Deliverable D 5.1
Report on (a) Generic Business Case Elements

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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 homologated transport unit for passengers and goods and a separate specific carrier unit. [1] As part of Work Package 5 (WP5), Business Cases are to be developed and analysed with the aim to examine the economic feasibility of the proposed Pods4Rail System both for passenger and freight transport.

In Task 5.1 of Work Package 5, the basis for the development of Pods4Rail Business Cases were laid enabling different generic Business Cases to be developed. Initially, the conceptual differences between a Business Model, Business Owner, and Business Case were explained, and generic Business Case elements were identified. Four key elements of Business Cases were identified, relating to customer-specific, offer-specific, Business development-specific and financial-specific elements. Using a cost value framework, potential cost segments for the Pods4Rail Business Cases were defined. This was followed by an insight into the methodology, the process, and the results for the determination of the Pods4Rail Business Cases. Through a catalogue of various determined Pods4Rail Business Cases an initial assessment of the economic and technical feasibility of the Pods4Rail Business Cases was provided. Finally, a brief conclusion and the next steps conclude this D5.1.

Main Outcome of Task 5.1 is the development of various potential Business Cases for Pod Systems in both passenger and freight transport, relevant for different stakeholders. These Business Cases targeted distinct customer segments with regards to Use Cases as described in D.4.1 [2], revealing promising approaches tailored to each segment. An initial evaluation of the economic and technical feasibility offered a preliminary insight into the viability of Pod Systems. Crucially, additional assessments by experts from Trafikverket, as Swedish agency for long-term infrastructure planning for transport in the field of road, rail, shipping and aviation, which owns, constructs, operates and maintains all state-owned roads and railways and operates many car ferry services, highlighted the potential of Pods4Rail.

A revision of generic business case elements 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
BMC	Business Model Canvas
CBA	Cost-Benefit-Analysis
Dx.x	Deliverable x.x
EU	European Union
GA	Grant Agreement
JU	Joint Undertaking
MMS	Mobility Management System
TSO	Transport System Operator
TU	Transport Unit
WPx	Work Package x
WSx	Work Stream x

3. Background

The Pods4Rail project [1] is clustered into three Work Streams (WS), Figure 1. The WS1 contains of five WPs dealing with the “Identification of use Cases, Business Cases/CBA, operating concept.” The WS2 also contains 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 work reported in this Deliverable has been performed within WP5 “Business Case Development” as part of WS1 “Identification of use Cases, Business Cases/CBA, operating concept.

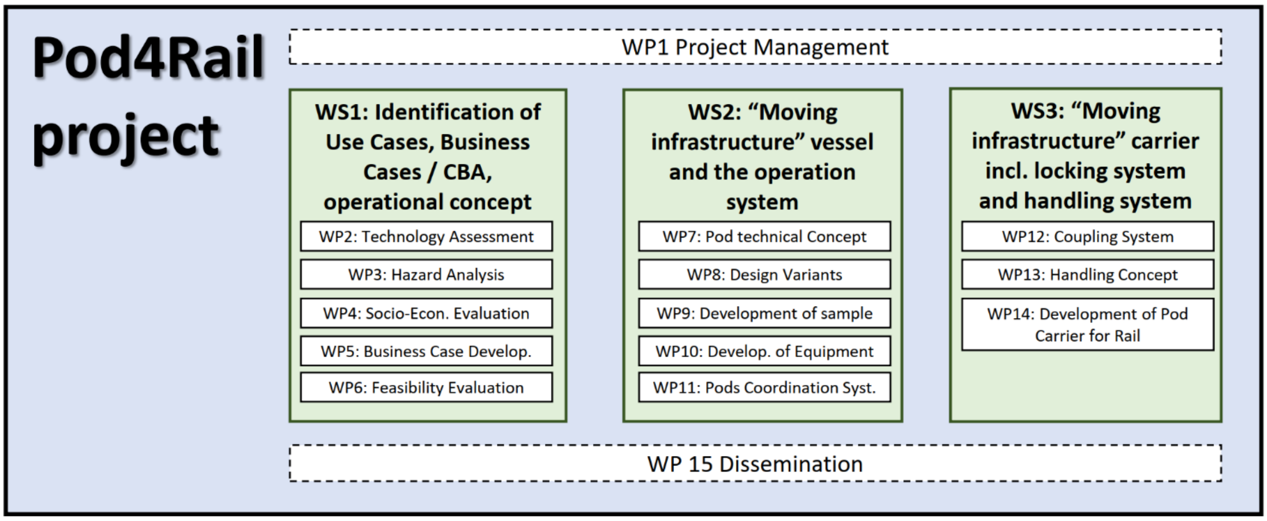

Figure 1: Overview of the Pods4Rail Structure

Work Package 5 is divided into two Tasks. Task 5.1 deals with the Identification of Generic Business Cases, while Task 5.2 deals with specific Business Cases. There are two Deliverables in relation to both tasks, which must be delivered at the end of both tasks. This Deliverable 5.1 will show the results and outcomes of the Task 5.1.

4. Objective/Aim

Besides the system definition and the derivation of possible Use Cases, a key objective of the Pods4Rail project is to analyse whether there are any corresponding business cases for the envisaged system given its complexity. This is considered all the more important because it does not seem sensible to start a technical development in all its forms before this aspect has been clarified. As such, the project aims to avoid starting a disruptive technical development without clarifying its potential economic feasibility. Hence, within 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. WP5 is divided into Task 5.1 and Task 5.2. 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). The WP5 Description according to 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, during the preparations of the Work Package-Start an issue has been detected in the Task Description (marked above): Methodologically, the term *"Cost Business Analysis"* does not exist. In general, the Acronym *“CBA”* stands for *“Cost-Benefit-Analysis”*. However, for a CBA no costs are available as there are currently no Business Cases in which Pod Systems are utilized. In addition, it is not possible to evaluate quantitative cost in a qualitative way. Hence, in order to solve the issue a suggested approach was to carry out a "Business Analysis". As part of a Business Analysis, certain strategic definitions and documentation of Business Cases can be analysed depending on the application of different methods. Thereby, the Business Analysis allow a qualitative assessment of cost values for different Business Cases in order to evaluate the economic feasibility of Business Cases, which would be in line with the objectives of WP5 as described in GA. A general overview of the objective, content and structure of WP5 according to the adjusted WP Description is presented in Figure 2.

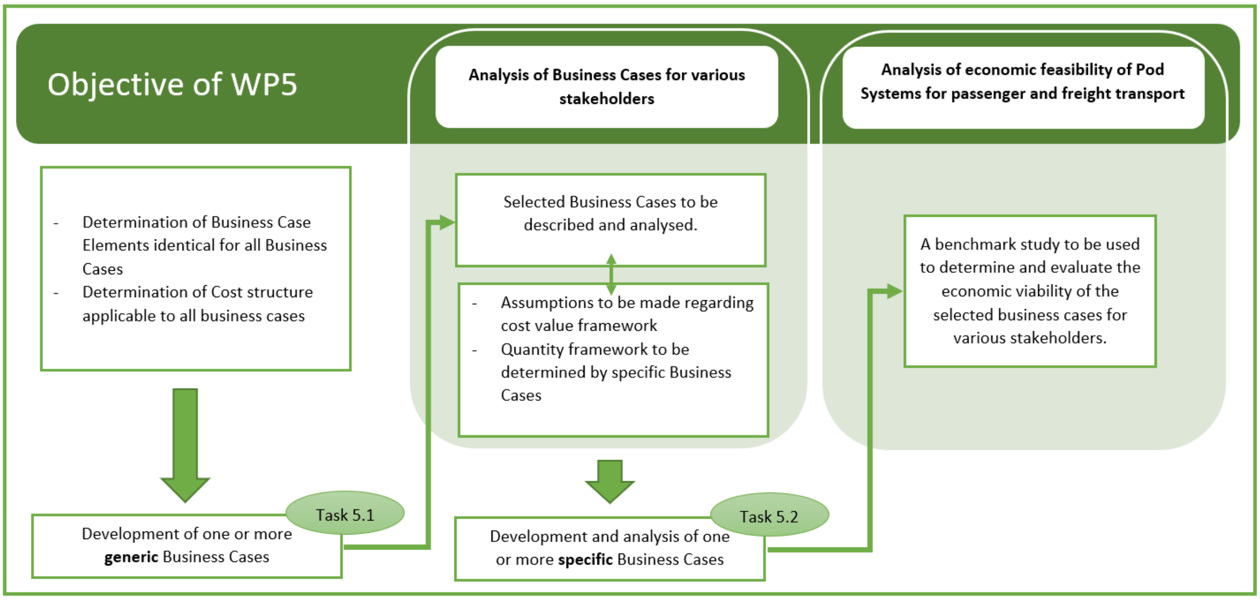

Figure 2: Objective, Content and Structure of WP5

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: The first two steps 1 and 2 of the methodological approach constitute the framework for Task 5.1 “Development of generic Business Cases”, while the next steps 3 and 4 constitute the framework for Task 5.2 “Development and Analysis of specific Business Cases”.

In the first step, generic Business Cases will be developed through an ideation process. An ideation process is a structured approach to generate ideas in order to find innovative solutions, develop new products or explore new Business ideas. The ideation process describes the act of brainstorming, concept development and idea generation. Also, it encourages collaboration, the exchange of ideas and the critical evaluation of concepts. [3] The ideation process will be conducted as part of a workshop in order to identify a variety of generic Business Cases. Subsequently, the identified Business Cases will be evaluated in terms of their technical and economic feasibility according to an initial appraisal of the business case's potential for successful implementation, taking into account possible stakeholders as well as potential customers, as defined in the Use Cases in D4.1. [2]. In the second step, a cost-structure framework is determined and analysed, considering requirements that are identical for all Business Cases. Based on the outcomes of Task 5.1, selected Business Cases will be specified and analysed via a Business Model Canvas (BMC) and evaluated through a Benchmark in Task 5.2. As far as possible, an attempt was made to carry out benchmarks in order to find possible Business Cases for the “Pods4Rail System”, which on the one hand are derived from already existing business models, which on the other hand were used to derive a Business Case due to their similarity. The Benchmark could help to define reference values as target-values for costs and benefits for the Pod System in the specific Business Cases. As the focus of this Deliverable is on Task 5.1, only step 1 and 2 of the methodological approach will be described in more detail in the following chapters. The work in WP5 is linked to the knowledge gained in the previous WPs, in particular of WP2 and WP4. The references are given in the corresponding chapters.

5.2. Business Concepts

For the development of different Business Cases, basic definitions of Business concepts are required. Thereby, Business concepts are distinguished into Business Models, Business Owners and finally Business Cases. These three terms will be defined and explained in the following chapter.

5.2.1. Business Model

Literature contains various definitions of Business Models. Specifically, attention is drawn towards differentiating Business Models from Corporate Strategy. While Corporate Strategy is defined as the approach and process of how a company can deploy its resources and capabilities to establish its market position, gain competitive advantage and achieve long-term goals, a Business Model is defined as how a company creates, captures and delivers value. Essentially, Business Models focus on the elements required to deliver value to customers while generating revenue. [4]

Depending on the Business, a wide variety of Business Model Typologies can be identified, representing Classic or Digital/Innovative Business Models. However, classic Business Models may also include digital/innovative aspects, as well as vice versa. Table 1 presents a number of Business Model Typologies, determined in WP4, Task 4.1 in Pods4Rail. [2] [5]

Table 1: Typologies and Description of Business Model [2] [5]

Type	Business Model	Description
Classic	Product-as-a-Service Model	This Model involves offering products to customers on a subscription basis or through pay-as-you-go/pay-per-use pricing Models rather than selling them outright. Customers pay for the utility or value derived from the product rather than owning it outright.
	Leasing Model	Instead of purchasing a product outright, customers can lease or rent it for a specific period, typically paying a recurring fee. This Model is often used for expensive items like cars, equipment, or property, allowing customers to access the benefits of the product without the upfront cost of Ownership.
	Direct Selling Model	In this Model, products or services are sold directly to consumers without intermediaries through channels like e-commerce platforms or company-owned stores. Customers typically pay a set price per unit purchased.
	Revenue Sharing	In this Model, multiple parties share the revenue generated from a product, service, or Business venture. This can occur in various forms such as platform Businesses where third-party sellers share revenue with the platform Owner, franchise Models, or joint ventures.
	Sale-Leaseback Model	This Model involves selling an asset (such as real estate or equipment) to a buyer who then leases it back to the seller. It allows the seller to access capital tied up in the asset while still retaining its use through a lease agreement.
	Integrator	An integrator Business Model involves bringing together various products, services, or technologies to provide a comprehensive solution to customers. Integrators add value by seamlessly

Type	Business Model	Description
		combining different components into a cohesive offering that addresses specific customer needs or challenges.
Digital/Innovative	Dynamic Pricing Model	In this Model, prices for products or services are continuously adjusted based on various factors such as demand, time of day, competitor pricing, and customer demographics. This allows Businesses to optimize revenue by charging higher prices when demand is high and lower prices when demand is low.
	Freemium Model	This Model offers a basic version of a product or service for free (the "freemium" version) while charging for premium features or functionality. It allows Businesses to attract a large user base with the free version and then convert some of them into paying customers by offering additional features or services.
	Experience Selling	This Model focuses on selling not just a product or service but also the experience associated with it. It involves creating memorable and positive experiences for customers throughout their interaction with the brand, leading to increased customer satisfaction and loyalty.
	Mass Customization	Mass customization involves offering products or services that are tailored to individual customer preferences or needs while still achieving economies of scale. It allows customers to personalize their purchases without significantly increasing production costs.
	Fractionalised Ownership	This Model involves multiple individuals or entities sharing Ownership of a product or asset, typically through a platform or arrangement facilitated by a company. It allows people to access the benefits of Ownership without bearing the full cost and responsibility.
	Data Monetisation	This involves generating revenue by leveraging data assets, such as customer information or insights gathered from user behavior. Companies can monetize data by selling it to third parties, using it to improve their products or services, or offering data-related services.

5.2.2. Business Owner

From individual entrepreneurs to shareholders, partners and investors to franchisees, self-employed entrepreneurs and non-profit organisations: Potential Business Owners are instrumental for the development of Business Cases, as they provide solid insights into their Business and ensure that Business decision such as investments in innovative concepts benefits the organisation. Regardless of the identified Use Cases, possible Business Owners were identified, depending on the nature of the Business and their specific role. Figure 3 presents a few examples of potential Business Owners for Pod Systems. Depending on the Business, various Business Owners can be identified, whose potential customers range from private individuals to society in general or to the transport/logistics sector.

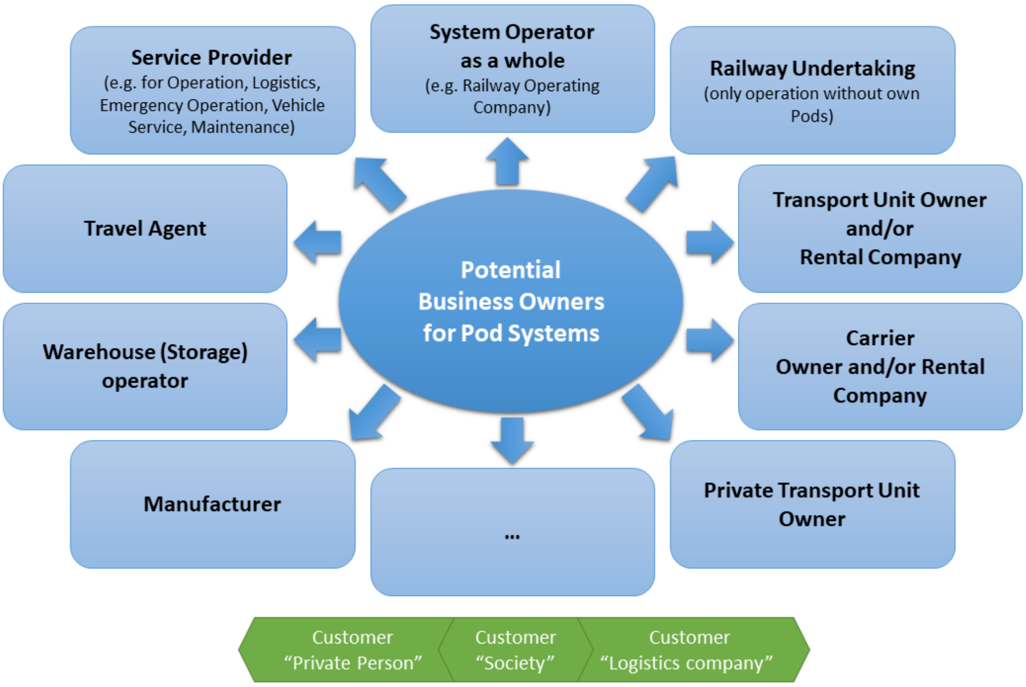

Figure 3: Potential Business Owners for Pod Systems

5.2.3. Business Case

Business Cases are defined as scenarios for Businesses aimed at assessing investments from a strategic and economic perspective. In the context of this deliverable, the focus is on investment in Pod Systems and thus on possible scenarios on how companies could deploy and operate with Pod Systems in order to be competitive and economically successful. Thereby, a Business Case is based on a specific Business Model as described in chapter 5.2.1 and considers potential Business Owner as described in chapter 5.2.2 as well as their target customers who will be provided with the service via Pod Systems.

5.3. Generic Business Case Elements

Business Cases consist of several generic elements that systematically describe the most important aspects of a product or service. To ensure a standardised structure of the Pods4Rail Business Cases, generic core elements were identified forming the framework of the Business Case to be developed: Firstly, elements of customer management were identified, which comprise various strategies for building and strengthening customer loyalty, including the identification and segmentation of customer groups and the selection and management of sales channels. Elements of the product and service were identified as the second key element. Here, the focus is on products or services and the associated value proposition that a company offers its customers to fulfill their needs and deliver added value. Thirdly, elements of Business development were identified, which includes all strategic and operational measures for implementing and scaling a company or Business segment. Finally, elements of the financial performance were identified, including expenses (costs), revenues (income) and the remaining surplus (profit). To ensure a standardized cost structure for possible Business Cases, the chapter 6 examines different cost components for the identified Pods4Rail Business Cases as part of a cost value framework.

6. Cost Value Framework

For a quantifiable analysis of the identified possible Pods4Rail Business Cases, assumptions have to be made regarding the cost value framework. Since a detailed, quantifiable list of the costs for the complete System for Pods4Rail, as described in D2.1 "Written report of the definition of multi-modal mobility Systems" [6], is not possible due to the technical constraints and design characteristics not yet available in detail, only individual target costs can be presented that will be associated with the System in the future to be achieved in order to allow comparison with existing transport Systems. Essential elements for the target costs can be derived from the investigations made in document D4.3. [7] It should be noted that target costs must be determined within the regional area of application to be considered, as costs vary greatly regionally within the EU. This applies equally to manufacturing costs as well as to procurement or operating costs.

6.1. Target Cost

6.1.1. Pods Manufacturing Cost

Regarding the manufacturing costs for Transport Units (TU) and carrier, only assumptions can be made which, due to the planned embodiment as a lightweight construction, essentially have to be based on the manufacturing costs of the automotive industry. Based on the assumptions regarding the TU dimensions, as made in D4.2, paragraph 7 [2] and which are the basis for further constructive design in Work Packages 8 to 10, comparisons must be made with existing, related means of transport, which enable a target cost estimate. It can be considered that due to the System concept and the desired standardisation of the TU, production in large quantities is possible in production facilities with a high level of automation. It should also be noted that the TU has no drive or chassis.

In addition to the arguments already stated above regarding the technical-constructive framework for the design of the TU and the carriers that does not yet exist, it must also be considered that the planned implementation of the System idea in 2040 resp. 2050 market-relevant aspects of the degree of technical development are more relevant for the System components (e.g., batteries, sensors) and their price development cannot be estimated. So, it is predicted that the cost of batteries could be halved by 2050. [8]

Possible estimates of the cost development for the necessary components for fully autonomous driving (GoA4 / SAE 5) are much more uncertain. Recent estimates from the automotive industry put costs between 7,400 and 17,100 Euro. A fall in the price of components of 5% per year is forecast, although overall price stability is expected in the first few years. [9] Since the carrier to be used for rail traffic would have to be equipped with the appropriate components in both directions, the values mentioned should be doubled. Based on the ranges mentioned, in an optimistic scenario costs of 30,000 Euro per carrier can be assumed.

Based on information about the production costs of electric cars [10], the values given in the following Tables can be assumed. If one assumes that the required components will be purchased in larger quantities and that the components will be designed to be compatible with the railway, a factor of minimum 3 should be assumed for the costs of corresponding components for a railway Carrier , see Table 2.

Due to the desired simpler construction of the TU, a factor of 2 can be assumed, see Table 2. This estimate assumes that the construction of the carrier and the TU will be based primarily on components from the automotive sector and that large-scale production will be carried out in a highly automated manner using new design principles. This will need to be critically reviewed in later project phases once the detailed design has been completed.

Table 2: Manufacturing cost assumptions for Railway Carrier for 2030

Cost factor	Costs in 2030 acc. [10] [EUR]	Target Costs for Carrier [EUR]
Battery	4,000	12,000
E-Drive Equipment	1,800	5,400
Drive	800	2,400
Chassis / vehicle frame	1,200	3,600
Manufacturing	1,300	3,900
Others	2,000	6,000
Equipment for autonomous driving	unknown	30.0000
Total		63,300

Table 3: Manufacturing cost assumptions for Transport Unit for Public Transport for 2030

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

6.1.2. Vehicle Procurement Cost

When considering vehicle procurement costs, the basic idea of Pods4Rail's System approach must be considered, which provides for a separation of the TU and the mobile vehicle (Carrier). This means that different TU can be transported on one and the same Carrier. The procurement costs must therefore be stated separately for the TU and the Carrier. Table 4 shows the target cost assumptions for TU Type B, derived from the list in D4.3. [7, p. 15]

Table 4: Target cost assumptions for TU Type B (6 m length)

Comparable vehicle / transport units	Procurement costs per piece [EUR]	TU Type B	Target Costs per piece [EUR]
-	-	for public transport	16,000
Caravan trailer, 6 m length	20,190 - 22,830	for private luxury transport	19,000 – 21,000
20' Standard Container	2,650 - 5,400	for freight transport	2,500 – 3,500
Swap Body, Class C	14,650 – 15,990	for freight transport, Swap Body	14,000 – 15,500

Similar statements must also be made when estimating costs for the carrier, as no comparable vehicles are currently offered for fully autonomous operation, see Table 5. When comparing with autonomous minibuses that are already in experimental operation, it should be noted that the costs stated relate to the chassis (with drive and sensors as well as the control unit) and the vehicle body with equipment.

Table 5: Target cost assumptions for Carrier (for TU Type B, 6 m length)

Comparable vehicle	Procurement costs per piece [EUR]	Target Costs for Carrier [EUR]
Automated Guided Vehicles (AGV)	60,000 – 150,000	100,000
Navya's small autonomous shuttles	276,000	100,000

6.2. Operating Cost

6.2.1. General Consideration

Operating costs are those costs that are associated with the operation of a means of transport (e.g., railway). They must also be determined for the individual transport modes (e.g., railway, road transport) depending on the application (e.g., public passenger transport, private passenger transport, freight transport). [11] To be able to make a quantitative estimate of the operating costs of the Pods4Rail System, it helps to consider the cost components of the transport options that exist today.

The operating costs of the Pods4Rail System are currently difficult to estimate. On the one hand, the acquisition, and proportional operating costs of the Mobility Management System (MMS) must be considered for the new System. For the safe operation of the Pods, costs will also be incurred in an operations centre, which arise from personnel who can intervene manually in conflict situations. There are also maintenance and repair costs for the TU and carriers, which cannot yet be quantified due to the new technology to be used.

Furthermore, the different procurement Models used today and in the future for public transport vehicles must be considered. In addition to the direct procurement of vehicles by the railway undertaking or transportation companies (e.g., for bus transport) at their own expense, the procurement of vehicles is heavily supported regionally or by states in the EU. On the other hand, vehicles are procured by companies who then rent them out to railway undertakings or transportation companies. [12] Depending on the procurement approach chosen, different values for vehicle costs and depreciation must be specified.

When considering the target costs, it should also be noted that within the EU, among other things, different financial support is provided by the EU, the states, and regions for the operation of local public transport, for example procurement of vehicles or the operation. [13]

Since the System is intended to use the existing infrastructure and therefore no new routes need to be built for the System, costs only arise for the use of the existing infrastructure. When considering the track access charge for to be paid for this, it should be noted that these are charged at different levels in each EU member state and therefore cannot be set at a uniform amount. [14] This also applies to road tolls. [15]

As already shown in [7, p. 16] savings in personnel costs can be expected due to the autonomous operation of the Pods, consisting of TU and carrier. These vary between 4.7% and 10%. A value of 6% can be assumed for the target cost calculation. It should also be borne in mind that the use of more modern and longer-lasting components as well as the use of AI-based predictive maintenance could reduce vehicle maintenance costs for carriers. The same applies to the transport units.

6.2.2. Railway Operation Cost

The following Tables lists the cost components for local public rail transport (Table 6) and freight transport (Table 7 & Table 8) in Germany. [16] [17] [18]

Table 6: Cost Components for local public transport in Germany in 2016 acc. [16]

Cost Component	Quantity [%]
Charge incurred for train path	32,1
Charge incurred for station usage	7,9
Energy costs	13,0
Cost of capital for vehicle	22,0
Personal costs for drivers and attendants	9,0
Vehicle maintenance	10,0
Administration and profits	6,0

Table 7: Cost Components for rail freight transport in Germany in 2012 acc. [17]

Cost Component	Quantity (for special wagon) [%]	Quantity (for standard wagon) [%]
Charge incurred for train path	20	19
Energy costs	20	22
Cost of capital for locomotive	16	24
Cost of capital for waggon	25	14
Personal costs	9	11
Others	10	10

Table 8: Cost Components for rail freight transport in Germany in 2021 acc. [18]

Cost Component	Quantity [%]
Charge incurred for train path	16
Energy costs	12
Cost of capital for vehicle	33
Personal costs	24
Administration	14

Equivalent lists must be drawn up for each individual EU member state to be able to make individual operating cost estimates. A study from 2015 shows that in 2012 the spread of operating costs in the EU lay broadly in the range of 20 € to 40 €/km, see Figure 4. [19]

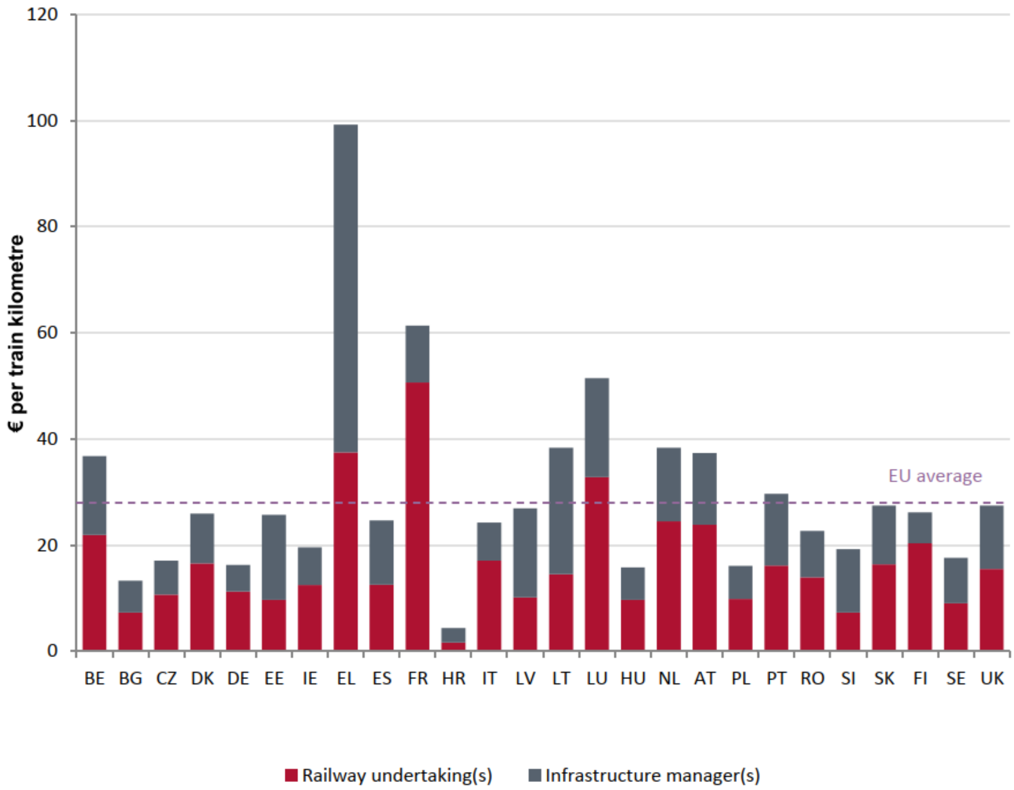

Figure 4: Operating costs per train kilometre by EU Member State (2012) [14]

A differentiated presentation of operating costs according to the railway lines served (main line, branch line) is also much more difficult. According to [20], the operating costs of branch lines in

France are not precisely known due to the lack of analytical cost calculations. Accordingly, a value of around 11 €/km was estimated in 2016. Relevant research suggests that it would be possible to achieve operating costs of around 5 €/km per train, following a certain operating Model (only one operator agent, train with low capacity, stock, ticket sales on board, reduced controls, etc.).

In addition, there are different taxation regulations within the EU that affect the individual means of transport. [21] As an example, Figure 5 shows the different levels of taxation on railway electricity within the EU in 2023.

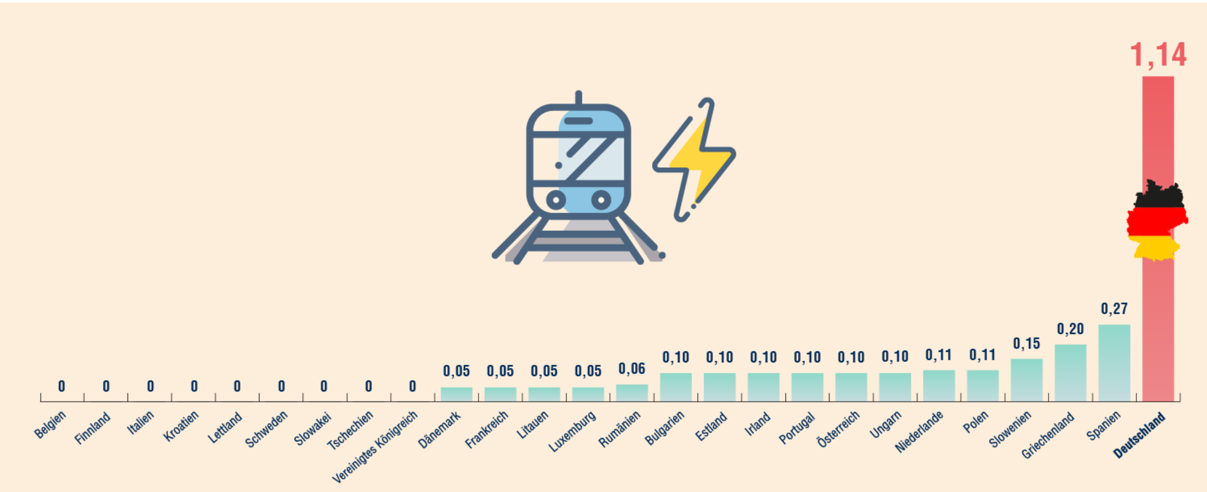

Figure 5: Taxation of railway electricity within the EU in 2023 acc. Allianz pro Schiene [22]

6.2.3. Bus Transportation Operation Cost

The operating costs in public transport with buses are much more difficult to estimate. A study from 2018 assumes that the operating costs of a bus company with a daily mileage of 250 km and without the personnel costs for the driver in the EU are around 0.65 €/km for a diesel bus and 0.3 €/km for an electric bus with overnight (depot) charging. [23] A study from 2021 shows how different the perspectives are, which assumes operating costs of 0.11 €/km for an electric bus with overnight (depot) charging. [24] A study from 2023 shows operating costs of 0.55 €/km for a battery-electric city bus (12/18 m length, 39/49 seats) and 1.27 €/km for a city bus with fuel cells (12 m length, 31 – 39 seats) for a bus company in a medium-sized city in Italy. [25] It should be noted that personnel costs have been at 41 to 48 percent of operating costs for decades and must be added here. In general, the proportion of operating costs in 2017/18 in Germany listed in Table 9 are stated. [26]

Table 9: Cost Components for Bus transport in Germany in 2019 acc. [27]

Cost Component	Quantity [%]
Cost of capital for vehicle and material	38.7

Personal costs	39.7
Administration and others	21.7

6.2.4. Mini Bus and Taxi Operation Costs

The cost splitting of operating costs looks significantly different when using mini buses and taxis. Personnel costs represent the largest cost component. For the operation costs for mini buses and taxi in Germany some figures can be given in Table 10.

Table 10: Cost Components for Bus transport in Germany in 2019 acc. [27]

Cost Component	Quantity Mini Bus [%]	Quantity Taxi [%]
Cost of capital for vehicle	19.5	10.8
Personal costs	56.0	61.3
Energy	-	16.3
Inspection, Service, Infrastructure	-	5.6
Administration	10.5	-
Administration and Distribution	-	6.0
Distribution	5.8	-
Operation and others	8.2	-

6.2.5. Autonomous Mini Bus Operation Costs

For the operation of autonomous minibuses, only estimations of the operating costs are available in several scenarios, which can serve as the basis for a comparison for the Pod System in road traffic, see Table 11.

Table 11: Estimated Cost Components for Autonomous Mini Bus transport in Germany acc. [9]

Cost Component	Quantity Auton. Mini Bus, for 6 persons [%]	Quantity Auton. el. Mini Bus [%]
Cost of capital for vehicle	50.9	26.0

Energy	20.9	35.0
Inspection, Service,	15.2	34.0
Administration, Distribution	13.0	-
Other costs	-	5.0

A German Model calculation for the use of an autonomous minibus (type NAVYA DL4-4WD) with operation in local public transport on an 2,45 km round course shows the estimated operation cost in Table 12

Table 12: Estimated Operation Costs for Autonomous Mini Bus transport in Germany acc. [27]

Cost Component	Estimated Operation Costs
2 autonomous mini buses, speed 6 - 18 km/h, operating time of 6-10 hours, with attendant	14.55 - 15.69 €/km
2 autonomous mini buses, speed 6 - 18 km/h, operating time of 18 hours, with attendant	12.87 €/km
2 autonomous mini buses, speed 6 - 18 km/h, operating time of 18 hours, without attendant	7.28 €/km
2 autonomous mini buses, speed 19,6 km/h, operating time of 18 hours, without attendant	2.51 €/km

According to the last scenario, the operating costs would be approximately 28 % lower than when using classic diesel-powered minibuses (Mercedes Benz Sprinter City 75 L). The assumed costs for this would be 3.21 €/km.

6.2.6. Freight Truck Operation Costs

Operating cost estimates are possible for freight transport with trucks, as provided by a study from 2022. It assumes that in 2030, for a rigid urban delivery truck with a daily mileage of 200 km, operating costs for a diesel vehicle will be around 0.60 €/km and for a battery-electric vehicle around 0.40 €/km. For a regional delivery truck with a daily mileage of 200 km, operating costs for a diesel vehicle will be around 0.80 €/km and for a battery-electric vehicle around 0.70 €/km. For a long-haul truck with a daily mileage of 200 km, the operating costs in both cases are 0.75 €/km. [26] It should be noted that personnel costs, energy costs and spare parts costs are variable cost factors and corresponding price increases have been unbearable in recent years.

6.2.7. Autonomous Mobile Robot Costs

The numbers presented in this table are based on an example made by Qviro, a robotics marketplace. [28] The costs 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 costs 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. When implementing AMRs 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 AMRs. Navigating onto trains and inside train stations, is a more complex task for the AMRs 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". [28] 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 AMRs. Additionally, the cost of a single AMR ranges from $10.000 to $100.000. [28] In the context of WP5 the focus will be on robots that range from small to medium, with a carrying capacity from 100kg-600 kg [29] [30], dimensions of approximately 80cm x 62cm x 33cm (L x W x H) [30] and has a (single) unit price range from $10.000 to $50.000. [30] [31] In conclusion, it is not possible to provide specific costs that represent the total cost of implementing AMRs, however these mentioned figures are as close as possible to the current phase of the project

Table 13: Estimation of the total cost of ownership of an AMR

Cost Component	Estimated Operation Costs (USD)
Initial purchase of AMR	50.000 USD
Operational Cost for Maintenance (over 5 years)	2.000/year = 10.000 USD
Operational Cost for Software Updates (over 5 years)	1.000/year = 5.000 USD
Operational Cost for Staff Training (over 5 years)	3.000/one-time = 3.000 USD
Additional costs for System reconfiguration (over 5 years)	5000 USD
Additional costs for additional equipment (over 5 years)	4000 USD
Total cost over 5 years, for one AMR	77.000 USD

6.3. Link between Cost Value Framework and Business Case Development

Through the statements made in the above sections, it becomes evident, that it is difficult to make precise, quantifiable statements regarding achievable target costs in the current phase of the project. This may be done at a later stage of the project when the technical framework is specified more precisely and is therefore more calculable. In addition, for the development of specific Business Cases it must be considered that statements about the specific Business Cases need to be made within a narrow local framework and cannot be generalized for all EU member states. Also, the investigation from D4.3 points out, among other things: "For the freight transport scenario, based on the example of distribution of retail and parcels in a densely populated region in the Netherlands, the cost per kilometre that a Pods System should compete with is around 6,00 Euro." [7, p. 1] In order to achieve any comparability between the selected specific Business Cases and already implemented comparable Business Cases, the Business Cases need to be much more detailed, e.g. country-specific. Also, the costs of operation depend on several factors, such as technology development, infrastructure, operation and maintenance, and can vary greatly depending on the Business Case. In addition, cost figures for comparable systems to each Business Case will be difficult to find, as many projects are either still in the pilot phase or are operated by companies that do not make this data publicly available.

In general, it can be stated that the business analysis to be carried out in Task 5.2 can only provide qualitative statements on costs for the majority of the selected Business Cases. Under certain conditions, it may be possible to forecast potential target costs for some of the Business Cases. However, it should be emphasised that any assessment of target costs (whether qualitative or quantitative) is solely based on a rough estimation.

7. Development of Business Cases: Procedure and Results

As part of WP5, the project team conducted a workshop to ensure a common understanding of the objectives and content of Task 5.1 as well as to engage in an ideation process for exploring potential Business Cases for Pod Systems.

Within the workshop, participants were given a comprehensive overview of the objectives and content of Task 5.1 including the purpose of an ideation process. Numerous creative ideas and concepts for potential Business Cases were generated through the ideation sessions and brainstorming exercises. Initially, potential Business Owners were identified based on different Business Models described in chapter 5.2.1. Subsequently Business Case ideas with the potential to support the success of the project and create value for interested stakeholders were brainstormed depending on the identified Business Models and Business Owner. The working sheets of the Workshop as wells as an overview of the brainstormed Pods4Rail Business Cases can be found in appendix of this deliverable. The following chapters will present the procedures and the results of the identified Business Cases.

7.1. Procedure for Determination of Business Cases

The ideation process made it possible to identify a high range of possible Business Cases for Pod Systems based on the identified Use Cases and with a view to the overall system. Each Business Case was compiled in three levels. In Level 1, the Business Models as shown in chapter 5.2.1 were listed initially. Based on the Business Models, possible variants of Pod System Business Cases were identified in Level 2. Lastly, the identified Business Cases were specified in Level 3. The following Figure 6 outlines the process of collecting Pod System Business Cases using the leasing/rental Model as an example.

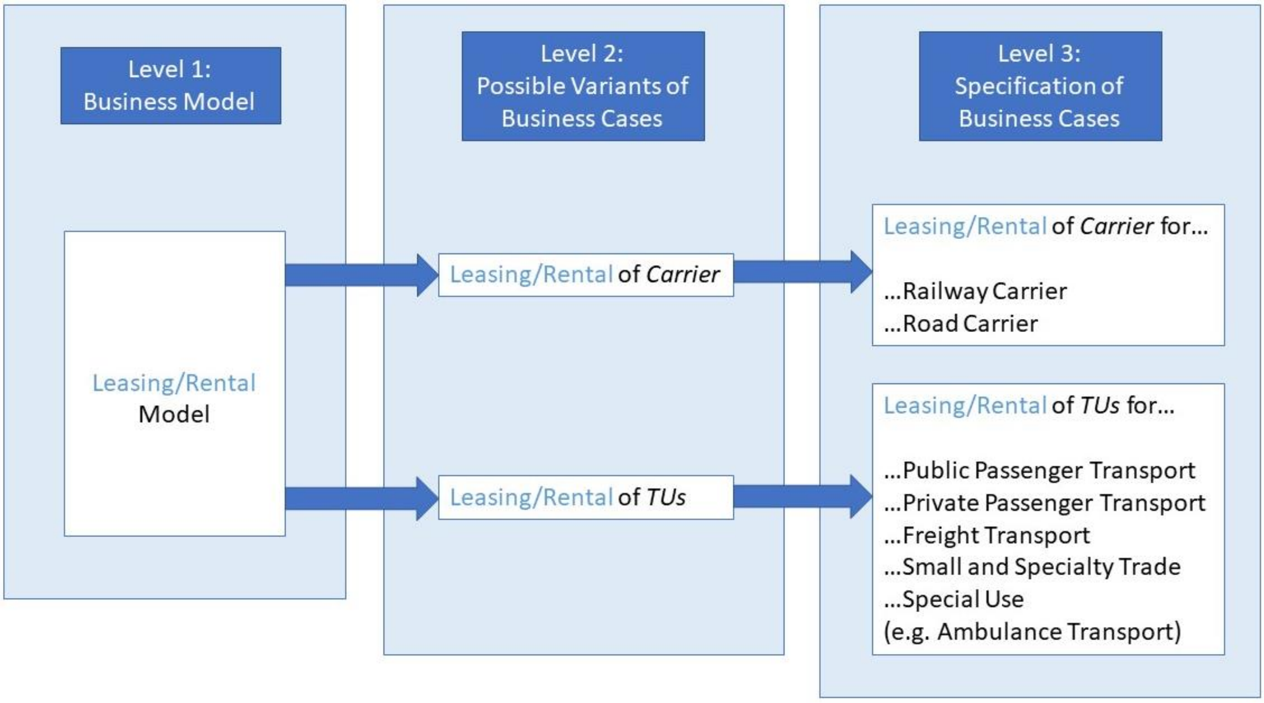

Figure 6: Collection process for Pod System Business Cases based on the example of the Leasing/Rental Model

7.2. Results of the Development of Business Cases

Through the described 3-level-process of collecting Business Cases, it was possible to develop more than 60 possible Business Cases that can be related to the system. To compile all the Business Case Ideas, a database of the findings was created. Figure 7 shows an excerpt from the collection of the determined Pod System Business Cases. The complete list can be found in the appendix of this Deliverable.

Pods4Rail - Possible Business Case Ideas - 23.04.2024

No.	Business Case Idea Level 1	Level 2	Level 3	Example of Use Case (WP4, T4.1)	Example of possible Business Owner / Stackholder
1	System Operation (for the entire system)				Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis)
2	Mobile Management System (MMS) Operation				Railway Undertaking (e.g., DB AG, ÖBB), Digital Technology / IT Companies (e.g., Alphabet, IBM)
3	Transport Service (w/o MMS) / Mass customization Model				
3.1		Passenger Transport w/o own Pods			
3.1.1			on Railway	Public & Private Transport	Railway Undertaking (e.g., DB Regio, ÖBB), Transport Companies (e.g., agilis, Keolis)
3.1.2			on Road	Public & Private Transport	Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis), Bus Companies
3.1.3			within every transport mode	Public & Private Transport	Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis), Bus Companies
3.2		Passenger transport with own Pods			
3.2.1			on Railway	Public & Private Transport	Railway Undertaking (e.g., DB Regio, ÖBB), Transport Companies (e.g., agilis, Keolis)
3.2.2			on Road	Public & Private Transport	Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis), Bus Companies
3.2.3			within every transport mode	Public & Private Transport	Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis), Bus Companies
3.3		Carrier Operator			
			on Railway		Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis)
			on Road		Transport Companies (e.g., agilis, Keolis), Bus Companies, Logistics, Freight Forwarding and Transport Companies
			within every transport mode		Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis), Bus Companies, Logistics, Freight Forwarding and Transport Companies
3.4		Freight Transport only			Railway Undertaking (e.g., DB AG, ÖBB), Rail Freight Operators (e.g., HUPAC, VTG),

Figure 7: Excerpt of the Comprehension of identified Pod System Business Cases

7.3. Discussion on Business Case Results

7.3.1. Expert opinion from industry and science

The results coming from the finding process for possible Business Case were discussed, allowing the project team to refine the most promising approaches and to evaluate their technical and economic feasibility. To simplify the evaluation, the Business Cases were described by examples of how such a company or an entrepreneur would operate in the corresponding Business Case. As a result of this activity, a catalogue was created on Business Cases according to Level 3, which will be presented in this chapter. However, it should be noted that the following catalogue only provides insights into some possible Business Cases and therefore does not claim to be exhaustive. Also, it should be noted, that for the evaluation of the Business Cases, attention was paid to the characteristics of Pod Systems as defined in D4.1 [2]: Pod Systems are currently not foreseen for metro transport.

Business Case 1:	Public Transport Service with rented TUs/Carrier
Example describing how such a Business would operate:	With a Public Transport Service, a Pod Transport Service Company, e.g. Railway Undertaking could operate with rented Pods/Carrier on branch lines, offering passengers the benefits of Door-to-Door transport. Passengers will book a Pod in advance via App. The Pod will pick the passenger up at their front door and take them directly to their destination without having to change the transport mode on their own. Furthermore, The Pod Transport Service can also be offered by freight companies or parcel service providers, where the pods could operate e.g. from the distribution center. The data for parcels could be transmitted electronically to Pods delivering the parcels in assigned area/district. Shortly before arriving at the destination address, the pod identifies a nearby car park or a suitable place to stop (max. 100 meters from the destination).
Evaluation of the Business Case feasibility:	By offering a door-to-door service in combination with demand-responsive services, Pod Systems especially improve the mobility of people in rural areas. This creates significant value for passengers who are reliant on public transport due to age or health issues. Hence, making the use of Pod Systems attractive for the customer. Also, as the Pods/Carrier are rented in this Business Case, no high investment costs are required. This also applies to freight transport, where it is not only possible to offer a Freight Transport Service, but also a Combined Transport Service with Passengers and Parcels. Therefore, economically as well as technologically feasible for the Business Owner.

Business Case 2:	Public Transport Service with own purchased TUs/Carrier
Example describing how such a Business would operate:	Same as Business Case 1.
Evaluation of the Business Case feasibility:	This Business Case again demonstrates the attractiveness of using the Pod Systems for passengers and customers of Freight companies. However, it is unclear to what extent passengers and customers notice the difference between rented and self-purchased Pods through the Pod Transport Service Company. For this Business Case, where the company operates with own purchased Pods, a large number of Pods would be required, leading to high investment costs. For this reason, this Business Case is not considered economically feasible in short-term, but eventually in long-term.

Business Case 3:	Private Passenger Transport Service with rented or purchased TUs/Carrier (Dynamic Price Customisation)
Example describing how such a Business would operate:	The company offers passenger transport services via Pods. A special feature of this company is the dynamic fare adjustment based on various factors such as demand, traffic volume, time of day, distance, passenger numbers and carriage of parcels in the Pod. This Business would especially target passengers who are new to the city and not familiar with the language, the local public transport or the (foreign) currency, e.g. tourists. Passengers can book the autonomous Pod service via an app. The prices for the booking are automatically adjusted to the traffic situation and demand and displayed to the passengers in the app. The payment is made securely and digitally via the app. After entering the starting/destination locations as well as paying the fare shown in the app, the passenger receives confirmation of the journey including a QR code, enabling the passenger to access the Pod.
Evaluation of the Business Case feasibility:	As Pod Systems can theoretically operate 24/7 and are able to offer Door2Door, this Business Case is considered feasible especially in cities with high tourism rates.

Business Case 4:	Retail Service for Private Passenger Transport
Example describing how such a Business would operate:	The company could offer customised Pods that provide a wide variety of services, such as a rolling grocery shop, hairdresser, carpenter, pharmacy, etc. These ‘rolling service Pods’ could be booked by the customer by phone or smartphone on demand in order to specifically exploit the time during their journey. This service could be of particular interest to people who are either restricted in their mobility for reasons of age or health or who live in rural areas where access to such services is limited.
Evaluation of the Business Case feasibility:	A service company for transport and retail could meet different customer needs. It is both economically and technically feasible.

Business Case 5:	Freight Transport Service on Railway Stations for Logistics Companies
Example describing how such a Business would operate:	Usage of automated transport pods (AMR’s) 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 goal is to lessen the congestion on the roads near the train stations that is caused by trucks and freight transport.
Evaluation of the Business Case feasibility:	As this Service can be provided to a large number of logistics companies and their customers in and around railway stations, this Business Case is considered feasible.

Business Case 6:	Transport Service of Bulky Baggage for Passenger on train stations or airport terminals
Example describing how such a Business would operate:	A company for Freight Transport Service could generate benefits for its customers by offering the transport of bulky baggage such as strollers, bicycles, parcel service etc. on train stations or airport terminals via "Baggage Pods". The 'Baggage Pods' can also be rented by railway undertakings/airport Operator to offer the 'Baggage Pods' service to their passengers at the station/airport. Also, the company could offer "Cargo Pods" for ship transport from the port to the cargo terminal.
Evaluation of the Business Case feasibility:	This Business Case will be considered economically and technically feasible due to the demand for baggage transport services at train stations and airport terminals.

Business Case 7:	Leasing/Rental Service of TU for the high-class transfer of passengers
Example describing how such a Business would operate:	A Rental Company of Transport Units could offer TUs at the airport/train stations for the high-class transfer of passengers from the airport/train station to specific urban event locations such as (international) conferences. In cooperation with event organisers or the local municipality, the TU can be rented specifically for this purpose in order to ensure a high-class service of the transfer between airport/train station, the event location or the hotel for event participants.
Evaluation of the Business Case feasibility:	There would be great potential for Rental Company of Transport Units to gain cooperation with local authorities or event organizations. For this reason, the Business Case is considered feasible.

Business Case 8:	Leasing/Rental Service of TUs for small and specialty trade (e.g. premium travel and leisure)
Example describing how such a Business would operate:	Organisers of e.g. city trips or concerts can rent TUs whose design and equipment are specifically tailored to the purpose required by the organisers. For city trips, for example, headphones with digital city guides could be integrated or, for concerts, customised lighting/music and special drinks could be offered in the TU. Also, to bring the Business closer to the customer and increase the attractiveness of booking the Travel Pods, agreements can be made with governments or other entities for discounts for specific groups of people (e.g. kids).
Evaluation of the Business Case feasibility:	This Business Case is very attractive towards travel agents as they offer enhanced service through the Pods to the direct customer. Also, as the TU could be equipped for different occasions, such as "City Trip Pods" or "Party Pods", it covers a high range of segments, which is why the Business Case is considered as feasible.

Business Case 9:	Leasing/Rental Service of TUs for private passenger transport
Example describing how such a Business would operate:	The Rental Company of Transport Units for Private Passenger Transport could offer individual transport for passengers in their own TUs. The customer could book a TU by either calling or via an app in order to receive private and separate transport for their journey. This Business Case could be described in the same way as a taxi company.
Evaluation of the Business Case feasibility:	With this Business, the rental company would have high investment costs for purchasing a fleet of Pods, which they would either have to factor into the price for renting the TUs or through a high rental rate. For the average customer, TU rental price could be too high, making this Business Case economically not feasible. However, as the costs for a driver would be cancelled due to the fully autonomous driving of the Pod Systems, the rental car price could be adjusted, which would then make the Business Case economically feasible.

Business Case 10:	Ride hailing Service via Pod Systems for private passenger transport
Example describing how such a Business would operate:	The Ride hailing company provides a user-friendly mobile app for booking travelling with Pods. The app offers features such as location tracking, route planning, vehicle selection and real-time price calculation. Thereby the Ride hailing service can be offered through own purchased TUs as well as rented TUs for private passenger transport.
Evaluation of the Business Case feasibility:	As this Business Case could be described as Business Case 9, with the focus on the booking via an online platform, the Business Case is considered feasible.

Business Case 11:	Ride-Pooling Service via Pod Systems for private passenger transport
Example describing how such a Business would operate:	In this Business Case, a franchise-taker/driver/operator leases a TU from a TU rental company in order to offer Private Ride Pooling Service for passengers via Pod Systems.
Evaluation of the Business Case feasibility:	As Pod Systems will drive fully autonomous, a driver for the "ride pooling service" is not required anymore. For this reason, this Business Case is considered not feasible for the driver/Franchise-Taker.

Business Case 12:	Ride-Sharing Service via Pod Systems for Private Passenger Transport (Franchise)
Example describing how such a Business would operate:	The company offers a platform for ride-sharing services that allows passengers to book and travel via Pods. The platform offers a user-friendly interface, location tracking, booking and payment of journeys as well as customer support. The company has established partnerships with investors and fleet Operator to provide a fleet of Pod Systems that are used in a ride-sharing network. 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.
Evaluation of the Business Case feasibility:	As the revenue sharing Model allows investors to generate passive income while the ride sharing company maintains and services the Pods fleet and operates the ride sharing services, the Business Case is considered feasible.

Business Case 13:	Leasing/Rental Service of TUs for special use (e.g. Ambulance Transport)
Example describing how such a Business would operate:	The Rental Company could offer customized solutions for hospitals and medical institutions by providing TUs with special medical equipment on board. The rented TUs with special equipment would then be operated as an Ambulance or for medical staff.
Evaluation of the Business Case feasibility:	In this case, hospitals could stock up on high-tech TUs without having to bear the cost of the equipment themselves, making the Business Case attractive to the customers. However, the rental service of modular medical Pods carries a high risk of the medical equipment being damaged or stolen, which would result in high financial losses. In order for this Business Case to be economically feasible, special measures must be taken to ensure that the TU is burglar-proof. In addition, the question remains as to whether hospitals would prefer to purchase in-house medical Pods in the long term.

Business Case 14:	Leasing/Rental Service of TU Fleets for healthcare institutions
Example describing how such a Business would operate:	The Rental Company could offer TU Fleet for pure operation without any equipment on board. For this Business Case healthcare services in the domestic sector could be a potential customer as the healthcare staff can use the TUs to drive from one patient to another. Special algorithms for a mobility service could also be installed so that the TUs automatically receive the number of patients and their addresses from a control center so that the medical staff simply have to enter the TU. A leasing contract can be agreed with the healthcare company.
Evaluation of the Business Case feasibility:	In this case, healthcare institutions would benefit from the rental service as they would be provided with a TU fleet for their healthcare staff without having to bear the full acquisition costs for TUs. This makes the Business Case attractive for its customers and is therefore considered economically feasible.

Business Case 15:	Leasing/Rental Service of Carrier
Example describing how such a Business would operate:	Carrier can be leased from all different transport companies, especially for transport service companies of both passenger and freight transport.
Evaluation of the Business Case feasibility:	This Business Case reflects more or less a Business Case of current Wagon Owners. For this reason, the Business Case is considered feasible.

Business Case 16:	Leasing/Rental Service of Energy Supply Application for special purposes e.g. catastrophes etc.
Example describing how such a Business would operate:	In case of catastrophes Energy Supply Application Carrier will be sent out to provide Energy in short time for TUs.
Evaluation of the Business Case feasibility:	As this Business Case would be considered as a niche product and would only be offered for special purposes such as catastrophes, it is required to ensure economic feasibility. For this reason, it is suggested for this Business Case to have the rental of the Energy Supply Application as one Offer of the company's portfolio alongside other renting services of TUs. In this case, the economic feasibility of this Business Case would be given.

Business Case 17:	Sale and Lease Back of Transport Units
Example describing how such a Business would operate:	Retail investors can acquire customised TUs and resell them to investors such as Banks to finally lease them back.
Evaluation of the Business Case feasibility:	The aim of this Business Case is to optimise tax refunds for Investor, making the Business Case attractive for investors. Therefore, the Business Case is considered feasible. However, it should be mentioned that such a concept is not suitable for mass customisation.

Business Case 18:	Warehouse Service for TUs and/or carriers
Example describing how such a Business would operate:	A warehouse operator Business can be aimed at e.g. railway companies and freight Operator, but also private individuals (premium sector) who require temporary or long-term storage for their TUs and/or carriers. Its range of services includes flexible rental options for the short or long-term rental of storage space (e.g. seasonal or due to maintenance work) as well as the storage of spares and equipment together with repair and maintenance areas with optional maintenance and repair services for TUs and carriers.
Evaluation of the Business Case feasibility:	This Business Case is considered feasible due to the requirement of storage space, in particular when investing in a larger Pod fleet.

Business Case 19:	Manufacturing of TUs and/or Carriers
Example describing how such a Business would operate:	Manufacturers produce TUs and/or carriers for local public transport. The TUs or carriers will be sold, for example, to a wide variety of customers ranging from local authorities and railway Operator to private customers.
Evaluation of the Business Case feasibility:	As this Business Case is a prerequisite for all possible Business Cases of Pod Systems, it is considered feasible.

Business Case 20:	Direct Selling Service of TUs and/or Carrier
Example describing how such a Business would operate:	The company enables customers to purchase TUs and/or carriers directly from the manufacturer without taking the diversions via intermediaries or retailers.
Evaluation of the Business Case feasibility:	Corresponds to Business Case 19"Manufacturing of TUs and/or Carriers". Hence, this Business Case is considered feasible.

Business Case 21:	Maintenance and Repair service for TUs and/or carriers
Example describing how such a Business would operate:	The company enables all possible Pod System fleet Operator to outsource the maintenance of their Pod Systems and instead subscribe to a monthly/annual service contract. The service contract can e.g. include regular maintenance, repairs when needed and technical support to ensure that the TUs and/or carriers are always operational. Wide range of customers: The company is aimed at fleet Operator who use Pod Systems for the transport of people or goods. This includes cities, public transport Operator, companies in the transport and logistics sector, airports, universities, etc. (all possible Pod System Operator)
Evaluation of the Business Case feasibility:	Due to the wide range of customers, this Business Case is considered feasible.

Business Case 22:	Data Services Company for Pods Systems
Example describing how such a Business would operate:	The company offers Data-as-a-Service for Pod System Operator such as Railway Undertakings to monitor railway lines by using sensor technology and data analysis techniques to collect and analyse real-time data on the condition of railway lines. Data can be used for several goals: • Data services—such as predictive maintenance and data-powered insurance, where value is created through the processing and use of vehicle data. • Connected services—such as entertainment and tolling 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

Business Case 22:	Data Services Company for Pods Systems
	This data (e.g. smart operational reporting service, KPIs, statistics, mean or min transport times, etc.) is then sold to railway undertakings and Operator, both passenger and freight transport, as well as government authorities and other stakeholders involved in the monitoring and maintenance of railway infrastructure such as maintenance companies or manufacturers. The data can be used to ensure the efficiency, safety and reliability of railway operations, especially with operation via TUs. As services portfolio, real-time data collection through smart sensors and other technology, can be used for real-time monitoring of infrastructure and equipment (railway components and assets), data analytics for predictive maintenance, AI data analysis, operational optimization-traffic management, data storage, CCTV services, Passenger Information Services (PIS), train delay analysis, intelligent driving assistance, among others.
Evaluation of the Business Case feasibility:	The usage of data in the global transportation industry has been increasingly important the last years. Even though the exact value of vehicle data is difficult to estimate, consensus is that vehicle data has great potential value for a number of related products and services. As digitalisation and the demand for data is increasing in all sectors for analysis purposes and as various comparable data service providers already exist, this Business Case is considered feasible.

Business Case 23:	Catering Service for Pod System Operator
Example describing how such a Business would operate:	The company is aimed at Pod Systems Operator, including cities, public transport Operator, companies in the transport and tourism sectors, airports and other facilities that use Pod Systems for passenger transport. The company enables Pod System Operator to offer their passengers high-quality food and drinks during the journey.
Evaluation of the Business Case feasibility:	A Catering Service while travelling via Pod creates a unique experience for passengers and opens up additional revenue streams for Pod Operator, hence this Business Case is considered feasible. However, it is important to consider that catering is more likely to be offered for the premium sector. For the basic sector, small snack vending machines in TUs may provide a more suitable solution.

Business Case 24:	Cleaning Service of TUs for Pod System Operator
Example describing how such a Business would operate:	The company enables Operator of Pod Systems to outsource the cleaning of their TUs and instead conclude a monthly/annual service contract. The service contract includes regular cleaning, disinfection and interior maintenance of the TUs to ensure a clean and pleasant driving environment for passengers. The company is aimed at Operator of Pod Systems, including cities, public transport Operator, companies in the transport and tourism sectors, airports and other facilities that use Pod Systems for passenger transport.
Evaluation of the Business Case feasibility:	As the outsourcing of cleaning services is a common standard, this Business Case is considered feasible.

Business Case 25:	Entertainment Software Service in TUs for Pod System Operator
Example describing how such a Business would operate:	The company offers entertainment software such as music, (online) games, films etc. to TUs equipped with monitors/speakers. The entertainment software can be accessed via an app or a website with QR code. The company allows passengers to enjoy free basic entertainment during their journey via Pods and offers additional premium entertainment options for a fee. Passengers can use the basic entertainment services free of charge, making the journey more enjoyable. When interested in premium entertainment options, passengers can upgrade to premium features as needed or stay with the free basic version. Besides, the company can also integrate content from content providers to offer a wide range of entertainment options. This can include partnerships with music streaming services, film studios, gaming developers and other content providers. Agreements for the provision of this service is needed between Pod Operator and the software company.
Evaluation of the Business Case feasibility:	Especially for passengers who travel for at least 15 minutes or who are frequent travellers, entertainment options during the journey play an important role. As this entertainment service can improve the customer experience for passengers, this service is considered feasible.

Business Case 26:	Consulting and Implementation Services for Pod System Operator
Example describing how such a Business would operate:	The company provides a single point of contact for companies, cities and communities by offering a comprehensive approach to planning, implementing and managing Pod Systems. Thereby, the company primarily offers consulting and planning services for companies, cities and communities interested in Pod Systems. The services include the development of customised mobility solutions, the identification of suitable deployment scenarios, the planning of routes and infrastructures, the assessment of legal and regulatory requirements and support in the procurement of funding. In particular, the integration of various technologies for Pod Systems together with a wide range of data (vehicle data, traffic data, weather data, etc.) and data on operational processes for Pod Systems, including fleet management, maintenance and repair, charging management, driver training and customer support, will be a key focus for the company
Evaluation of the Business Case feasibility:	As Pod Systems are an innovative mobility solution, such an integrative company can attract a high level of demand from key stakeholders such as railway undertakings, cities and communities. Hence, this Business Case is considered feasible.

Business Case 27:	Offering and selling PODs network capacity to Transport System Operators
Example describing how such a Business would operate:	The company or entity is responsible for network capacity and safe operation especially when it comes to sharing one network with other Transport System Operators (TSOs) which means different TSOs competing in getting hold of capacity on railway track network and related infrastructure facilities such as e.g., Handling Systems for loading/unloading used by the Carriers and Transport Units attached to them. As such, available capacity is offered on a market based on network access rules to be published by the company or entity. The capacity can be ordered by TSOs paying the price for it to the company or entity. The pricing model could be either based on fixed price model or demand based flexible pricing or even on a mixture of both.
Evaluation of the Business Case feasibility:	This Business Case is considered feasible because it follows well known principles for resource owners to offer and sell the use of the resource on a free and open market of TSOs operating on one and the same rail network including all related infrastructure facilities and services.

7.3.2. Additional Feedback from Trafikverket experts

For an evaluation of the feasibility of the determined Business Cases, 14 experts from outside the project of Trafikverket were kindly requested to provide feedback. Feedback has been received from eight representatives from different departments such as planning, transport, strategic development and maintenance. The experts' individual evaluation of the economic and technical feasibility of the respective Business Cases (as described in chapter 7.3) can be found in the appendix. The feedback from the external experts covered three aspects, i.e. the technical and economic feasibility of the Pods4Rail Business Cases were evaluated and general considerations on the project from a railway operator's perspective were provided:

Regarding the technical feasibility of the project, it was stated that the utilisation of already existing infrastructures would be a major benefit for Pod Systems, allowing a reduction in the demand for finite resources. It was also stated that from a technical point of view, Pod Systems could be designed regarding sustainability, implying the System to fulfil sustainability requirements.

From an economic perspective, it was initially indicated that the current railway System is already functioning efficiently, considering the on-time introduction of new technologies and proper operational processes. In this regard, it was stated that the implementation of new mobility and transport systems would require significant investment. Given the high investment costs, the project would not appear economically feasible. However, it was pointed out that from a Business perspective, the Business Cases should consider not only the purchase but also the rental or leasing of Pods as feasible options. It was indicated that investors play a crucial role in determining feasible Business Cases. In particular, the intent to generate profit should be considered in the Business Cases to identify sustainable Business Cases. Finally, it was stated that the reduced labour costs associated with autonomous vehicles would be a major advantage for stakeholders. Both the public and private sectors could have an interest in Pod System. Also, smaller companies, in particular, could benefit from niche applications, once the Pods are more widely adapted and accessible.

In general, it was stated that Pods4Rail is a very visionary and exciting project. However, it is difficult to see the connection to the railway system as Pods are meant to be autonomous. It seemed unclear why Pod Systems would need to take a “detour” on rail. For this reason, Pod Systems were deemed most useful for local transportation of goods and passengers. Additionally, it was mentioned that autonomous Pods could improve the reliability and safety of the traffic system, as well as offer a type of flexibility that today’s transport system cannot provide. Their ability to adapt to population density, other modes of transport in the region, and the overall transport needs in specific areas could be major benefits, making the system profitable. In summary, it was stated that the Business Cases evaluated as feasible by the project team all seem reasonable given the project’s goals. However, the main concern is whether this will be a worthwhile investment that indeed meets future travel needs, and whether the timing of implementation will align with current and future travel needs and investments.

8. Conclusion and Next Steps

Through the work in Task 5.1, a variety of potential Business Cases for Pod Systems, both for passenger and freight transport and for different stakeholders, were developed. Promising approaches emerged that addressed different customer segments depending on the Business Case. A preliminary assessment of economic and technical feasibility provided an initial impression of the Pod System feasibility. In particular, the assessment by external experts provided an important indication of the potential of Pods4Rail.

However, through the cost-value framework it became evident that cost value differences will occur not only between different Business Cases, but also among different European countries in the general introduction of Pod Systems on the European market. In particular, country-specific circumstances will lead to different cost levels, e.g. in relation to taxation. Especially, regarding the cost analysis of the Business Cases, it has been determined, that it is difficult to make precise, quantifiable statements regarding achievable target costs in the current phase of the project. In addition, through the discussion of the feasibility of the determined Pods4Rail Business Cases it has been recognised that when making investment decisions, it is not sufficient to only consider associated costs to evaluate the feasibility of Pod System Business Cases. Rather, additional criteria such as societal gains or environmental benefits must be included in the evaluation to obtain a complete picture of the costs and benefits of Pod Systems and thus facilitate a thorough feasibility evaluation of Pods4Rail Business Cases.

Therefore, based on the insights gained from Task 5.1, Task 5.2 will involve detailed specification and qualitative business analysis of selected Business Cases. The outcomes of this subsequent analysis will be documented in D5.2.

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Appendices

Appendix 1: Worksheet of the Workshop: "Identification of Business Owner"

<u>Task 1:</u> Please list possible Business Owners associated with the Business Models as indicated in WP4 T4.1.

Pods4Rail WP5 Task 5.1 : Developing of (a) generic Business Case(s)

Business Modells (WP4 T4.1)	Short Explanation	Identified Business Owner
Product-as-a-service model	This model involves offering products to customers on a subscription basis or through pay-as-you-go/pay-per-use pricing models rather than selling them outright. Customers pay for the utility or value derived from the product rather than owning it outright.	Railway Manafacturer; Swap-Boda Manufacturer; Bus Manufacturer; Caravan Manufacturer; Container Manufacturer; Signalling service companies; Data Storage Company; Software service companies; Catetering Company; Service provider; Travel Agent; App-Developer; System operator; Railway operator; TOCs; Governments and similar administrations; Carrier owner/Rental company; POD owners (like container owners)
Dynamic pricing model	In this model, prices for products or services are continuously adjusted based on various factors such as demand, time of day, competitor pricing, and customer demographics. This allows businesses to optimize revenue by charging higher prices when demand is high and lower prices when demand is low.	Freight transport company using pods and optimising for capacity use; Passenger transport company using pods and optimising for capacity use; Railway operator
Integrator	An integrator business model involves bringing together various products, services, or technologies to provide a comprehensive solution to customers. Integrators add value by seamlessly combining different components into a cohesive offering that addresses specific customer needs or challenges.	Trnasport Unit Owner; Companies like Siemens and Alstom; Companies like Honeywell; DB; System operator

Sale-leaseback model	This model involves selling an asset (such as real estate or equipment) to a buyer who then leases it back to the seller. It allows the seller to access capital tied up in the asset while still retaining its use through a lease agreement.	Investors / Creditors; Any large asset owner/lease company; Asset finance; Warehouse owner
Freemium model	This model offers a basic version of a product or service for free (the "freemium" version) while charging for premium features or functionality. It allows businesses to attract a large user base with the free version and then convert some of them into paying customers by offering additional features or services.	Travel Agent; Travel agent; System Operator as a whole; Servide provider; Service Provider
Leasing model	Instead of purchasing a product outright, customers can lease or rent it for a specific period, typically paying a recurring fee. This model is often used for expensive items like cars, equipment, or property, allowing customers to access the benefits of the product without the upfront cost of ownership.	Transport Unit Owner/Rental Company; Carrier Owner/Rental Company; Train leasing companies; System operator; (New) pod (TU) leasing companies; Automotive leasing companies; Private Transport Unit Owner; Private Transport Unit owner; Truck leasing companies
Fractionalised ownership (sharing)	This model involves multiple individuals or entities sharing ownership of a product or asset, typically through a platform or arrangement facilitated by a company. It allows people to access the benefits of ownership without bearing the full cost and responsibility.	Private Transport Unit owner; Transport Unit Owner/Rental Company; Carrier Owner/Rental Company; Railway Undertaking; Different regional governments that together want to kickstart the technology
Experience selling	This model focuses on selling not just a product or service but also the experience associated with it. It involves creating memorable and positive experiences for customers throughout their interaction with the brand, leading to increased customer satisfaction and loyalty.	Transport unit owner; Travel Agent; Travel Agent; System Operator; Servide provider; Railway Undertaking; Companies like Apple

Data monetization	This involves generating revenue by leveraging data assets, such as customer information or insights gathered from user behavior. Companies can monetize data by selling it to third parties, using it to improve their products or services, or offering data-related services.	Service provider; Service Provider; System Operator; Data as a Service
Mass customization	Mass customization involves offering products or services that are tailored to individual customer preferences or needs while still achieving economies of scale. It allows customers to personalize their purchases without significantly increasing production costs.	All the possible Business Owners?
Revenue sharing	In this model, multiple parties share the revenue generated from a product, service, or business venture. This can occur in various forms such as platform businesses where third-party sellers share revenue with the platform owner, franchise models, or joint ventures.	Railway Undertaking; System Operator as a whole; Investors / Creditors
Direct selling model	In this model, products or services are sold directly to consumers without intermediaries through channels like e-commerce platforms or company-owned stores. Customers typically pay a set price per unit purchased..	Carrier Owner/Rental Company; Transport Unit Owner/Rental Company; Private Transport Unit Owner; Carrier / TU manufacturer

Appendix 2: Worksheet of the Workshop: "Determination of Business Cases"

Task 1: Please list possible Business Owners associated with the Business Models as indicated in WP4 T4.1. → **Task 2: Please determine possible Business Cases based on the identified Business Owner.**

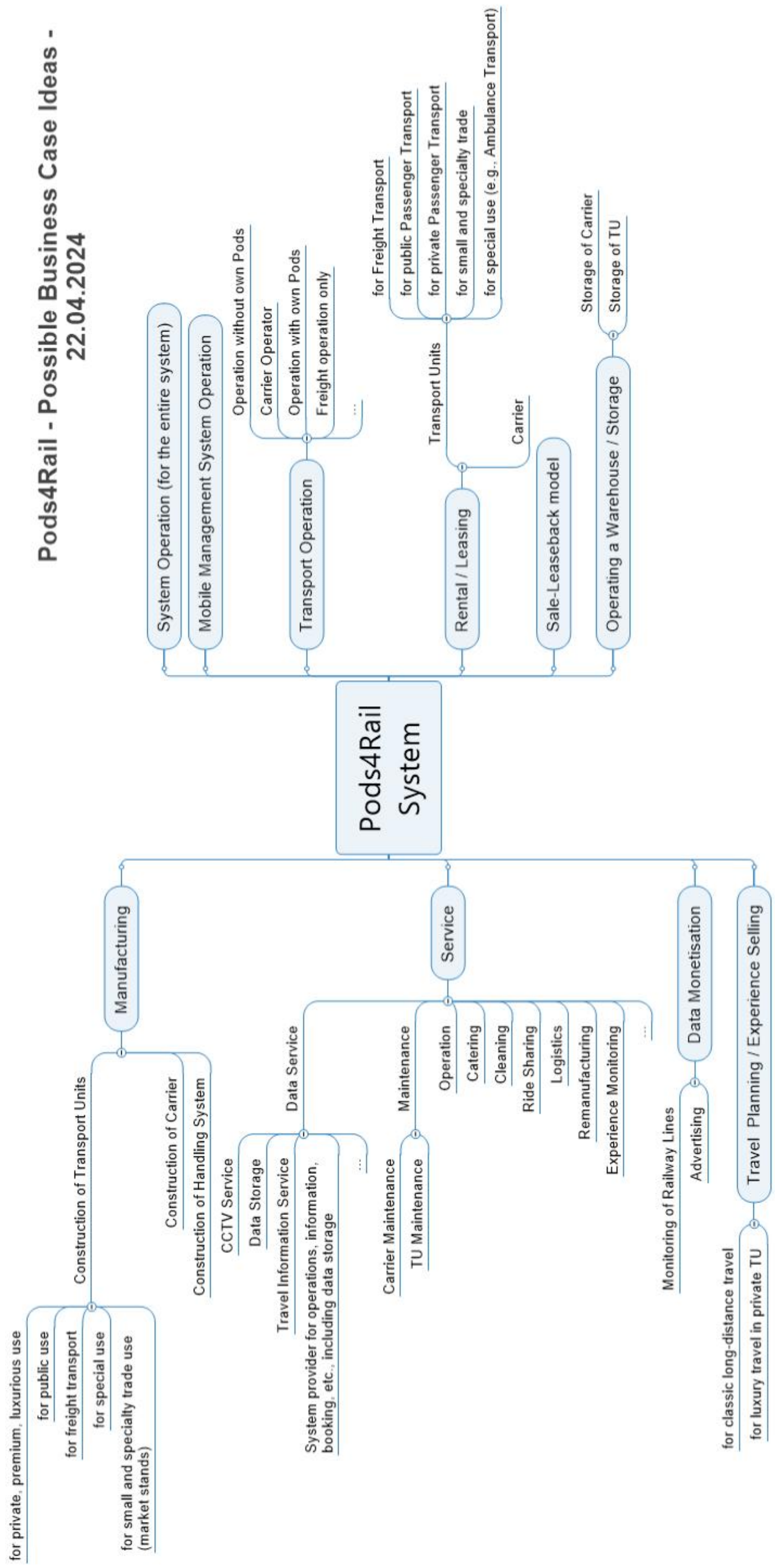
Pods4Rail WP5 Task 5.1 : Developing of (a) generic Business Case(s)

Business Modells (WP4 T4.1)	Short Explanation	Identified Business Owner
Product-as-a-service model	This model involves offering products to customers on a subscription basis or through pay-as-you-go/pay-per-use pricing models rather than selling them outright. Customers pay for the utility or value derived from the product rather than owning it outright.	Railway Manafacturer; ~~Signalling service companies~~; Service provider; System operator → Railway operator → TOCs; Governments and similar administrations; Carrier owner/Rental company → POD owners (like container owners); Swap-Boda Manufacturer; Data Storage Company; Travel Agent; Bus Manufacturer; Software service companies → App-Developer; Caravan Manufacturer; Catetering Company; Container Manufacturer
Dynamic pricing model	In this model, prices for products or services are continuously adjusted based on various factors such as demand, time of day, competitor pricing, and customer demographics. This allows businesses to optimize revenue by charging higher prices when demand is high and lower prices when demand is low.	Freight transport company using pods and optimising for capacity use; Passenger transport company using pods and optimising for capacity use; Railway operator
Integrator	An integrator business model involves bringing together various products, services, or technologies to provide a comprehensive solution to customers. Integrators add value by seamlessly combining different components into a cohesive offering that addresses specific customer needs or challenges.	~~Trnasport Unit Owner~~; Companies like Siemens and Alstom; ~~System operator~~; Companies like Honeywell; ~~DB~~
Sale-leaseback model	This model involves selling an asset (such as real estate or equipment) to a buyer who then leases it back to the seller. It allows the seller to access capital tied up in the asset while still retaining its use through a lease agreement.	Investors / Creditors; Any large asset owner/lease company; Warehouse owner; Asset finance; public transport companies, logistics companies, government agencies, ...; manufacture and sale to a leasing company (focuses on the transport sector); long-term leasing contracts with a fixed (monthly) rental payment and comprehensive maintenance and services: data services, insurance services, operation services, maintenance/(technology/components) update services, end of leasing contract: remanufacturing/new models, (disassembling factory); carrier (cross modal): TU mass transport, TU premium transport, TU freight, TU combined, TU special transport (-> use cases), warehousing

Freemium model	This model offers a basic version of a product or service for free (the "freemium" version) while charging for premium features or functionality. It allows businesses to attract a large user base with the free version and then convert some of them into paying customers by offering additional features or services.	Travel Agent Travel agent System Operator as a whole Servide provider Service Provider software ...
Leasing model	Instead of purchasing a product outright, customers can lease or rent it for a specific period, typically paying a recurring fee. This model is often used for expensive items like cars, equipment, or property, allowing customers to access the benefits of the product without the upfront cost of ownership.	Transport Unit Owner/Rental Company Carrier Owner/Rental Company Train leasing companies System operator (New) pod (TU) leasing companies Automotive leasing companies Private Transport Unit Owner Private Transport Unit owner Truck leasing companies carrier (cross modal) TU mass transport TU premium transport TU freight transport TU combined transport TU special transport (-> use cases) warehousing
Fractionalised ownership (sharing)	This model involves multiple individuals or entities sharing ownership of a product or asset, typically through a platform or arrangement facilitated by a company. It allows people to access the benefits of ownership without bearing the full cost and responsibility.	Private Transport Unit owner Transport Unit Owner/Rental Company Carrier Owner/Rental Company Railway Undertaking Different regional governments that together want to kickstart the technology Private enterprises that buy a number of pods for sharing it (individual manage as a company)
Experience selling	This model focuses on selling not just a product or service but also the experience associated with it. It involves creating memorable and positive experiences for customers throughout their interaction with the brand, leading to increased customer satisfaction and loyalty.	Transport unit owner Travel Agent Travel Agent System Operator Servide provider Railway Undertaking Companies like Apple experience publishing channels (with advertizing opportunities) Bad experience / complaints management (reducing impact on future demand) app/service for sharing experiences Agreements with specialized enterprises for the developing of an efficient app to make the booking process more quick and easy Agreements with governments or other entities for discounts for specific groups of people (e.g. kids) 'Party-Pods' / 'Meeting Pods' experience (celebrations, anniversaries with guests, business meetings) Agreements with multimedia content providers
Data monetization	This involves generating revenue by leveraging data assets, such as customer information or insights gathered from user behavior. Companies can monetize data by selling it to third parties, using it to improve their products or services, or offering data-related services.	Service provider Service Provider System Operator Data as a Service smart operational reporting service (KPIs, statistics, , mean or min transport times, etc) CCTV and safety data (service provider) can be used for differents surveys and comparations with other transport modes (e.g. number of Booking data Data provision service for keeping baseline data updated (infrastructure, temporary restrictions etc) Intermodal information service provision

Mass customization	Mass customization involves offering products or services that are tailored to individual customer preferences or needs while still achieving economies of scale. It allows customers to personalize their purchases without significantly increasing production costs.	All the possible Business Owners?	
Revenue sharing	In this model, multiple parties share the revenue generated from a product, service, or business venture. This can occur in various forms such as platform businesses where third-party sellers share revenue with the platform owner, franchise models, or joint ventures.	Railway Undertaking; System Operator as a whole; Investors / Creditors	Small scale delivery operations; Transportation of medical supplies to the home and to assisted living facilities
Direct selling model	In this model, products or services are sold directly to consumers without intermediaries through channels like e-commerce platforms or company-owned stores. Customers typically pay a set price per unit purchased..	Carrier Owner/Rental Company; Transport Unit Owner/Rental Company; Private Transport Unit Owner; Carrier / TU manufacturer	Small scale delivery operations; Transportation of medical supplies to the home and to assisted living facilities

Appendix 3: Overview of the brainstormed Pods4Rail Business Cases



Appendix 4: Collection of the determined Pod System Business Cases

Pods4Rail - Possible Business Case Ideas - 23.04.2024

	Business Case Idea				
No.	**Level 1**	**Level 2**	**Level 3**	**Example of Use Case (WP4, T4.1)**	**Example of possible Business Owner / Stackholder**
1	System Operation (for the entire system)				Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis)
2	Mobile Management System (MMS) Operation				Railway Undertaking (e.g., DB AG, ÖBB), Digital Technology / IT Companies (e.g., Alphabet, IBM)
3	Transport Service (w/o MMS) / Mass customization Model				
3.1		Passenger Transport w/o own Pods			
3.1.1			on Railway	Public & Private Transport	Railway Undertaking (e.g., DB Regio, ÖBB), Transport Companies (e.g., agilis, Keolis)
3.1.2			on Road	Public & Private Transport	Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis), Bus Companies
3.1.3			within every transport mode	Public & Private Transport	Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis), Bus Companies
3.2		Passenger transport with own Pods			
3.2.1			on Railway	Public & Private Transport	Railway Undertaking (e.g., DB Regio, ÖBB), Transport Companies (e.g., agilis, Keolis)
3.2.2			on Road	Public & Private Transport	Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis), Bus Companies
3.2.3			within every transport mode	Public & Private Transport	Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis), Bus Companies
3.3		Carrier Operator			
			on Railway		Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis)
			on Road		Transport Companies (e.g., agilis, Keolis), Bus Companies, Logistics, Freight Forwarding and Transport Companies
			within every transport mode		Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis, Keolis), Bus Companies, Logistics, Freight Forwarding and Transport Companies
3.4		Freight Transport only			Railway Undertaking (e.g., DB AG, ÖBB), Rail Freight Operators (e.g., HUPAC, VTG), Logistics and Transport Companies (e.g., Hapag-Lloyd AG, DACHSER, DHL)
3.4.1			on Railway	Parcel delivery, General freight, Special applications	Railway Undertaking (e.g., DB AG, ÖBB), Rail Freight Operators (e.g., HUPAC, VTG), Logistics and Transport Companies (e.g., Hapag-Lloyd AG, DACHSER, DHL)
3.4.2			on Road	Parcel delivery, General freight, Special applications	Logistics, Freight Forwarding and Transport Companies (e.g., Hapag-Lloyd AG, DACHSER, DHL)
3.4.3			within every transport mode	Parcel delivery, General freight, Special applications	Railway Undertaking (e.g., DB AG, ÖBB), Rail Freight Operators (e.g., HUPAC, VTG), Logistics, Freight Forwarding and Transport Companies
4	Rental / Leasing Model				
4.1		of Transport Units (TU)			
4.1.1			for Freight Transport	Parcel delivery, General freight, Special applications	Company for rental of container or swap bodies, Freight Cars Leasing Companies (e.g., GATX, TRANSWAGGON)
4.1.2			for public Passenger Transport	Public transport	Rolling Stock Leasing Companies (e.g., Akiem, Alpha-Trains, Angel Trains, Beacon Rail)
4.1.3			for private Passenger Transport	Private transport	Car Rental Companies (e.g., SIXT), Caravan Rental Company
4.1.4			for small and specialty trade	Service-to-people transport, Temporary space	Company for rental of containers
			for special use (e.g., Ambulance Transport)	Special applications	
4.2		of Carrier			
4.2.1			for Railway Carrier		Rolling Stock Leasing Companies (e.g., Akiem, RAILPOOL, Porterbrook)
4.2.2			for Road Carrier		Truck Leasing Company (e.g., Penske Truck Leasing)
4.3		of Energie Supply Application	for Road Carrier	Energy supply application	Car Rental Companies (e.g., SIXT), Caravan Rental Company
5	Sale-Leaseback Model				Public Transport Companies, Logistics Companies, Government Agencies, Manufacture to a sale to leasing company (focuses on the transport sector), long-term leasing contracts with a fixed (monthly) rental payment and comprehensive maintenance and services: data services, insurance services, operation services, maintenance/(technology/components) update services, end of leasing contract: remanufacturing/new models, (disassembling factory)
5.1		of Transport Units (TU)			
			Mass transport	Mass passenger public transport (UC4)	
			Premium Transport	Premium passenger private transport (UC6)	
			Freight Transport	Parcel delivery, General freight, Special applications	
			Combined Transport	Service-to-people transport, Temporary space	
			Special Transport	Special applications	
5.2		of Carrier (cross-modal)			
5.3		Warehousing (see 6)			
6	Operating a Warehouse / Storage				
6.1		for Carrier			
6.2		for TU			
7	Travel Planning / Experience Selling Model				
7.1		for classic long-distance travel			Travel Agents (e.g., TUI)
7.2		for luxury travel in private TU			Travel Agents (e.g., Abercrombie & Kent, Black Tomato)
7.3		'Party-Pods' / 'Meeting Pods' experience (celebrations, anniversaries with guests, business meetings)			Travel Agents (e.g., TUI)
7.4		app/service for sharing experiences			System Operator

7.4.1			Agreements with specialized enterprises for the developing of an efficient app to make the booking process more quick and easy		Service provider
7.4.2			experience publishing channels (with advertizing opportunities)		Railway Undertaking, Companies like Apple
7.4.3			Agreements with governments or other entities for discounts for specific groups of people (e.g. kids)		Service provider
7.4.4			Agreements with multimedia content providers		Service provider
8	Manufacturing				
8.1		of Transport Units			
8.1.1			for private, premium, luxurious use		Caravan Manufacturer
8.1.2			for public use		Railway Manufacturer (e.g. Alstom, CAF, Siemens Mobility), Bus Manufacturer (e.g., Solaris, MAN)
8.1.3			for freight transport		Container Manufacturer
8.1.4			for special use		Ambulance Manufacturer (e.g., aramed, System Strobel)
8.1.5			for small and specialty trade use (market stands)		Container Manufacturer (e.g. algeco), Manufacturer of Trailers (e.g., Borco Höhns, multitrailer)
8.1.6			for passenger and parcel transport		
8.2		of Carrier			
8.2.1			for Railway		Railway Manufacturer (e.g. Alstom, CAF, Siemens Mobility)
8.2.1			for Railway		Railway Manufacturer (e.g. Alstom, CAF, Siemens Mobility)
8.2.2			for Road		Truck Manufacturer (e.g., MAN, Renault), Car Manufacturer (e.g., VW, Tesla)
8.2.3			for Ropway / Funicular		Ropway Manufacturer (e.g., Doppelmayr, Leitner)
8.3		of Handling System			Manufacturer of Cranes or Handling Systems (e.g., ABUS, Thyssen-Krupp)
8.4		of Components / Subsystems	...		
9	Service / Product-as-a-Service Model				
9.1		Data Service			
9.1.1			System Provider for Operation, except information, booking, etc.		Railway Undertaking (e.g., DB AG, ÖBB), IT Companies
9.1.2			Travel Information Service		Travel Information Companies (e.g., Thales Group, Siemens Mobility, Garmin Ltd., Kapsch TrafficCom, Tomtom Int., Q-Free ASA)
9.1.3			Data Storage / Cloude Providing		Data Storage Companies (e.g., Dell, IBM, Google Drive)
9.1.4			CCTV Service		Securitie Companies (e.g., IBM, SECUINFRA), Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis)
9.1.5			Digital Experience Monitoring		
9.1.6			Asset-Management		
9.1.7			Data Communication Service		Mobile Services Provider (e.g., T-Mobile, Vodafon)
9.2		Maintenance			
9.2.1			Full Pod Maintenance		Railway Undertaking (e.g., DB AG, ÖBB), Transport Companies (e.g., agilis), Railway Manufacturer (e.g. Alstom, CAF, Siemens Mobility)
9.2.2			Carrier Maintenance		Railway Undertaking (e.g., DB AG, ÖBB), Railway Manufacturer (e.g. Alstom, CAF, Siemens Mobility), Truck Maintenance Comp.
9.2.3			TU Maintenance		
9.3		Catering			Catering and Hospitality Companies (e.g. LSG Sky Chefs, gategroup)
9.4		Cleaning			Cleaning Copanies
9.5		Ridehailing / Trip Agent			Ridehailing / Trip Agent Companies (e.g., Uber, Flixbus)
9.6		Logistics			
9.6.1			for TU handling		
9.6.2			for TU transport		
9.7		Electric Charging			Electric Charging Companies (e.g., DB Energy, Vattenfall, Allego)
9.7		Electric Charging			Electric Charging Companies (e.g., DB Energy, Vattenfall, Allego)
9.8		Fast Battery Replacement			
9.9		Remanufacturing, Refurbishment			Railway Manufacturer (e.g. Alstom, CAF, Siemens Mobility), Bus Manufacturer (e.g., Iveco, Volvo)
10	Data Monetisation Model				
10.1		Monitoring of Railway Lines			
10.1.1			CCTV and safety data (service provider) can be used for differents surveys and comparations with other transport modes		Railway Undertaking (e.g., DB AG, ÖBB), IT Companies
10.1.2			Booking data		Railway Undertaking (e.g., DB AG, ÖBB), IT Companies
10.2		Advertising			
10.3		Data as a Service			
10.3.1			smart operational reporting service (KPIs, statistics, , mean or min transport times, etc)		Service Provider
10.3.2			Data provision service for keeping baseline data updated (infrastructure, temporary restrictions etc)		Service Provider
10.3.3			Intermodal information service provision		Service Provider
11	Architecture	of TU (mobile home) integration			Architects
12	Design	of TU interior			Designer
13	Direct selling Model				
14	Revenue sharing Model	Small scale delivery operations			
14.1			Use of pods as a delivery		Companies like McDonalds
14.2			Transportation of medical		
15	Freemium Model				
15.1		Entertainment Software while Pod-			Software Provider like Spotify, Xing, LinkedIn
15.2		Software for Booking Special			Travel Agents, Service Provider
16	Integrator Model				Companies like Siemens, Alstom, Honeywell
16.1		Manufacturing			

16.1.			of TU	Public & Private Transport	
16.1.			of Carrier	Public & Private Transport	
16.2		Leasing			
16.2.			of TU	Public & Private Transport	
16.2.			of Carrier	Public & Private Transport	
16.3		Service			
16.3.			Transport Service	Public & Private Transport	
16.3.			Customer Service	Public & Private Transport	
17	Dynamic Pricing Model				
17.1		Passenger Transport		Public & Private Transport	Railway Operator
17.2		Freight Transport		Parcel delivery, General	
18	Fractionalised Ownership				
18.1		for TU		Public & Private Transport	Private enterprises that buy a number of pods for sharing it (individual manage as a
18.2		for carrier		Public & Private Transport	Private enterprises that buy a number of pods for sharing it (individual manage as a

Appendix 5: Feasibility assessment of Pods4Rail Business Cases by Trafikverket experts

We kindly ask for your support:
The following catalogue provides an overview of possible Pods4Rail Business Cases.
The aim of the analysis is to assess the economic and technical feasibility of the Business Cases.
Please indicate in the column below the WP5 member's assessment whether you agree with the assessment and - if not - why?

Business Case 1:	Public Transport Service with rented TUs/Carrier
WP5 Member´s Assessment:	By offering a door-to-door service in combination with demand-responsive services, Pod Systems especially improve the mobility of people in rural areas. This creates significant value for passengers who are reliant on public transport due to age or health issues. Hence, making the use of Pod Systems attractive for the customer. Also, as the Pods/Carrier are rented in this Business Case, no high investment costs are required. This also applies to freight transport, where it is not only possible to offer a Freight Transport Service, but also a Combined Transport Service with Passengers and Parcels. Therefore, economically as well as technologically feasible for the Business Owner.
Do you agree? If "No", why?	Depends on the time perspective and what prerequisites are in place. If all the infrastructure is in place, then the business case might be feasible but it is a long way to get there.

Business Case 2:	Public Transport Service with own purchased TUs/Carrier
WP5 Member´s Assessment:	This Business Case again demonstrates the attractiveness of using the Pod Systems for passengers and customers of Freight companies. However, it is unclear to what extent passengers and customers notice the difference between rented and self-purchased Pods through the Pod Transport Service Company. For this Business Case, where the company operates with own purchased Pods, a large number of Pods would be required, leading to high investment costs. For this reason, this Business Case is not considered economically feasible in short-term, but eventually in long-term.
Do you agree? If "No", why?	Feels like a more viable business case on long-term but agree that the initial investment will be too big.

Business Case 3:	Private Passenger Transport Service with rented or purchased TUs/Carrier (Dynamic Price Customisation)

WP5 Member´s Assessment:	As Pod Systems can theoretically operate 24/7 and are able to offer Door2Door, this Business Case is considered feasible especially in cities with high tourism rates.
Do you agree? If "No", why?	No, the cost of offering taxis/Ubers is likely to be lower and that the passenger will not choose a Pod service if there are taxis/Ubers available.

Business Case 4:	Retail Service for Private Passenger Transport
WP5 Member´s Assessment:	A service company for transport and retail could meet different customer needs. It is both economically and technically feasible. (see Rotterdam)
Do you agree? If "No", why?	I don't know how the Rotterdam case looks like but important that there is a demand for it to work and that the pods are flexible to support different use case.

Business Case 5:	Freight Transport Service on Railway Stations for Logistics Companies
WP5 Member´s Assessment:	As this Service can be provided to a large number of logistics companies and their customers in and around railway stations, this Business Case is considered feasible.
Do you agree? If "No", why?	-

Business Case 6:	Transport Service of Bulky Baggage for Passenger on train stations or airport terminals
WP5 Member´s Assessment:	This Business Case will be considered economically and technically feasible due to the demand of baggage transport services at train stations and airport terminals.
Do you agree? If "No", why?	Yes ____ No, the extra cost will reduce the likelihood of success for such a business. Too little of added value.

Business Case 7:	Leasing/Rental Service of TU for the high-class transfer of passengers
WP5 Member´s Assessment:	There would be great potential for Rental Company of Transport Units to gain cooperation with local authorities or event organizations. For this reason, the Business Case is considered feasible.
Do you agree? If "No", why?	Yes ____ Perhaps, but not if the participant has to pay by themselves. Today's

	taxis/Ubers/Bolts will already supply the service.

Business Case 8:	Leasing/Rental Service of TUs for small and specialty trade (e.g. premium travel and leisure)
WP5 Member´s Assessment:	This Business Case is very attractive towards travel agents as they offer enhanced service through the Pods to the direct customer. Also, as the TU could be equipped for different occasions, such as "City Trip Pods" or "Party Pods", it covers a high range of segments, which is why the Business Case is considered as feasible.
Do you agree? If "No", why?	Yes ___________________________________ I'm not sure the business case is very attractive but if the pods are highly flexible with equipment and personalisation it would not mean much more additional costs for extra value.

Business Case 9:	Leasing/Rental Service of TUs for private passenger transport
WP5 Member´s Assessment:	With this Business, the rental company would have high investment costs for purchasing a fleet of Pods, which they would either have to factor into the price for renting the TUs or through a high rental rate. For the average customer, TU rental price could be too high, making this Business Case economically not feasible. However, as the costs for a driver would be cancelled due to the fully autonomous driving of the Pod Systems, the rental car price could be adjusted, which would then make the Business Case economically feasible.
Do you agree? If "No", why?	-

Business Case 10:	Ride hailing Service via Pod Systems for private passenger transport
WP5 Member´s Assessment:	As this Business Case could be described as Business Case 9, with the focus on the booking via an online platform, the Business Case is considered feasible.
Do you agree? If "No", why?	Yes

Business Case 11:	Ride-Pooling Service via Pod Systems for private passenger transport
WP5 Member´s Assessment:	As Pod Systems will drive fully autonomous, a driver for the "ride pooling service" is not required anymore. For this reason, this Business Case is considered not feasible for the driver/Franchise-Taker.
Do you agree? If “No”, why?	Yes, but could probably be combined with number 6 to make it feasible as a whole concept? ____ (i)If the rental company provides specific extra convenient booking possibilities, it might attract some attention by guaranteeing, for example, something valuable like a well-cleaned pod or well-equipped for travelling by night. (But then the same as 8?) (ii) No

Business Case 12:	Ride-Sharing Service via Pod Systems for Private Passenger Transport (Franchise)
WP5 Member´s Assessment:	As the revenue sharing Model allows investors to generate passive income while the ride sharing company maintains and services the Pods fleet and operates the ride sharing services, the Business Case is considered feasible.
Do you agree? If “No”, why?	Yes

Business Case 13:	Leasing/Rental Service of TUs for special use (e.g. Ambulance Transport)
WP5 Member´s Assessment:	In this case, hospitals could stock up on high-tech TUs without having to bear the cost of the equipment themselves, making the Business Case attractive to the customers. However, the rental service of modular medical Pods carries a high risk of the medical equipment being damaged or stolen, which would result in high financial losses. In order for this Business Case to be economically feasible, special measures must be taken to ensure that the TU is burglar-proof. In addition, the question remains as to whether hospitals would prefer to purchase in-house medical Pods in the long term.
Do you agree? If “No”, why?	-

Business Case 14:	Leasing/Rental Service of TU Fleets for healthcare institutions
WP5 Member´s Assessment:	In this case, healthcare institutions would benefit from the rental service as they would be provided with a TU fleet for their healthcare staff without having to bear the full acquisition costs for TUs. This makes the

	Business Case attractive for its customers and is therefore considered economically feasible.
Do you agree? If "No", why?	Could be specialised equipment easily be added and removed between transports, then the first scenario also could be feasible. ____________________________________ No, what special equipement?

Business Case 15:	Leasing/Rental Service of Carrier
WP5 Member´s Assessment:	This Business Case reflects more or less a Business Case of current Wagon Owners. For this reason, the Business Case is considered feasible.
Do you agree? If "No", why?	Yes

Business Case 16:	Leasing/Rental Service of Energy Supply Application for special purposes e.g. catastrophes etc.
WP5 Member´s Assessment:	As this Business Case would be considered as a niche product and would only be offered for special purposes such as catastrophes, it is required to ensure economic feasibility. For this reason, it is suggested for this Business Case to have the rental of the Energy Supply Application as one Offer of the company's portfolio alongside other renting services of TUs. In this case, the economic feasibility of this Business Case would be given.
Do you agree? If "No", why?	Yes

Business Case 17:	Sale and Lease Back of Transport Units
WP5 Member´s Assessment:	The aim of this Business Case is to optimise tax refunds for Investor, making the Business Case attractive for investors. Therefore, the Business Case is considered feasible. However, it should be mentioned that such a concept is not suitable for mass customisation.
Do you agree? If "No", why?	Yes ____________________________________ Travelling in night-time? Bringing kids to school/kindergarten/after school activities? Supporting in transportation of disabled/elderly people?

Business Case 18:	Warehouse Service for TUs and/or carriers
WP5 Member´s Assessment:	This Business Case is considered feasible due to the requirement of storage space, in particular when investing in a larger Pod fleet.
Do you agree? If "No", why?	Yes

Business Case 19:	Manufacturing of TUs and/or Carriers
Example describing how such a Business would operate:	Manufacturer produces TUs and/or carriers for local public transport. The TUs or carriers will be sold, for example, to a wide variety of customers ranging from local authorities and railway Operator to private customers.
WP5 Member´s Assessment:	As this Business Case is a prerequisite for all possible Business Cases of Pod Systems, it is considered feasible.
Do you agree? If "No", why?	Yes

Business Case 20:	Direct Selling Service of TUs and/or Carrier
WP5 Member´s Assessment:	Corresponds to Business Case xx "Manufacturing of TUs and/or Carriers". Hence, this Business Case is considered feasible.
Do you agree? If "No", why?	-

Business Case 21:	Maintenance and Repair service for TUs and/or carriers
WP5 Member´s Assessment:	Due to the wide range of customers, this Business Case is considered feasible.
Do you agree? If "No", why?	Yes

Business Case 22:	Data Services Company for Pods Systems
WP5 Member´s Assessment:	As digitalisation and the demand for data is increasing in all sectors for analysis purposes and as various comparable data service providers already exist, this Business Case is considered feasible.
Do you agree? If "No", why?	Yes

Business Case 23:	Catering Service for Pod System Operator
WP5 Member´s Assessment:	A Catering Service while travelling via Pod creates a unique experience for passengers and opens up additional revenue streams for Pod Operator, hence this Business Case is considered feasible. However, it is important to consider that catering is more likely to be offered for the premium sector. For the basic sector, small snack vending machines in TUs may

	provide a more suitable solution.
Do you agree? If "No", why?	Probably too much of a niche market. However, if customers can pre-order (like on long-distance trains) or if food is included in premium tickets, it might be feasible.

Business Case 24:	Cleaning Service of TUs for Pod System Operator
WP5 Member´s Assessment:	As the outsourcing of cleaning services is a common standard, this Business Case is considered feasible.
Do you agree? If "No", why?	Yes

Business Case 25:	Entertainment Software Service in TUs for Pod System Operator
WP5 Member´s Assessment:	Especially for passengers who travel for at least 15 minutes or who are frequent travellers, entertainment options during the journey play an important role. As this entertainment service can improve the customer experience for passengers, this service is considered feasible.
Do you agree? If "No", why?	Yes ____ Perhaps no, a prerequisite is to have all the necessary hardware installed.

Business Case 26:	Consulting and Implementation Services for Pod System Operator
WP5 Member´s Assessment:	As Pod Systems are an innovative mobility solution, such an integrative company can attract a high level of demand from key stakeholders such as railway undertakings, cities and communities. Hence, this Business Case is considered feasible.
Do you agree? If "No", why?	Yes

Business Case 27:	Offering and selling PODs network capacity to Transport System Operators
WP5 Member´s Assessment:	This Business Case is considered feasible because it follows well known principles for resource owners to offer and sell the use of the resource on a free and open market of TSOs operating on one and the same rail network including all related infrastructure facilities and services.
Do you agree? If "No", why?	-