final conclusions of this analysis can be taken in consideration for similar Business Cases involving other transport modes.
Technology:	• Integration of different transport modes • Data Analytics and IoT for predictive maintenance • Cybersecurity • AI Analytics • Digital platforms • Communications • Cloud computing • Data acquisition • Data transformation, contextualization and sharing
Related Use Case:	The use cases (D4.1) applicable are the following: UC1: Basic Public Passenger UC2: Premium Public Passenger UC3: First Class Public Passenger UC4: Mass Public Passenger UC5: Basic Private Passenger UC6: Premium Private Passenger UC7: Luxury Private Passenger UC8: PRM Application UC9: Ambulance Application UC10: Tourism Application UC11: Transport Service UC12: Shop floor UC13: Rescue UC16: Parcel Delivery UC17: Night Logistics UC18: Container 10/20' UC19: Temp-sensitive Application UC20: Individual Pods Dispatch UC21: Energy Supply Application
Implementation:	The implementation of the proposed case can be achieved through the implementation in a company able to provide the data services. Several

	monetization models and possible types of companied have been considered.
Potential Benefits:	• Reduction of LCC • Reduction of maintenance costs • Reduction of costs caused by delays • Optimization of operations • Increase of availability • provide the same safety level of the railway system • Better network utilization of the railway network • Reduction of the price of the mobility packages • Reduction of operational costs • Increase of customers satisfaction
Challenges:	• The technologies involved are at different stages of maturity, and there is a wide range when it comes to actual connectivity and frequency of uploading data. • Standardisation is also challenging. There are already a number of agreed standards, but there is still a lot of work to do in terms of standardisation so that data can be harmonized across brands, countries, products and companies. • The data privacy aspects are perhaps the biggest challenge. The European market is very careful where data protection is concerned. Since data protection is of the utmost importance to the service providers, this can be seen as an obstacle to the access to the data generated by the vehicle.

6.5.2. Canvas Model

Business Case: Data Service for Pod System Operators			Perspective: Data Services Provider	
Problem	Solution	Unique Selling Point	Unfair advantage	Societal Benefits
• Privacy policy of data (related concerns) • Strict data protection regulations • Security risks (hackers) • Dependency on third-party platforms for data management • Need of high quality and accuracy of data • Significant investments associated with technology implementation, tools, etc.	• Users being informed and consent being asked for • Adequate information phase about the current regulations in force • Strict access controls, methods like encryption and regular security audits to identify flaws in the system • Evaluate and study the reputation of third-party vendors; negotiate adequate contract agreements* • Strategic planning that includes adequate selection of investors and negotiation, tools like ROI calculation, and continuous performance tracking	• Data automation with high quality and accuracy information linked to a new transport mode • Data privacy and its adequate use are assured through a strict procedure and strategy • Real time-monitoring of data and information (e.g. CCTV services and related security)	• Existing infrastructure / superstructure and necessary compatibility with it • The concept of innovative experience and efficient operation must be taken in consideration • Partnerships must be established with railway / signalling operators (etc) to access certain type of data (possible opposition) • The personnel must have a high level of expertise in railway (to consider other modes of transport) operations and data analysis/management	• Optimization of the operational efficient of the system – reducing of the traffic congestion; society gets satisfied with the characteristics of this transport mode • Improvement of the customer service through and efficient PIS (Passenger Information Service) • Improvement of the passengers' and transport's security through an efficient and accurate CCTV system • Creation of new jobs

Key Metrics	Market & Alternatives	Channels	Customer Segments	
• Data quality and accuracy metrics • Regulatory compliance metrics • Passengers' opinions and feedback • Operators and infrastructure managers opinions and feedback • Metrics (accuracy and quickness) compared to other transport modes • Monthly revenues	• Other Data Services Companies that may have experience in the conventional railway sector (or other transport modes' sectors) • New start-ups with ambitious and interesting plans for data management	• Traditional advertising methods • Former customers recommendations (not only for Pods Systems but for similar systems as railways and trams)	• Local authorities; governments • Operators • Owners of the Pods • Infrastructure managers • Logistic Companies (Freight-focused) • Maintainers	

Cost Structure	Revenue Stream
• Costs for compliance with legal regulations, permits, licenses and insurance in terms of data management and privacy • Costs of related technology (selection, purchase, installation, monitorization and maintenance, software) • Staff and personnel costs • Operation costs including the costs related to third-party platforms/investors • Costs related to marketing, advertising and related to passenger information and consents.	• Revenue from subscriptions and memberships of the target customers for providing data services related to Pods Systems • Revenue from data selling to other operators/customers from the same transport mode or others • Consulting services – Management and analysis of data

Eco-Social Cost	Eco-Social Benefit
• Economical concerns related to the important investment that the implementation, operation, maintenance, etc. of the system requires • Concerns in society about their privacy and how their data is being used • Environmental impact found in the associated technology for the services if they are going to use batteries; the disposal of these elements is a concern • Environmental impact if the functioning of some elements of the system depends on non-renewable energy sources • The automation of processes always implies the reduction of jobs; in this case e.g. security personnel, surveys responsible	• Reduction of the numbers of accidents and incidents during the operation of the Pods systems through the implementation of CCTV technology and the correct decision-making based on its compiled data • Improvement of the service performance through an upgrade in the Passenger Information Services and traffic congestion reduction • Efficiency gains and increased competitiveness of this new transport mode. • Environmental benefits through the reduction of carbon emissions. • Social benefits through the connection between rural and remote areas that the Pod System as-a-whole-provides

6.5.3. Benchmark

This Benchmark has been built around the Business Case Data Services for Pods Systems. The aim of this chapter is to identify the key features of this Business Case, the main companies/developers already providing services similar to those being considered, and the possible target costs and benefits, including an explanation of how they have been estimated and where the figures come from. This Business Case is based on the business model concepts known as Data as a Service. According to [25], Data as a Service (DaaS) is a data management strategy that aims to leverage data as a business asset for greater business agility.

For the Benchmark, different data services offered by the railway sector's rolling stock companies [26] [27] [28] as well as by several equipment and service providers in this sector [29] [30] [31] have been studied.

The results of this first analysis allow to identify a wide range of services such as, AI-driven insights, asset management, CCTV solutions, Continuous monitoring of railway components, cybersecurity solutions, data analytics and IoT for predictive maintenance, digital twin technology, intelligent infrastructure, operational analytics and optimization, predictive maintenance using data analytics, remote monitoring and diagnostic, PIS and CCTV, traffic management systems, and train control software. However, they provide limited economic data on costs, revenues or business volumes, and few data on quantitative estimates of potential benefits are available (e.g. maintenance costs can be reduced by up to 15%) [26]

Secondly, several R&D projects under EU and Shift2Rail programmes have been analysed [32, 33, 34, 35, 36, 37]. These projects include extensive technical information, but they also do not provide economic data on business volume, but they do describe potential benefits, as will be included in the next chapter. Their main contribution is the information they define various KPIs. Using these KPIs, it would be possible to identify and quantify the benefits and revenues of this type of service. For several KPIs, some targets are included, such as track LCC: reduce LCC by about 25% over a 25-year time horizon; availability: increase availability by about 30%.

Finally, several reports from strategic consulting companies have been studied [37, 23, 24, 22, 38] Although these reports are focused on the automotive sector, the results are very useful and can be extrapolated to this project, because the Pod System can also operate as road traffic and the business based on .data services can also be perfectly applied to the railway sector.

For the following Benchmark quantitative data are included first, followed by qualitative considerations for Target Cost as well as Target Benefits. The reports developed by several strategic consultancy companies include some data that can give an idea of the volume of business are given below.

- The value of vehicle generated data is estimated to be USD 450 to 750 billion by 2030 [22]
- The global market of digital services is expected to more than triple by 2030, to more than USD 12 billion [23]

- Automotive Data Service Market size was valued at USD 100 Billion in 2023 and is expected to reach USD 185 Billion by the end of 2030 with a CAGR (Compound Annual Growth Rate) of 9.91% during the forecast period 2024-2030 [23]
- 60 to 70 percent of new vehicles sold in North America and Europe reaching Connected Car Customer Experience (C3X) Level 3 or above by 2030 [24]
- On a per-vehicle level, this equates to up to USD 310 in revenue and USD 180 in cost savings per year, on average, in 2030 [24]
- Five in six (83%) of the 305 executives surveyed for the report in [23] told that they believe that digital services will be the key differentiating factors for competitive advantage in the automotive industry by 2040.

As an example of the information extracted from R&D projects, IN2SMART [32] defined several KPI and their objectives related to the intelligent maintenance of assets through integrated technologies. For example:

- LCC of Track: reduce the LCC about 25% in a time horizon of 25 years
- Availability: increase the availability about 30%.
- Process Complexity: reduce the number of steps and communication by 10%

Another idea of quantified potential benefits comes from the data provided by rolling stock and service companies, mainly for data services related to operations, maintenance and asset management:

- Maintenance costs to be reduced by up to 15% [26, 30]
- By combining all relevant data from the entire rail system, the costs caused by delays cab be reduced by up to 40% [26]
- For optimized operations, up to 100% system availability, and up to 10% greater reliability [26]
- Miles per casualty Improved by 60% [30]
- Return on investment < 9 months [30]

Finally, one of the challenges will be the equipment of the vehicle and the infrastructure, including the IT infrastructure. For reference, electronics represent 40% of a new car´s cost [18]. Of course, there is much more to vehicle electronics than this BC covers, but this figure gives an idea of the importance of electronics in today´s vehicle.

From an operational point of view, the direct benefits are numerous: reduction of LCC, reduction of maintenance costs, reduction of delay costs, optimisation of operations, increase in availability, better utilisation of the rail network, reduction of operating costs, reduction in the price of mobility packages and increase in customer satisfaction.

From a technological point of view, data services will contribute to the development and consolidation of new technologies, such as: integration of different transport modes, data analytics and IoT for predictive maintenance, cybersecurity, AI analytics, digital platforms, communications, cloud computing, data collection or data transformation, contextualisation and sharing.

Indirect environmental benefits can also be identified. Emissions can be reduced through the use of data generated by the vehicle. Examples of factors that can reduce emissions include: intelligent routing with less time spent in traffic and more efficient routes, dynamic speed limits or access to live data so that users can travel at less congested times.

In terms of societal benefits, increased safety and comfort for the customer/passenger can be achieved. The use of vehicle generated data has the potential to reduce accident rates. More data will be collected for exposed areas so that safety measures can be implemented at these locations. By collecting a wide range of data, authorities can determine whether, for example, a speed reduction or a change in infrastructure is the best measure to reduce the accident rate. Ultimately, society will be satisfied with the characteristics of this mode of transport and the improvement in customer service.

In terms of economic benefits, data monetisation can generate tangible ROI by selling data to third parties. Data can be sold to data aggregators or data marketplaces that distribute the data. Data can also be sold directly to service providers who offer new products and services based on connected car data, such as pay-as-you-drive insurance.

On the other hand, the data generated by connected vehicles can be used by providers to generate intangible ROI through value-added services, including improved products and services, and internal improvements through increased efficiency through processes and data use.

Several monetisation models can be considered for this Business Case, as indicated in [23]:

- Pure revenue sharing: In the "pure revenue share" monetisation model, the business owner typically has limited resources to develop the necessary capabilities to offer its own digital services but has an attractive customer base that can give it significant negotiating power in partnership with an external platform provider. The companies most likely to choose this monetisation model are those with high volumes in the entry-level price segments, where consumers are highly price-sensitive and attracted to off-the-shelf digital services. Railway operators, car rental companies or car/bus fleet companies may be examples of possible companies that can use this model.
- Full indirect charge: In the “full indirect charge” monetisation model, the business owner offers and includes the cost of the digital services as part of the purchase price of the vehicle. This model is likely to appeal to long-established companies selling large volumes of vehicles in a market where the hardware is easily commoditised and not highly differentiated from competitors. Rolling stock manufacturers or car manufacturers can be examples of this model.
- Full direct charge: This model attempts to charge consumers separately (i.e., over and above the vehicle purchase price) for all digital services. Charging for digital services on a subscription basis would provide them with a recurring revenue stream throughout the vehicle lifecycle, while avoiding the need to increase the purchase price of the vehicle, which could deter price-sensitive consumers. The companies most likely to adopt this

approach are premium and luxury brands, whose smaller but loyal customer base is willing to pay for exclusivity in this price segment. IT companies can serve as an example of this model.

- Hybrid approach: This model combines elements of both the fully indirect and the fully direct models. In this model, companies include most basic digital services in the price of the vehicle and then charge separately for a few 'premium' digital services on a subscription basis, hoping to upscale to a larger user base. The companies most likely to adopt this approach are those whose potential customers are willing to move from free digital services to paying for premium digital services - and who sell enough vehicles to partially scale the cost of all the digital services they provide, both free and premium. IT providers can also be an example of this model.

The data services business also faces several significant barriers. Firstly, the technologies involved are at different stages of maturity, and there is a wide range when it comes to actual connectivity and frequency of uploading data. Second, standardisation is also challenging. There are already a number of agreed standards, but there is still a lot of work to do in terms of standardisation so that data can be harmonised across brands, countries, products and companies. Finally, the data privacy aspects are perhaps the most important. The European market is very careful where data protection is concerned. Since data protection is of the utmost importance to the service providers, this can be seen as an obstacle to the access to the data generated by the vehicle.

6.5.4. Conclusion

The use of data in the global transport industry has become increasingly important in recent years. Although the exact value of vehicle data is difficult to estimate, there is a consensus that vehicle data has great potential value for a range of related products and services.
The company enables Pod System operators to access a variety of real-time data generated by the autonomous Pods. This data is used to a lot of applications, as for example optimise operational efficiency, improve safety and gain a better understanding of the traffic environment. The service spectrum can cover anything from travel information service to data storage/cloud providing or CCTV service, digital experience monitoring as well as asset management and data communication service.
In general, this Business Case is driven by two objectives: to generate revenue or to reduce costs. Players in related, complementary or even non-transport related industries may be interested in using vehicle data to enable use cases for one or both of these purposes, as vehicle generated data offers opportunities for both internal improvement and external data sharing.
Each of the four monetisation models outlined in this report - pure revenue share, full indirect charge, full direct charge and the hybrid approach - can accelerate returns. But to compete in the coming years, POD manufacturers will need to embrace change or be left behind. Hence, this Business Case has a high potential to be successful implemented onto the current market.
This BC was selected based on the general trend that data services are often offered as new business opportunities by new players, independent of established providers (e.g., route optimisation, booking of trips).

6.6. Leasing/Rental Service of Carrier for Public Passenger & Freight Transport

6.6.1. Fact Sheet

Business Case Title: Leasing/Rental Service of Carrier for Public Passenger & Freight Transport	
Short description of the Business Case: Rail Carriers Provider acts as an "interface" between fixed rail infrastructure and TU. It offers a universal rail vehicle to TU owners/providers/users for passenger and freight transport as well. Since the Pods will be used for door-to-door transport, they have to combine both rail and road transport modes (and later also ropeway, air, etc.), and they cannot be permanently linked with one particular carrier. The carriers will circulate in the system and will be available on-demand depending on the planned route. Separation of Carriers from TU can decrease number of carriers circulating in the system, increase their utilization rate, and decrease purchasing costs of the TU for the final customers. Customers are TU owners/providers/users, who generate requests for carriers for transport on the particular route.	
Why was this Business Case selected? The BC is focused on one of the crucial parts of the moving infrastructure – the rail carrier.	
Operational scope:	Public/Private Passenger, Combined and Freight Transport
Transport mode:	Rail (Road)
Technology:	Modularity of the Pods and ability to combine both rail and road carriers for the transport of TU from door-to-door. Carriers will be autonomous electrically driven vehicles, powered from the electrical network on electrified lines or independently from batteries.
Related Use Case:	Carriers should be universal for all use cases UC1-UC24 In particular for Type A (or B) transport modules as described in D4.1
Implementation:	Co-existence with the current transport modes is possible with fulfilling several safety and logistic conditions.
Potential Benefits:	• Modal shift from road to rail. • Door-to-door transport. • Flexibility to combine universal carriers with any Pods leads to better use of the fleet, as there are fewer temporarily unused wagons compared to conventional wagon keepers. • Economies of scale in larger production volumes for the carrier, even though the production of the carrier is more complex
Challenges:	• Capacity of existing lines. • Planning of carrier capacities (storing of unused carrier, logistics, etc.) • Handling of Transport Units • User acceptance.

6.6.2. Canvas Model

Business Case: Leasing/Rental of Carrier for Public Passenger & Freight Transport			Perspective: Rail Carriers Provider	
Problem • Fixed railway infrastructure is operated by a company taking care of the rail tracks, signalling, etc. • The infrastructure is rented by vehicle operators. • Renting is based on various models. Major part is based on vehicle-kilometres travelled. • Travel agents/ travel service providers offers their transportation units to the customers in various modes (public/private transport, tourism, premium transport, parcel delivery, special transport, etc.)	Solution • TU are "independent" on the fixed infrastructure. • Requirements on the TU are defined by purpose (intended end-customer needs) • Carriers are universal vehicles for TU transportation (independent on the end-customer needs). • Partnership with providers of the fixed infrastructure, recharging facilities, etc.	Unique Selling Point • Universal use of the carriers saves number of the units and increases efficiency of the vehicles. • The carries provider can make the operation, all the safety standards easier and cheaper than individual carrier owners. • TU providers do not need to take care of the carrier part of the moving infrastructure. They pay only for vehicle-kilometres they spend. • Operating the fleet of carriers offers more options for increasing the efficiency and flexibility of the system (various users at various destinations). • Booking of the carriers online. • Various rental models for different group of customers (frequent users, random users, etc.)	Unfair advantage • The direct competitor would be conventional wagon owners or providers of complete Pod Systems, i.e. carrier + TU. They have to keep the right wagons / cars available for different purposes.	Societal Benefits • Flexible and comfortable door-to-door transport • Improving accessibility to public transport, especially in areas with limited public transport, • Enhancing mobility and trade in the less populated areas (decreasing of the agglomeration effect) • Reducing traffic congestion and optimizing traffic flow • Reducing number of accidents (injuries and fatalities) due to automated/autonomous driving. • Decreasing the carbon footprint due to higher utilisation of the vehicles • Decreasing of the parking problems in urban areas (more space for living, green, etc.)

• They operate their own or rented/leased TU, and offer the service to the end-customers. • They rent carriers for their TU. • The carriers are universal standardized vehicles adopted for rail or road transport, accepting standardized TU. • They require regular maintenance and renewal, storing, charging, etc. • They must fulfil safety standards, and they are relatively expensive.		• Risk avoidance - customers will always have carriers available • Thanks to the modular approach of the Pod System, the carrier provider can take advantage of the flexibility to combine universal carriers with any Pods. They can use this to make better use of the fleet, as there are fewer temporarily unused wagons compared to conventional wagon keepers. • This can lead to lower costs and therefore greater competitiveness.		• Creating new jobs • Cheaper transportation offers compared to those from providers of Pod Systems (TU+Carrier)
Key Metrics • Number of vehicle-kilometres (frequency of use) • Capacity utilisation of the carriers during each journey • Overall operating costs • Flexibility • Booking trends	Market & Alternatives • Conventional rail and road transport • Providers that offer Pod Systems (TU + Carrier)	Channels • Online booking system for partners (TU providers) • Traditional advertising methods such as posters, flyers, adverts, etc. • Customer Recommendations	Customer Segments • TU providers and owners	

<table>
<tr><td>• Utilization rate of the carriers</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Cost Structure
• Costs for the purchase (or rental) of the carriers
• Costs of the related fixed infrastructure (maintenance, storing, recharging, parking, etc.)
• Operating costs: electricity for the vehicles, maintenance and repairs, insurance, licence fees, vehicle management systems and software and any licence fees.
• Personnel: Costs for system supervisors, if required, as well as for employees in the areas of customer service, maintenance and administration.
• Costs for marketing and advertising
• Investments in technological infrastructure such as booking systems, website development, and other IT tools.
• Costs for compliance with legal regulations, permits, licences and insurance in connection with the operation.</td><td colspan="2">Revenue Stream
• Revenue from carrier rentals
• Revenue from subscription models or memberships
• Revenue from partnerships with TU providers/owners, and fixed infrastructure providers/owners.</td></tr>
<tr><td colspan="3">Eco-Social Cost
• Competition with conventional transportation systems which are already installed (and payed for).</td><td colspan="2">Eco-Social Benefit
• Reduction of accidents and injuries in road traffic by equipping the Pod Systems with advanced safety systems
• Increased efficiency through higher utilization of the carriers
• Reduction of traffic congestion and travel times through optimised routes</td></tr>
</table>

6.6.3. Benchmark

In this Business Case, Leasing/Rental Service of Carrier for Public Passenger & Freight Transport, it is assumed that the Carriers (for both rail and road) will be provided by new or established companies. The following Figure 7 represents a possible integration of a Carrier Provider into the current market.

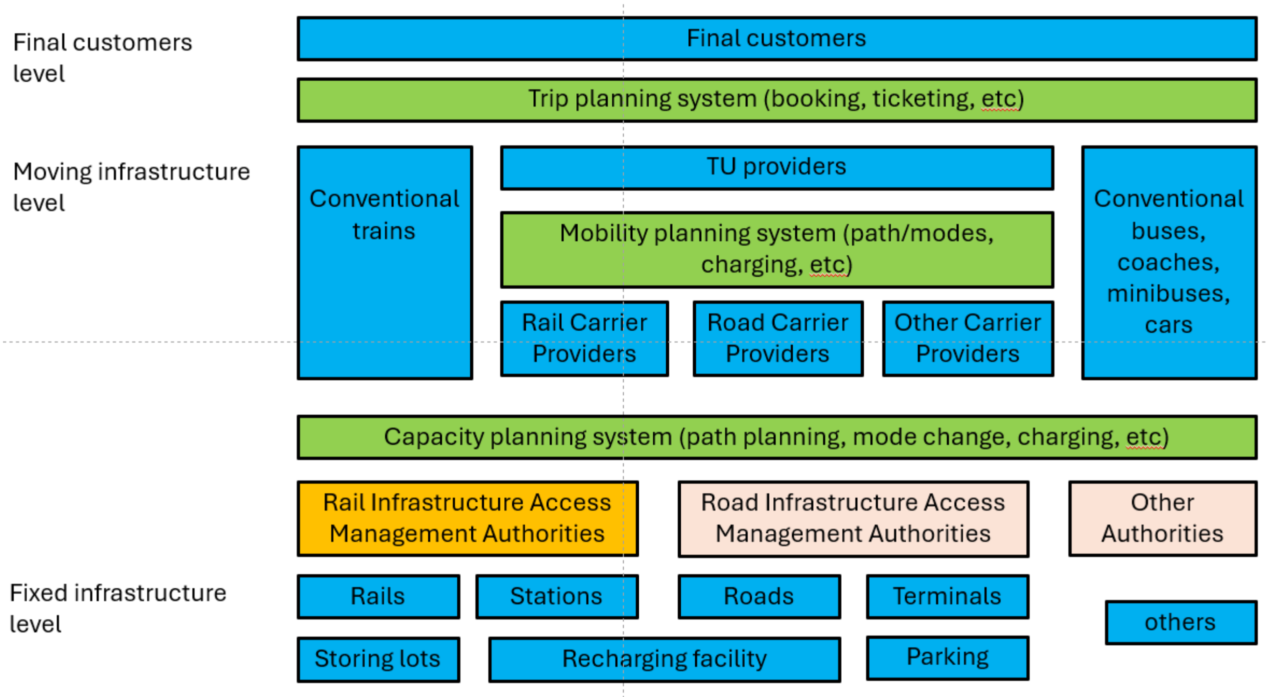

Figure 7: Possible integration of a Carrier Provider into the current market

When considering the benchmark for this business case, it was important to consider that no identical business case currently exists. Comparable business cases would be leasing/rental services for automobiles (as complete transport units) or for locomotives or multiple units. Another key difference lies in the size of the vehicles and the transport capacity.

From the point of view of the building structure respecting autonomous driving, a similarity with Automated Guided Vehicle (AGV)- used in logistics centres can be identified. However, these AGV-usually do not move on rails and their coexistence with existing rail transport is not assumed (e.g. their crash resistance and other safety features). Competing BCs are current rail and road transport (transportation providers). It can be expected that even in this conventional transport there will be changes towards electrification and automation/autonomous driving. The control of access to fixed road infrastructure and its charging will probably be introduced to guarantee road capacity, similar to what is the case with rail transport.

The following tables summarise the calculated target costs (Table 6)and target benefits (Table 7) for this specific Business Case based on the estimates made through the Benchmark.

Table 6: Estimated Target Costs for Leasing/Rental Service of Carrier

Cost Type	Cost Segment	Cost Sub-Segment	Estimation of Target Costs for the specific Business Case
Acquisition costs	Manufacturing	Transport unit	n/a
		Carrier	AGV-like carrier ap.100,000 EUR (estimation based on example given in D5.1).
	Equipment	Interior fittings, entertainment systems, etc.	n/a
	Research and development (R&D)	Software development	Traffic management, mobility planning, etc. (costs are unknown)
		Sensor technology	Sensorics' systems for the autonomous driving, identification of the vehicles, planning and logistics, etc. Assuming that autonomous transport is common in 2050, and that rolling stock safety systems continue to improve, this Business Case will not generate any additional requirements and costs beyond the systems currently in use and installed.
Operating Costs	Energy consumption	Costs for electricity, depending on the frequency of use and energy prices.	Based on the cost framework and example from Germany (D5.1) an estimate ap.15% of annual operational costs were made (current share in annual operational costs is 12-13%, and slightly higher circulation of the carriers and vehicle-kilometres travelled are expected). Also, Energy consumption depends on other things such as the design of the Pod and the propulsion system etc.
	Operation, maintenance and repairs	Regular maintenance, software updates, etc.	Based on the cost framework and example from Germany (D5.1) an estimate was made: - ap.10% of annual operational costs for vehicle maintenance and renewal.
	Insurance	Insurance costs for autonomous driving and liability insurance.	unknown

Infrastructure Costs	Charging points	Construction and maintenance of charging stations, especially in holiday regions and heavily frequented areas.	This Business Case assumes an electrified track as the energy source for the vehicle. This electrical energy can also be used to charge backup batteries (in case an independent drive is needed) while driving. No extra charging points are needed in this case.
	IT infrastructure	Costs for networking, data transmission and ensuring cyber security.	unknown
	Swap Body infrastructure	Construction and maintenance of Swap Bodies for transfer to other modes of transport	Fees for access to transhipment services in terminals. It is assumed that the vehicle will be equipped with a low-capacity loading and unloading system for handling TU in places with low traffic, where it is not worthwhile to build a large-capacity TU transfer stations. In terminals with a large capacity, a fixed infrastructure will be used for the handling of TU. The costs of these transactions are likely to be included in the terminal usage fees – station charges. However, their amount cannot be estimated at the moment (current share of the station charges is a Pod.8% of annual operational costs).
Other Costs	Personnel costs	Personnel are required for monitoring operations, technical support and customer care. Training required for maintenance and operation.	Administration, booking, supervision, interventions in critical situations, etc. Assumptions: autonomous driving, automated booking, path planning, outsourcing of repairs and maintenance. Based on the cost framework and example from Germany (D5.1) an estimate ap.28% of annual operational costs were made (current share in annual operational costs is in range from 19 to 38%, a decrease a Pod. 6% can be expected due to autonomous driving)
	Regulatory costs	Costs for authorizations and compliance with legal regulations.	Unknown. Costs vary depending on the region and the complexity of the legal framework.

	Other Cost		Based on the cost framework and example from Germany (D5.1) an estimate was made: From 16 to 32% of annual operational costs for charges incurred for the train path access (depending on the ratio freight / passenger transport and vehicle-kilometres)

Table 7: Estimated Target Benefits for Leasing/Rental Service of Carrier

Benefit Type	Benefit Segment	Benefit Sub-Segment	Estimation of Target Benefits for the specific Business Case
Direct Benefits	Revenue	e.g. from sales and rental	Revenues are generated by providing transport services (carriers) to end users, i.e. owners or tenants of TU. The amount will depend on the number of vehicle-kilometres. It can be advantageous, for example, by the frequency of transport, etc. (subscription, vouchers, etc.)
	Additional Revenue		unknown
Indirect Benefits	Environmental benefits	e.g. reduction of CO_2 emissions	The vehicles in the Pods system will be electrically powered, so a significant reduction in CO_2 emissions can be expected compared to the current state. However, it should be noted that it is reasonable to expect that in 2050 all or almost all rail vehicles will be electrically powered.
	Cost Savings	e.g. savings through lower operating costs	Due to the higher rate of use of the carriers (circulation and use together with various Transport Units TU), a higher efficiency of the initial investment for the purchase of the vehicle can be assumed.
	Societal Benefits	e.g. increased safety and comfort for customer/passenger	Door-to-door transport. Decreasing of non-productive time losses and increasing of travel comfort and safety due to autonomous transport and reduced need for changing modes/vehicles, walking and waiting between connections. Reduction of accident costs and congestion by partial modal shift from road to rail (mainly for passenger cars).

External Benefits	Economic benefits	e.g. creation of new jobs	It can be assumed that, as a result of autonomous driving, the positions of "driver" will disappear, and new positions of "operator/supervisor" will be created. In connection with automatic check-in, for example, the position of "train guide" will disappear and another position will be created to oversee check-in at the station, etc. However, this development can also be expected in conventional transport systems.
	Technology benefits		unknown
	Other Benefits		unknown

6.6.4. Conclusion

The cost estimates listed above are based on the current regionally specific data listed in the cost framework in D5.1. [2] It should be considered, that the calculations are only a very rough estimate, which for other locations will depend on many unpredictable factors (local commodity prices, Gross domestic product (GDP), average wages, legislation, tax burden, support from public sources, political decisions, etc.)

However, to forecast the economic success of this Business Case attention must be place to the level of acceptance of Pods systems by end users. Separating the carrier from the transport unit can be attractive to TU owners/renters as they only purchase/lease unpowered transport unit, the carriers are shared and leased as needed. This will significantly reduce their acquisition/lease costs. On the carrier operator's side, one can expect a higher rate of vehicle utilization (transportation of passengers and goods, higher circulation of carriers, greater transport capacity) and thus a faster return on the investment in the purchase of the vehicle.

In addition, the availability of door-to-door shared transport capacity can lead to a change in population behaviour (vehicle ownership) and thus a reduction in the number of private vehicles in metropolitan areas (reduction in parking requirements and potential increase in green space). A substantial part of the benefits lies in an area that is either difficult to monetize (increased passenger comfort and satisfaction, door-to-door transport, etc.) or belongs rather to global benefits for society. The most important of them are on the one hand increasing of safety and decreasing of accidents, fatalities and following costs - health care, etc and on the other hand decreasing of congestion and related time losses. Global changes in transport (e.g. electrification, autonomous driving), but also e.g. reduction of road transport by transferring part of it to railways (door-to-door transport using the Pods system) will contribute to increasing these social benefits.

The indicative quantification of these benefits can be estimated from the tables 10, 14 and 15 in document D4.3 [39], which list the costs of congestions and accidents converted to passenger-kilometres and tonne-kilometres for rail and road transport.

In conclusion, for this Business Case it was impossible to quantify the direct economic impacts at this stage of the project due to the lack of knowledge of the details of the vehicle construction, transport capacity, future fixed infrastructure development, etc. A more accurate estimate might be possible in the later stages of the project.

6.7. Leasing/Rental Service of Transport Units for Emergency Medical Services

6.7.1. Fact Sheet

Business Case Title: Leasing/Rental Service of Transport Units for Emergency Medical Services	
Short description of the Business Case: This Business Case is about a rental platform for emergency equipment. The business owner is a rental company that offers transport units for emergencies as part of its service portfolio. The TU is equipped with the appropriate payload (for the current situation) and rented or leased to customers. Customers include such organisations as the Red Cross, fire brigades or technical relief organisations.	
Why was this Business Case selected? The UC was chosen to enable a very important and cost-relevant business. Sharing and leasing of trains and locomotives is the most important business driver for private railway investors today. In the future there will be a need for shared use of infrastructure and rolling stock, especially in niche markets such as "emergency and time-critical freight". Therefore, this business case will be on the one hand a future model of how efficient networks in rail transport can be operated and maintained, and on the other hand how a modern network can be financed.	
Operational scope:	Passenger transport & Freight transport
Transport mode:	Road, Rail, Air and Water
Technology:	Autonomous driving and operation in remote areas as well as high payload capacity (TU in the size of standard 10ft and 20ft)
Related Use Case:	UC13: Rescue application UC14: Housing application UC15: Event application UC20: Individual Pods Dispatch UC21: Energy Supply Application
Implementation:	• Service could be offered as free trails for non-governmental organisations (NGO´s). • Proof of concept could be used as an additional service for emergencies. • Service could be included in Go2Market - with low entry fees
Potential Benefits:	• Affordable high-end emergency equipment for all kind rescue organizations • Ready to use anytime, anywhere • No service duties for customers • No investment in stationary equipment
Challenges:	• To Convince local organizations to use a platform for the required equipment instead of buying it by their own.

6.7.2. Canvas Model

Business Case: Rental/Leasing of TU for Emergency Medical Services			Perspective: Leasing Provider	
Problem • Long and complex process to bring heavy goods & services like ambulance / first responder equipment to remote locations where help is urgently needed (earthquake, pandemic situation, ...) • The equipment is not used frequently and will invest a lot of cost to emergency organizations instead of just using when it's needed	Solution • TU will be equipped with relevant payload (for current situation) and leased or rented to customers (first responder organizations – where help is needed) • Used in an emergency pool of vehicles	Unique Selling Point • Sending equipment on TU to mission where imminent support is needed. • Very high payload possible (i.e., MRT device for mobile ambulance, electric generator, freshwater purification system, etc.) • Low CAPEX for costumers due to "Abo model"	Unfair advantage • Heavy equipment can be transported very easily to different location (earthquakes, military zones, ambulance in pandemic situations...) • Critical situations can be exploited	Societal Benefits • Fast and efficient help (where help is urgently needed) • Service will be managed
Key Metrics • Delivery time and capacity from storage to point of action • Monthly fee per costumer	Market & Alternatives • Africa • NAM, SAM • Partly EUR • Global (where instant help is needed)	Channels • Sales / Leasing model for organizations • Network of first responders • Military networks • Civil rescue organizations	Customer Segments • Public organizations (Red cross) • Government (Military) • NGO's	

Cost Structure • Acquisition cost for TU • Cost for service and maintenance of equipment	Revenue Stream TU will be leased / rented to costumer: • Model 1) Fee per month (Abo-style) for a long period (10yrs) —> lower rates • Model 2) Fee for unexpected request occasionally —> higher rates • Frequent Cash flow with “Abo” model
Eco-Social Cost • Reduction of resources and CO_2due to less vehicles and better efficiency	Eco-Social Benefit • Low cost for Rescue organizations or governmental organizations • Emergency organizations can use the money where is mostly needed

6.7.3. Benchmark

Nowadays, the process of getting heavy goods and services such as emergency ambulance/first aid equipment to remote locations where help is urgently needed in the wake of earthquakes, pandemics, etc. is long and complex. The equipment is often not used and causes high costs for emergency organisations.

As part of this Business Case, Transport Units will be equipped with the appropriate payload (for the situation at the time) and rented or leased to customers such as rescue organisations (where help is needed). The following Figure 8 illustrates a potential version of this type of TU.

Figure 8: Pod System for Ambulance and First Responder, Source: Siemens/Moodley [40]

The following Benchmarks were found to be comparable to the Transport Units TU described in this Business Case:

- The HydroSub 1200 is a water-cooled diesel hydraulic pump aggregate that allows access to open water. [41]
- The Hytrans Fire System which are mobile hydraulically driven submersible pumps for water supply at a higher level for fire brigades, civil defence and emergency services. [42]
- Container for fire brigade operations. [43]

The following tables summarise the calculated target costs (Table 8) and target benefits (Table 9) for this specific Business Case based on the estimates made through the Benchmark.

Table 8: Estimated Target Costs for Leasing/Rental Service of Transport Units for Emergency Medical Services

Cost Type	Cost Segment	Cost Sub-Segment	Estimation of Target Costs for the specific Business Case
Acquisition costs	Manufacturing	Transport unit	<50,000 Euro [49]
		Carrier	n.a.
	Equipment	Interior fittings, entertainment systems, etc.	Strongly depending on situation (estimation: between 10k and 1 Mio).
	Research and development (R&D)	Software development	Included in Costs for Manufacturing.
		Sensor technology	Included in Costs for Manufacturing.
Operating Costs	Energy consumption	Costs for electricity, depending on the frequency of use and energy prices.	Costs depending on the results of WP7 (currently not available)
	Operation, maintenance and repairs	Regular maintenance, software updates, etc.	20 years of operating time and service. Most of these relate to the equipment on board (e.g. water treatment, power generator, ...).
	Insurance	Insurance costs for autonomous driving and liability insurance.	n.a.
Infrastructure Costs	Charging points	Construction and maintenance of charging stations, especially in holiday regions and heavily frequented areas.	Not required (as there will be an onboard generator).
	IT infrastructure	Costs for networking, data transmission and ensuring cyber security.	n.a.
	Swap Body infrastructure	Construction and maintenance of Swap Bodies for transfer to other modes of transport	Costs depending on the results of WP13 (currently not available)

Other Costs	Personnel costs	Personnel are required for monitoring operations, technical support and customer care. Training required for maintenance and operation.	Only for Service / Cleaning/ Checking: 0,2 FTE TU will be managed by NGO's personal (e.g. volunteer fire brigade)
	Regulatory costs	Costs for authorizations and compliance with legal regulations.	n.a.
	Other Cost		n.a.

Table 9: Estimated Target Benefits for Leasing/Rental Service of Transport Unit for Emergency Medical Services

Benefit Type	Benefit Segment	Benefit Sub-Segment	Estimation of Target Benefits for the specific Business Case
Direct Benefits	Revenue	e.g. from sales and rental	Fee: depending on technical equipment, e.g. Fire brigade 10k p.a. for earthquake equipment
	Additional Revenue		n.a.
Indirect Benefits	Environmental benefits	e.g. reduction of CO_2 emissions	Lots of technical equipment for special operations can be reduced CO_2 reduction due to reduction of resources
	Cost Savings	e.g. savings through lower operating costs	Cost savings e.g. for Fire truck ~ 500 k [50] Fee model with an annual fee of 10 k p.a. In 15 yrs.: 150 k Leading to cost savings of approx. 350k
	Societal Benefits	e.g. increased safety and comfort for customer/passenger	Fast and efficient help (where help is urgently needed) Low cost for Rescue organizations or governmental organizations
External Benefits	Economic benefits	e.g. creation of new jobs	Reduction of investment cost for the public and NGO due to a sharing approach
	Technology benefits		The leasing contract will guarantee the latest technology in the related field of application (e.g., firefighting) and the

			equipment is fully serviced and ready to use.
	Other Benefits		Heavy equipment can be transported very easily to different location (earthquakes, military zones, ambulance in pandemic situations…)

6.7.4. Conclusion

Through the Benchmarks as well as the analysis of the possible Target Cost and Target Benefits, this Business Case has shown to be the best choice when it comes to very expensive equipment that is not used frequently (only in emergencies).

The sharing model will reduce the impact of investments and provide organisations with perfectly maintained equipment anytime, anywhere. Equipment stored in the garage of emergency organisations will be used efficiently thus reducing the environmental impact. However, it should be considered that the level of demand and therefore the price of renting/sharing a TU would increase significantly as soon as a catastrophe occurs. For this reason, it is advisable to reconsider whether NGO would prefer to purchase or to lease rather than to temporarily rent/share.

In conclusion, this Business Case identifies great potential in the successful implementation of Pod Systems for stakeholders specifically operating in this segment.

6.8. Leasing/Rental Service of Transport Units for Tourism, Events and Leisure

6.8.1. Fact Sheet

Business Case Title: Leasing/Rental Service of Transport Units for Tourism, Events and Leisure	
Short description of the Business Case: This Business Case is focused on an innovative business model in which City Tour or Concert Organisers can offer specifically equipped TU to their customers for rental. The TU are suitable for a wide range of purposes, whether for city tours, concerts or business trips, and offer target group-orientated features. The equipment on board can be customised e.g., for (children´s) birthday parties, graduation parties, stag and hen parties, wedding parties, anniversaries, cultural events, sporting events, music and art festivals, city tours and much more. Accordingly, the TU are specially designed and equipped depending on the customers age such as interactive games for children or relaxing music for senior citizens as well as depending on the purpose of their trip such as headphones with digital city guides for city tours or customised lighting, special music and special drinks for concerts.	
Why was this Business Case selected? This Business Case was selected, because autonomous customised TU can revolutionise the travel and event sector and offer an improved experience for both organisers as well as passengers. By providing customised equipment such as child seats or entertainment systems, TU offer a high level of comfort. In addition, attractive transport options promote tourism, and the barrier-free design ensures access for everyone, including people with reduced mobility. The Business Case is therefore ideal from an economic perspective, e.g. by promoting tourism and sponsoring local businesses, as well as from a social perspective, e.g. through easy access to TU, community events and functions can be better attended and promoted.	
Operational scope:	Public/Private Passenger Transport
Transport mode:	Road, Rail, Air, Water
Technology:	Customisation of TU, WLAN, digital guides and entertainment systems, Door2Door and optimised route planning.
Related Use Case:	Use Case 2: Premium passenger private transport Use Case 3: First class passenger public transport Use Case 7: Luxury Passenger Transport Use Case 8: PRM Application Use Case 10: Tourism Application Use Case 15: Event Application
Implementation:	Implementation can be achieved by integration into existing transport systems and through targeted partnerships: Cooperation's with public transport and organisers of concerts, trade fairs and amusement parks enable to use the TU as shuttle or pick-up services. Through cooperation with local tourism organisations, the TU can be used for city tours or as a means of transport between sights. Marketing campaigns and target group-specific advertising can be applied to raise public interest and

	awareness of the customised TU. A user-friendly app or website facilitates booking and planning, while integrated payment options simplify the process. Customer feedback helps to continuously improve the service and adapt it to their needs. Compliance with necessary safety standards and legal regulations must be coordinated with authorities.
Potential Benefits:	• Depending on the traffic situation, the TU will determine optimal routes for the journey through Door2Door as well as precise timetables while operating on different transport modes. • Due to customised equipment TU offer a high level of comfort for first class transport or at the level requested by the customer • Advanced sensors and algorithms minimise accident risks and ensure increased safety, while additional safety features can be integrated specifically for children and elderly passengers. • Drivers are not needed, leading to cost savings. • Through intelligent route planning energy consumption can be minimised, making the Pod System environmentally friendly. As the Pods are electrically powered, CO_2 emissions can be reduced.
Challenges:	• Research needed to determine customised equipment for TU • Customer acceptance of new technology may initially be limited • Intense competition with established transport services • High investment in technology and vehicles required • Integration into existing transport systems requires careful planning • Regulatory challenges

6.8.2. Canvas Model

Business Case: Leasing/Rental Service of Transport Units for Tourism, Events and Leisure			Perspective: Leasing/Rental Provider	
Problem • Pressure on traditional travel agencies from online platforms (wide range of transport options at competitive prices) • Variety of transport options and booking of different transport solutions make planning and booking trips difficult • Prices for transport services differ significantly • Availability of transport services depends on demand and season • Growing number of tourists/travellers emphasise environmentally friendly transport options • Customers have different preferences regarding transport, such as convenience, time savings, cost and environmental sustainability, making it difficult for transport companies to meet the needs of all customers.	Solution • With Pods: More flexible travelling options • Integration of Pods into booking and planning systems: organising travel routes becomes much easier (Door2Door) • Seamless and convenient travel (no need to change modes) can strengthen customer relationships • Pods can meet the needs of increasingly environmentally conscious travellers and fulfil customer requirements due to customised equipment on board.	Unique Selling Point • Travel agencies can seamlessly integrate Pods into their travel planning and booking systems to offer their customers a comprehensive and optimised travel experience. • Pods can consider individual passenger preferences and offer personalised routes or provide specific recommendations based on travellers; interests and needs. • Pods can be equipped with specialised equipment depending on the purpose of the journey	Unfair advantage • Use of Pods can improve the overall travel experience not only on road but also on rail, which has a positive impact on customer satisfaction • Unique and innovative travel experience can increase customer/brand loyalty • Quick and easy organisation of transport options, especially in the premium sector	Societal Benefits • Enhancing mobility for People with Reduced Mobility (barrier-free and accessible transport solution) • Improving accessibility to public transport, especially in areas with limited public transport • Pods can save travellers time and allow them to see and experience more of their destination. • Pods offer a high level of safety, especially for travellers in new surroundings.

Key Metrics	Market & Alternatives	Channels	Customer Segments	
• Number of journeys per day (frequency of use) • Capacity utilisation of the Pods during each journey • Customer satisfaction: quality, convenience and reliability • Operating costs per journey • Revenue per journey (e.g. through ticket prices or other sources of income such as advertising or partnerships) • Punctuality and reliability of the Pods • Uptime and maintenance intervals • Booking trends	• • For Tourism purposes: o Travel/Tour Bus o Sightseeing Bus • For Event purposes: o Event Bus o Limousines for Events	• Integration into known online travel booking sites and platforms • Own website or mobile app • Social media • Cooperation with hotels, airlines, event venues, congress centres, etc. • Traditional advertising methods such as posters, flyers, adverts, etc. • Customer Recommendations	• Tourists, families, group travellers (e.g. a wedding party or corporate event) or elderly travellers looking for an easily accessible and barrier-free transport solution for city trips or holiday destination. • Events Visitors: People attending events such as concerts, sporting events or festivals who need a reliable way to move between locations.	

Cost Structure	Revenue Stream
• Costs for the purchase or rental of Pods • Operating costs: electricity for the vehicles, maintenance and repairs, insurance, licence fees, vehicle management systems and software and any licence fees for autonomous technology. • Personnel: Costs for Pod supervisors, if required, as well as for employees in the areas of customer service, maintenance and administration.	• Revenue from ticket sales • Additional Revenue: o from advertising or sponsorship o from premium services or upgrades such as express journeys, luxury vehicles, group reservations, luggage service or special journeys o from subscription models or memberships o from partnerships with hotels, airlines, venues, etc.

• Costs for marketing and advertising • Investments in technological infrastructure such as booking systems, mobile apps, website development, data analyses and other IT tools to manage shuttle operations. • Costs for compliance with legal regulations, permits, licences and insurance in connection with the operation of autonomous vehicles.	
Eco-Social Cost • Indirect environmental impact, e.g. through the manufacture and disposal of batteries and the energy consumed during charging. • Traffic congestion: When public transport user switch to Pod Systems • Reduction of Jobs for drivers of traditional transport modes, which could lead to social challenges such as unemployment and economic insecurity.	Eco-Social Benefit • Reduction of air pollution through electrically powered Pods leads to improved air quality and reduced health risks for the population • Pods as an environmentally friendly transport option can reduce the carbon footprint of travellers. • Reduction of accidents and injuries in road traffic by equipping the Pod Systems with advanced safety systems • Increased efficiency through shared journeys • Reduction of traffic congestion and travel times through optimised routes • Economic advantage: cost-efficient operation of Pods (no driver needed) • Creating new jobs in technology development and for the maintenance and operation of Pods

6.8.3. Benchmark

For the benchmark, it should be noted that there are currently no Business Cases on the current market which are identical to the one described here. While there are various comparable transport services for events, leisure activities or tourist purposes, these usually focus on passenger transportation by road. There are also providers who offer city tours by tram or cable car, however these are usually exceptional.

In order to be able to carry out a target cost estimate for this Business Case, Benchmarks were identified that are located on the German market and whose focus is on customising their vehicles for leisure, event and tourism activities. Common examples of such transport services are tour buses, and sightseeing buses [44]as well as party buses and specially equipped limousines for all kinds of luxury events. [45] [46].

In the Benchmarks identified the companies are mostly aimed at private customers who want to celebrate special occasions such as birthday parties, stag parties, weddings, anniversaries, company celebrations, parties and corporate events a premium to luxury ride with a strong focus on musical experiences and entertainment. Thereby the Business Model is based on the hourly or daily hire of high-quality and customised equipped vehicles. In addition to vehicle hire, the companies also offer additional services such as chauffeur services, decorations and special event packages that include individual decorations, drinks and special entertainment options depending on the customer's wishes.

The following assumptions have been made for the target cost estimation of companies that offer customised TU for hire:

- TU are rented for city trips, events, conferences, large events to individuals, tourists, event visitors, companies, etc
- There are specialised pods for different needs (e.g. luxury pods, family pods, event pods, etc.)
- The TU are operated and maintained by the company, the carriers are provided by the city.
- No chauffeur/driver is required, but service personnel can be hired.
- A maximum of 15 people can be seated in the TU

The following tables summarise the calculated target costs (Table 10) and target benefits (Table 11) for this specific Business Case based on the estimates made through the Benchmark. However, it should be considered, that for this Business Case only qualitative statements can be given w.r.t Target Cost as the technical framework of the TU is not clear at the moment.

Table 10: Estimated Target Costs for Leasing/Rental Service for tourism, events, leisure

Cost Type	Cost Segment	Cost Sub-Segment	Estimation of Target Costs for the specific Business Case
Acquisition costs	Manufacturing	Transport unit	Production costs of 15,200 euros per TU can be expected per transport unit (see D5.1) As the Company will purchase the TU on its own, acquisition costs can be expected to be between EUR 19,000 and EUR 21,000 per TU. (see D5.1)
		Carrier	Assumption: The cities will provide the carrier for shared use. In return, a monthly/annual usage fee is charged.
	Equipment	Interior fittings, entertainment systems, etc.	Standard Equipment included in Manufacturing Cost The cost of interior design can vary significantly depending on a number of factors such as: • the range of materials required e.g., premium leather seats in luxury pods, standard leather seats in Event-Pods and seats with fabric for minor events. • the equipment on Board: Audio and video systems, lighting, cooling and heating systems for seats, specialised electronics etc.
	Research and development (R&D)	Software development	Research needed to determine customised equipment for TU, Investments in technological infrastructure such as booking systems, mobile apps, website development, data analyses and other IT tools to manage shuttle operations.
		Sensor technology	
Operating Costs	Energy consumption	Costs for electricity, depending on the frequency of use and energy prices.	Energy is required for the equipment on board.
	Operation, maintenance	Regular maintenance,	The operating costs could be in the range of the operational costs for autonomous mini

	and repairs	software updates, etc.	buses. According to D5.1, these would be between €2.51 - €15.69 per kilometre depending on operating time, speed and service personnel on board. In comparison to a classic diesel-powered minibus (Mercedes Benz Sprinter City 75 L), whose operating costs are €3.21/km (see D5.1), lower operating costs can be assumed. In particular, considering the fact that the TU have no other major operating costs apart from cleaning, provision of equipment and maintenance of the TU as well as the payment of the fee for the use of the carriers.
	Insurance	Insurance costs for autonomous driving and liability insurance.	Costs for compliance with legal regulations, permits, licences and insurance in connection with the operation of autonomous vehicles.
Infrastructure Costs	Charging points	Construction and maintenance of charging stations, especially in holiday regions and heavily frequented areas.	n.a.
	IT infrastructure	Costs for networking, data transmission and ensuring cyber security.	n.a.
	Swap Body infrastructure	Construction and maintenance of Swap Bodies for transfer to other modes of transport	n.a.
Other Costs	Personnel costs	Personnel are required for monitoring operations, technical support and customer care. Training required for maintenance and operation.	Personnel: Costs for pod supervisors, if required, as well as for employees in the areas of customer service, maintenance and administration.
	Regulatory	Costs for	Costs for compliance with legal regulations,

	costs	authorizations and compliance with legal regulations.	permits, licences and insurance in connection with the operation of autonomous vehicles.
	Other Cost		n.a.

Table 11: Estimated Target Benefits for Leasing/Rental Service of TU for tourism, events, leisure

Benefit Type	Benefit Segment	Benefit Sub-Segment	Estimation of Target Benefits for the specific Business Case
Direct Benefits	Revenue	e.g. from sales and rental	Most of the revenue is generated by the rental fee for TU on an hourly basis. Based on the benchmarks found, a rental fee of 100 to 500 euros per hour can be assumed, depending on the vehicle model and equipment.
	Additional Revenue		Extras such as drinks, decorations and special music or lighting systems can incur additional revenue, which can range from 50 to 200 euros per service. Other additional revenue such as revenue from advertising or sponsorship are also to be considered, however no quantitative data was found.
Indirect Benefits	Environmental benefits	e.g. reduction of CO_2 emissions	The possibility of TU using the railways for tourist purposes may enable a modal shift from road transport to rail.
	Cost Savings	e.g. savings through lower operating costs	No driver is needed for the TU.
	Societal Benefits	e.g. increased safety and comfort for customer/passenger	Increased efficiency through shared journeys also leads to a reduction of traffic congestion and travel times for the customers through optimised routes not only via road but also via rail.
External Benefits	Economic benefits	e.g. creation of new jobs	Personal for on board service can be booked.
	Technology benefits		n.a.
	Other Benefits		n.a.

6.8.4. Conclusion

In conclusion, this Business Case focuses on Premium Transport as it is currently offered by means of Limousines, Party Buses and higher quality Shuttles.

Compared to conventional transport options for events and leisure activities, the acquisition costs for the Pod Systems will play a key role, as they can be more cost-effective depending on the vehicle selected. While the acquisition costs of (used) stretch limousines range between 13,000 and 70,000 EUR [47], the acquisition costs for a newly manufactured TU would be around 19,000-21,000 EUR. Even in comparison with travel or tour busses (mini busses), not only lower acquisition costs can be expected, but also significantly lower operating costs, as a TU does not require a driver or a chassis unit.

Another significant cost factor in this Business Case is the customised equipment of the Pods. However, a comparison with the Benchmarks revealed that various equipment options are already available which are more or less the same as the equipment of the TU described in this Business Case. Therefore, the costs should be expected to be within the same range.

Overall, this Business Case demonstrated that there is potential for Pod Systems to be implemented in the event and leisure sector, especially as current transport options in this sector are mainly focused on road transport. Pod Systems would also allow rail transport to be brought into the focus of event and leisure transport, especially in a tourist context such as for city trips. However, it should be noted that the quantitative statements given above are only based on an initial estimate as best as possible at this stage of the project. Even if this Business Case has potential for successful implementation on the market, making a specific statement on the implementation of the Business Case is currently not possible, as additional factors are required for this, particularly with regard to customer acceptance and interest on the part of stakeholders.

7. Summary and Recommendations

By specifying selected Pods4Rail Business Cases using Fact Sheets and subsequently analysing them using Business Model Canvas, a comprehensive impression of the capabilities and potentials of the Pod Systems with regard to the respective Business Case was provided. Based on the results of this Business Case Analysis, a Benchmark was conducted to assess the overall picture of the feasibility of the Pods4Rail Business Cases for different stakeholders as well as customers. Thereby, the overall focus of Task 5.2 was to generate a plausible impression of how feasible and successful the integration of the selected business models into the current market might be given qualitative statements on the costs and benefits of the Pods4Rail Business Cases. For this purpose, the Business Case Study did not only concentrate on determining costs, rather it considered these in an overall context along the benefits.

To summarise, the selected specific Business Cases provided detailed insights into the implementation of Pod Systems for various stakeholders as well as for several Use Cases. Despite the differences in the specific Business Cases, all Business Cases had positive results in common: The implementation of Pod Systems in all analysed specific Business Cases indicated a high potential for Pod Systems to be successful in the current market. Nonetheless, it is highly recommended to carry out a more detailed analysis of the Business Case feasibility at a later stage of the project, when the technical framework of the Pod Systems is clearer, in order to obtain a more precise assessment of the Business Case feasibility.

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Appendix

Appendix 1: How to fill out the Sustainable Lean Model Canvas

<table>
<tr><td colspan="6">Perspective: Who is the business owner & which business model is/will be marketed?</td><td colspan="4">Business Case: Identification Number of the BC</td></tr>
<tr><td colspan="2">Problem:

Which problems does the business owner face with his current product or service?

→ List the 5 Top Problems of the Business Owner.</td><td colspan="2">Solution:

In order to minimise/eliminate the problems, what solutions are available?

→ Outline a possible solution for each problem.</td><td colspan="2" rowspan="2">Unique Selling Point:

Which benefits will arise by adapting the new product or service with the identified solutions? (Both from an economic and a societal view)

→ Describe the top features of the solutions that highlight why the new product or service is different and worth paying attention to.</td><td colspan="2">Unfair Advantage:

Which fixed, non-modifiable or hard-to-change conditions/circumstances need to be taken into account for the implementation of the new product or service?

→ Describe the circumstances.</td><td colspan="2" rowspan="2">Customer Segments:

Who are the potential customers of the new product or service?

→ List the product or service target and users.
→ Add the possible Use Cases (WP4, T4.1)</td></tr>
<tr><td colspan="2">Key Metrics:

With which measurable indicators is it possible to evaluate the impact of the product or service?

→ List the key numbers that tell how the business is doing.</td><td colspan="2">Market&Alternatives:

Which alternatives are available on the current market?
→ List how these problems are/can be solved today.</td><td colspan="2">Channels:

How can potential customers for the new product or service be addressed?

→ List the channels to customers.</td></tr>
<tr><td colspan="5">Cost Structure:

Where will costs arise for the business owner when implementing the new product?

→ List all fixed, variable and external costs (qualitatively).</td><td colspan="5">Revenue Stream:

How can revenue be generated for the new product or service?

→ List the sources of revenue (qualitatively).</td></tr>
<tr><td colspan="5">Eco-Social Cost

What ecological or social cost is the business model causing?

→ List all eco-social costs (qualitatively).</td><td colspan="5">Eco-Social Benefit

What ecological or social benefit is the business model generating?

→ List all eco-social benefits (qualitatively).</td></tr>
</table>