HERMES PROJECT

HIGH EFFICIENT AND RELIABLE ARRANGEMENTS FOR CROSSMODAL TRANSPORT

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Introduction

In the past, intermodality has mainly been understood as related to the transfer of passengers between vehicles. Efforts have been undertaken in order to develop an intermodal infrastructure like railway stations at airports and transfer points with optimized transfer ways. Nevertheless fully integrated infrastructure has been an exception so far. On the demand side it is still unclear which level of intermodality is currently achieved. No proper measurement of intermodal behavior and no integrated statistical demand database exist, which could identify intermodal trips on a European level. This is mainly the outcome of the usually applied "modal view": transport statistics or surveys focus mainly on single modes and do not consider the underlying journeys that are often a combination of an access mode, one or more long-distance modes and an egress mode. Thus, it must be stated that up till today the users' requirements in terms of intermodality are not fully identified. Even the integrated concept of level of service is not fully matured and its implementation is hardly found. Recent research activities like the project "Towards Passenger Intermodality in the EU" (2004) created a work plan for the field of passenger intermodality and shed a first light on the users' requirements and their intermodal travel behavior.

The objective of HERMES, as defined in the European Commission in the 7FP work program, is the development and analysis of new mobility schemes and related organizational patterns at the interface and interconnection between long distance transport networks and local/regional transport networks of all modes. The concept under focus lies on the rational that it is possible to obtain better market share in long distance passenger transport modes (e.g. rail, coach or air transport) if only the "long-distance" part of the trip was considered by travelers for their modal choice. However, if the final destination is not easy to reach any of these advantages would be easily cancelled. Time spent on board the "long-distance" mode can be used to provide passengers with information about the best path from the arrival station to their final destination, and possibly also sell them valid tickets for that local transport, and to identify groups of passengers going to destinations close-by to one-another and organize, for example, a taxi or mini-van transport for them, selling the corresponding voucher aboard the "long-distance"

mode. These are conceptually simple operations, often requiring only some real-time telecommunication (such as the case of the train-taxi in the Netherlands) but there are organizational and contractual difficulties in its service provision that are invisible to the final customer. However, these services despite representing a small portion of the mobility chain offer an upgraded fluidity in the whole door to door trip and, as such, have a considerable influence on the public perception of transport attention to their needs and of the expected costs and difficulties of the local component of long distance transport. They represent the missing link of transport networks and will constitute the focal points of the present project.

More specifically, HERMES aims to identify and develop prototypes (i.e. examples) of suitable business models for intermodal or interconnecting services that will contribute to build sustainable mobility solutions. Prototypes of business models are examples that represent core aspects of a business, including purpose, offerings, strategies, infrastructure, organizational structures, trading practices, and operational processes and policies.

This Deliverable is part of the Work Package 2 (WP2) of HERMES project. WP2 aimed to develop prototypes of business models for improved interconnectivity and intermodality. A prototype of business models is here understood as an example of possible business models for intermodality, i.e. something to be tested against the real world. This is why we need to use the two expressions: prototype and business model. The Business Model concept is what we reflect in Figure 0.1 and it can assume a wide diversity of configurations that will be materialized in the proposed prototypes.

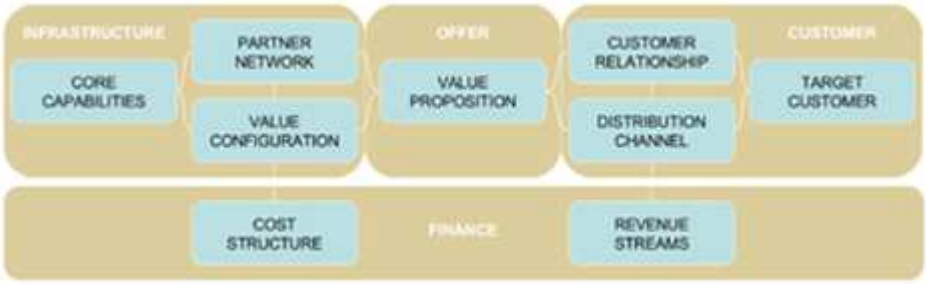


Figure 0.1 – Building blocks of a business model (source: Osterwalder 2004)

The prototypes of business models were designed based on the development of HERMES Case Studies. The Case Studies are reported in deliverable of WP5. Each case study focused on a specific real world case of intermodality. The current business model was assessed, along with the barriers for improved intermodality. Innovative business models were proposed for overcoming these barriers. The analysis of i) the current business models, ii) the barriers to improved intermodality, and iii) the proposal of business models provided information for the design of the prototypes.

Two fundamental types of barriers for improved intermodality were identified, accordingly with the nature of the problems they cause, being: problems in the link and problems in the nodes. The problems or issues in the links refer to problems related with the transport legs that prevent passengers to reach a given destination in a high quality intermodal service. The problems or issues in the nodes refer to problems in the terminal stations that make difficult for passengers transferring from one mode to another. As a consequence, two prototypes of business models have been elaborated.

This Deliverable is structured in 8 chapters. After this introductory chapter, follows the description of the methodological approach. Chapter 2 to Chapter 4 summarise the works of Task 2.1 to Task 2.4 and represent the body of knowledge that supported the development of the prototypes of business models (as explained in the Chapter 1). Chapter 2 defined the intermodal transport agents. Chapter 3 identified the needs and profiles of the passengers. Chapter 4 analyses the trans-boarding process. Chapter 5 presents the framework of business models used in HERMES project.

Chapter 5 briefly summarized the current business models of the Case Studies, as they are fully described in Deliverable 5. Chapter 6 presents the fundamental barriers of the Case Studies, that define the amount of prototypes. The prototypes are described in Chapter 7. The last chapter ends the Deliverable with the main conclusions.

1 Methodological Approach

Figure 1.1 schematises the methodological approach of WP2. The development of the prototypes of business models consisted in an iterative process of induction and validation stages. This iterative process was supported on the current body of knowledge on some domains and on the inputs from the advisory board.

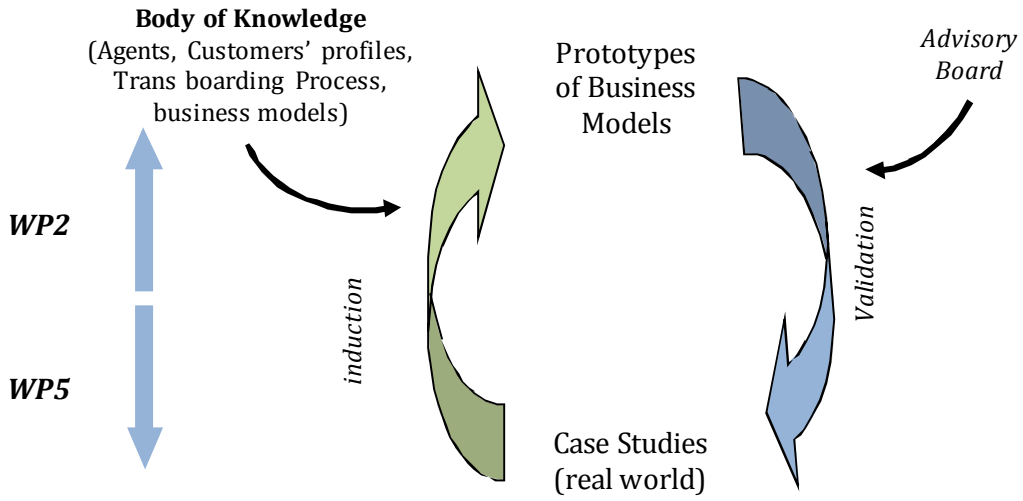


Figure 1.1 – Methodological approach of WP2

The Case Studies were the main source of information for the development of the prototypes of business models. The Case Studies are described in detail in WP5.

Based on the case studies description, the fundamental variables of the business models and of the barriers for improved intermodality were assessed. This assessment exercise was supported on the current body of knowledge on the following domains:

- nature of the intermodal transport agents;

- needs and profiles of the passengers';
- trans-boarding process.

The analysis of the barriers determined the amount of prototypes of business models. The design of the prototypes of business models was based on the framework of business model proposed by A. Osterwalder. This author proposed a framework based on nine building blocks. The analysis of a real activity's business model is done through the description and analysis of the building blocks. The next step in the methodological approach consisted in the validation of the prototypes of the business models. The validation was assessed through the case studies. Each case study assessed the validity of a prototype, accordingly with its fundamental barrier. The results of the validation were used to update the prototypes.

2 Identification of Agents Involved

2.1 Agents in the Transport Sector

Each one of the transport sectors that can compose an intermodal chain is constituted by several agents, with different functions, which allows the establishment of diversified types of relations between them. Nevertheless, it is possible to identify similar groups of agents amongst the transport sectors. These can be:

- Users / Customers – People whose purpose is to go from an origin to a destination;
- Public Authorities – Entities responsible for regulating the transport activity, establishing minimum levels and assuring the most adequate functioning of the network. They are also the entities to which users complain when unfair situations happen;
- Infrastructure Managers – Entities responsible for managing the infrastructures necessary for the vehicles and transport systems to function. These infrastructures can either be dedicated to several transport means (ex.: the intermodal stations) or just one (ex.; a urban bus stop or the rail lines);

- Transport Operators – Entities responsible for providing the transport services;
- Producers of Transport Means – Enterprises that produce the several types of vehicles used to transport passengers;
- Producers of Systems and Information – Entities that develop and produce the technologic systems to be applied in the transportation equipments so that the activity of transportation can benefit from an enhancement of efficiency. Amongst these can be referred:
    - traffic management systems;
    - instruments to improve allocation of scarce transport infrastructures (financial instruments such as congestion charges, the trade of rights to the use of the infrastructures, …);
    - information and communication systems which are essential to coordinate intermodal timetables, to provide intermodal real-time electronic information and transaction systems;
- The Government – despite do not directly perform in an intermodal transport system, is the entity responsible for the coordination of land use planning, to ensure the best allocation of resources.

There are agents that establish relations with almost all intermodal players of the several transport means: they are the travel agents. A travel agent is any individual or company that sells, resells, or offers to sell travel tickets, makes or offers to make travel arrangements or advertises any of those things (Business Licensing Authority Victoria). Many businesses are regarded as travel agents, including retail and corporate agents, tour wholesalers, consolidators, inbound tour operators, general sales agents, some bus or coach operators and some airlines. In this way, contracts and responsibilities must be set down between travel agents and providers of transport services and even authorities, so that the transport activity can be performed in a legal way.

So, to think about intermodal passengers transport systems it is to think about a system which main result is the transportation of passengers from an origin to a destination. In this process, given the integration of several transport means in the same route, one must think about terminals. Indeed, intermodal terminals, as

airports, stations, or ports, congregate several transport modes. In a certain route, a passenger can use one or more terminals to achieve the destination (Collet *et al*, 2008). In figure 2**Error! Reference source not found.** it is possible to see one example of a route and the several terminals that can be used to make it.

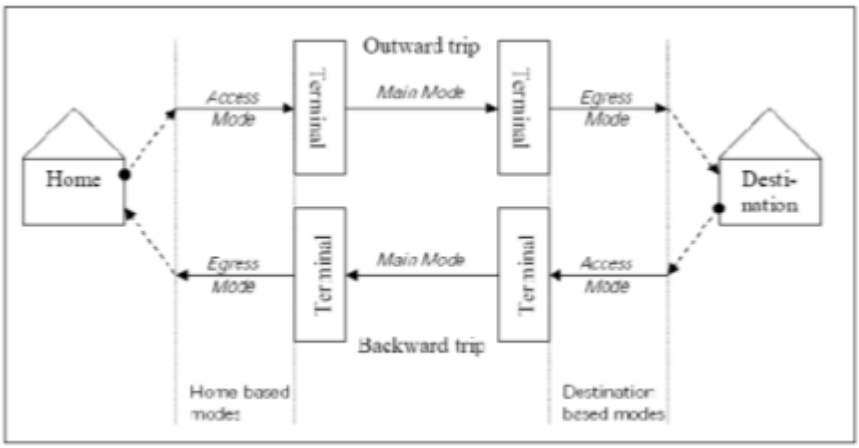


Figure 2.1 – Terminal Approach of Intermodality, Home and Destination Based Access and Egress Modes Schema (Source: Collet *et al.*, 2008)

Regarding it, one can understand the interdependencies of some of the agents previously described. For instance, if a traveler purpose is to leave home and arrive to its destination at a specific time, then the several transport operators must be integrated in a way that the end time of one leg happens before the star time of another leg of the route. For this, there must be a terminal that tries to coordinate schedules and provide up-to-date information to travelers. However, the producers of transport means should develop vehicles and other devices that meet travelers and transport operators' needs. Above this level, authorities should guarantee minimum services of level.

The existence of a great variety of agents in an intermodal chain often hinders the development of the transport activity. In fact, interests, roles and objectives of the several intermodal agents described in the past paragraphs justify the difficulty inherent to an optimization of the transport network. Meersman et al. (2000) states that the objectives of each transport player are not only different, as also change consonant one focus in the medium term or in the long term.

Table 2.1 – Objectives of the several agents in an intermodal transportation system (source: meersman et al, 2000, adapted)

Agent / Period Time	Long term	Medium Term (help to realize the long term ones and are more specific and easier to control)
Consumer / User of passenger public transport systems	Inter-temporal utility maximization	Punctuality and reliability, good connections and an optimal price/quality relation
Private producers or providers of transport services	Profit maximization	Profit Maximization: the way in which is realized will depend upon a number of intermediate targets such as the generation of added value, the increase of the market share, the improvement of safety and quality, etc. Which of those objectives are actually emphasized, will depend upon a number of factors such as the market structure, the mode and type of transport, the capital and ownership structure, etc
Companies	Using transport as an input for their production activities, this translates into profit maximization	Profit Maximization
Government	Maximization of social welfare. In general this implies guaranteeing economic efficiency and fair competition, safety and minimization of negative external effects	It will depend largely upon the mode of transport and the actual legal and market structure of the type of transport. To improve competition within and between modes, the intermediate targets are amongst others: fair and efficient pricing with internalization of external costs, transparency of the market, facilitation of market access, harmonization of competitive terms, etc. For the reduction of negative external effects a number of medium targets such as internalization of the external costs, the reduction of accidents, the promotion of public transport, etc., can be set.

Consequently, to assure that transportation of passengers is developed in an integrated way, taking advantage of the best characteristics of each transport mode, it is necessary to define minimum quality standards. In this way, the different agents must be interlinked in order to canalize their scarce resources to a

shared objective: provide the best quality of transportation services concerning its own resources.

Despite the common entities that are present in each transport sector, there are also some specific ones that should be noted. They exist in the maritime transport sector, but also in the rail, road and air transport sectors. In the following sections it is possible to see a detailed description of them.

2.1.1 Maritime Transport Agents

According to the European study *ABC da Intermodalidade* (2007), developed in the scope of INTERREG IIIB EC program, the agents for the maritime transport sector are:

- Passengers / Travelers – these are the one whose objective is to be transported between and origin and a destination. They are the main user of the transport system;
- Navigation Agents – Entities that exercise a set of activities in the name of carriers or ship-owners, namely: the fulfillment of the legal or contractual dispositions amongst port authorities or other authorities, and the celebration of maritime transport contracts (even though this last aspect is more relevant in freight transportation);
- Port Operator – Entities responsible for the loading, unloading and transshipment activities of cargo in ports. This activity is named of stowage and unstowage. In the passenger transport can be important when one consider passenger luggage and the goods needed for the well functioning of vessels and cruises;
- Port Work Enterprises – Enterprises that provide qualified workers for the stowage companies that operate in terminals;

2.1.2 Rail and Road Transport Agents

The agents that exist in the rail transport service are (ABC da Intermodalidade, 2007):

- Passengers / Travelers – the main users of the transport network;
- Rail / Road Infrastructures Managers – Organisms responsible for the management of rail infrastructures in what concerns: construction,

conservation, maintenance, heritage preservation and sources management. These entities grant the right to use railway / road infrastructure and also set and collect charges, make effort to meet all requests for capacity from all companies, and may cancel some trains paths if they are being under used. These entities can be public, private or both whether their capital is mainly supported by public or private sources;

- Rail / Road Transport Operators – The entities that provide rail / road transportation services to passengers and freight;
- Regulatory Authority – The Organism that regulates the sector. It is required to remedy the situation on the basis of the information it can obtain from all the parties concerned, in case of unfair or irregular situations;
- Land Transport Operator – The entity that provides traction services (in rail transport).

2.1.3 Air Transport Agents

In the air transport sector there is also some agents whose functions are similar to the ones of some agents described before. One can mention the airline operators and the airplane producers, as well as the regulatory bodies. They perform the role of providing the transportation services, the equipments used to transport passengers (and / or freight) and also the assurance of the most adequate functioning of the activity. Also, without a demand there is no point in providing transportation services. So, travelers are essential to an intermodal passenger transport service.

The infrastructure managers, in the case of the air transport, are the managers of airports. Airports used to be fully privatized infrastructures in the past. However, since the deregulation act in the USA, a trend has been perceived to privatize these facilities (Macário *et al*, 2009).

In this type of transport sector there is a specific agent whose role is fundamental to the development of the transport activity. It is the ground handling agent, which is responsible for the handling of passengers, luggage and freight, amongst others (Riga International Airport). Furthermore, it is the agent responsible for the services provided to an aircraft, while it is parked on the floor, usually at the

airport terminals. A distinction can be made between airside and landside services, the latter being passenger-related services such as ticketing and baggage handling at the check-in desks. Airside services comprise services such as ramp handling, fuelling and defueling operations, aircraft maintenance and the provision of catering services (European Commission – Mobility and Transport).

2.2 Relations between Intermodal Transport Agents

The several agents referred previously are, as it was already mentioned, interlinked somehow in order to develop transport services. However, the type of relations and the totality of roles of each of them is not defined yet (Rupprecht et al., 2010).

Nevertheless, in this paper it is presented an example of how the intermodal agents can be linked according to its functions (see **Error! Reference source not found.**). It must be said that the relations represented are not unique, nor even homogeneous considering the several Member-States of the *EU*, or the different transport modes. It only constitutes an attempt to organize the bilateral functions and interdependencies of each agent. Furthermore, the figure considers a transport sector in a very generalist approach, taking into account only some of the common transport sector players that exist in each transport mode.

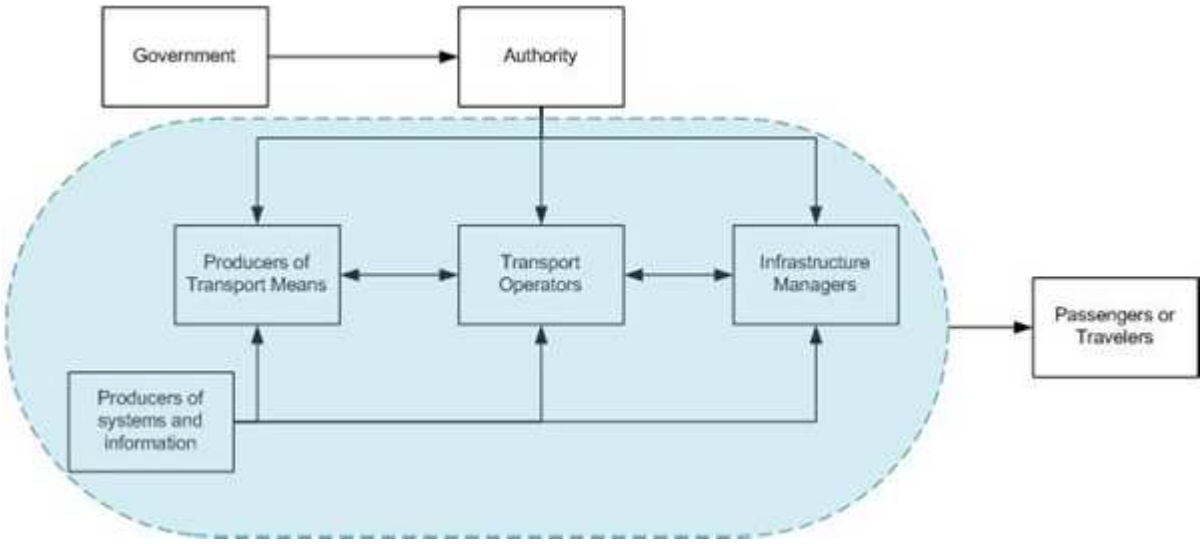


Figure 2.2 – Example of how the several intermodal agents can be interlinked

Regarding the figure, one should note that, in each country, the government is above all other agents, given its role in land use planning, accessing necessities of the population, namely, transport necessities, and defining priorities concerning the provision of transport services. Nevertheless, the government should follow communitarian advices and objectives.

Authorities, either public or private, should respect governmental directives and assure the well functioning of the transport system. To function, the transport system relies in three very important entities: the producers of transport means, the providers of transport services (transport operators), and the infrastructure managers. The producers of transport means deal directly with the providers of transport services, since the vehicles or other devices necessary to transport passengers should be in line with the real necessities of the transport service. For instance, if in one part of a city it makes sense to use bus vehicles of 50 people; in other peripheral regions it could be more efficient to use smaller vehicles. So, there should be cooperation between these two entities. Additionally, providers of transport services base its activities in consecutive periods of effective transport and stops at terminals. These terminals are managed by infrastructures managers, reason why there must be communication and integration of activities between these two organisms.

To be possible to communicate in several directions and regarding different levels of data complexity, the producers of data systems and information are irreplaceable. They provide agents with the up-to-date information on the activity of transportation, allowing also a more efficient management of services and an easier control of the transport system. More, they also facilitate communication between entities and allow passengers to access information about the transport services to use. The authority body assures the minimum levels of quality of the activities played by the four agents described before.

Passengers or travelers are the main agents in the intermodal transport system since, without demand; there is no sense in creating transport services. They should be the vital players of the transport network, and the focus of the services. All the organisms described before should be integrated and organized in order to perform according to users' expectations.

Beyond the simple relations described, complexity can be added to the scheme. Indeed, in an intermodal passenger transportation service, the time spent waiting at a multi-modal transit station is a key element in a passenger's assessment of transit service quality (Wardman, 2001). For this reason, passengers can be divided in two groups. Passengers with a small headway do not bother to consult timetables because vehicles arrive frequently. Therefore, these passengers tend to arrive at the station on a regular basis. On the contrary, passengers with a longer headway must consult timetables to reduce their waiting time. Therefore, these passengers tend to arrive close to the departure time. The main reason that impulses this behavior difference is that passengers need to use feeder services to get to the intermodal station and, later, the intercity transit service to reach the final destination (Hsu, 2010). Consequently, the waiting behaviors for these passengers will be affected not only by intercity transit performance, but also by the service characteristics of the feeder transit system (Debrezion et al., 2009). In figure 3 it is possible to see an example of the several time periods passengers use to wait in an intermodal connection.

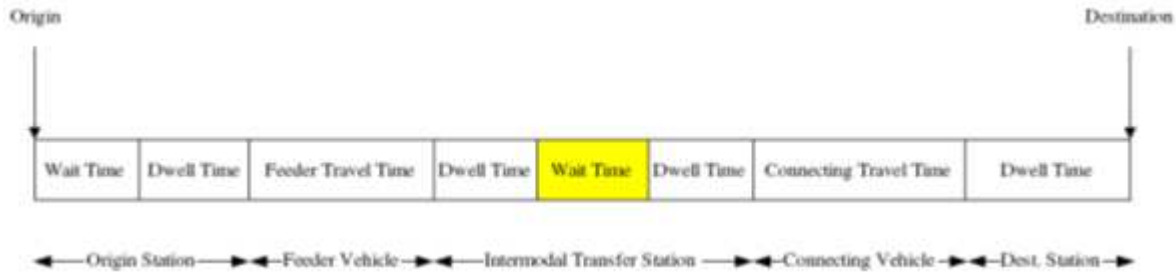


Figure 2.3 – COMPONENTS OF TOTAL TRAVEL TIME (SOURCE: HSU, 2010)

So, transport operators should also assure coordination of services and information between them, so that passengers feel the highest standards of quality (which means the less waiting tomes in intermodal stations). As Nielson *et al.* (2005, p.50) said: *"integrated planning of routes and timetables throughout the network is essential to competitive multi-modal public transport performance"*.

These relations are, as said, very generally described. There is no doubt that further research is needed to understand the singularities of each mode and produce a specific framework for each transport mode. Indeed, one of the difficulties inherent to the comprehension of the intermodal transport system relies in the fact that the way each transport mode is organized varies according to

the Member-State in analysis, as Mees (2000) and Banister (2005) concluded: *"transport systems for cities around the world are in different ways (…)"*.

3 Identification of Customer Needs and Profiles

3.1 The Relevance of Customers Needs

In what comes to developing a well organized intermodal trip and interchange node, with efficient services for the multimodal traveller (like for example baggage handling logistics or integrated ticketing), passenger perspective is the key element. The knowledge of customer needs at interchanges and while performing an intermodal journey is crucial for the constant improvement of intermodal services and consequent rising of user satisfaction. No matter how sophisticated the system can get, it will hardly reach the desired success if not serving the passengers. Therefore, having sound knowledge of passenger feedback is the first step towards providing successful intermodal journeys, especially in what concerns air-rail intermodality (Cokasova, 2003a and 2003b).

On the White Paper, the European Commission had shown its concern on improving the intermodality for multimodal travellers, especially for air-rail intermodality, which enlightens the importance of customer needs. Some mentioned instruments for this improvement were the possibility of integrated ticketing and a better management of baggage handling systems (White Paper, 2001).

When reviewing the literature about this issue, a paper about the evaluation of level of service for transfer passengers (which can be considered for this purpose as an intermodal trip) at airports was found. This paper concluded that transfer passengers have become an important market for many airlines and hub airports, and consequently the understanding and catering for the specific needs of this group was onsidered essential to attract demand in a competitive environment (Barros et. al., 2007).

While determining the barriers to intermodality, Europe's experience confirms that these could be sorted into three categories all directly or indirectly connected

to passengers: legal issues, distribution and passenger information, and operational integration (Cokasova, 2003b).

In terms of legal issues, the contracts between the entities of a multimodal journey (on the example of an air-rail multimodal travel, the airports, airlines, and railway companies) do not meet customer needs in case of loss or damage of baggage, delay or cancellation. Passengers will be reluctant to make an intermodal journey if their own safety and the safety of their luggage is not fully guaranteed, and it is sufficient to have one major accident/incident to modify their perspectives on intermodal travelling in general.

Concerning distribution and passenger information, the main problem is to enable the sale/purchase of air rail products technically feasible for air/rail operators, travel agencies, web sites and final customers. Another concern is to make available to travel agencies, rail and air operators, and final customers information about the existence of intermodal services.

Finally, when talking about the operational integration constraint, it is necessary to introduce some intermodal solutions that link modes of transportation. Just to mention a few examples, the possibility of doing the check-in to the flight while on the train, travelling to the airport, the availability of enough luggage storing space at trains and buses, or the existence of information systems and internet based intermodal platforms in order to disseminate information for the whole travel chain.

At the European level, there were already some efforts on putting user needs in the centre of intermodal travel schemes. The PIRATE project aimed to incorporate user and non-user requirements into guidelines for the design of transport interchanges and produced a handbook for the construction and operation of the "European Public Transport Interchange of Tomorrow". Aspects considered were:

- Connecting modes (e.g. walk environment overall quality, bike parking quality, car parking quality, etc.)
- Total impression (e.g. accessibility, attractiveness, personal security, etc.)
- Equipment and services (catering, ticket machines, etc.)
- Information (e.g. information about current traffic, travel, etc.)

- The station and the city (entrance accessibility, location) (CARISMA, 2000 and PIRATE, 2001).

The findings on this PIRATE project provided a detailed overview of user needs arranged by reference group as well as different access modes. The analysis of "Performance Gaps" demonstrated that user needs were to date not sufficiently accounted for when designing and constructing Public Transport Interchanges.

Some years after, this fact was also supported on the Final Report of the Analysis of the National Inventories on Passenger Intermodality, a report inserted in the EU's programme "Towards Passenger Intermodality in the EU". On this report it was said that at the European level numerous research projects have developed methods to assess user needs for information, interchanges, ticketing, luggage handling and accessibility, but such comprehensive user-needs specifications and design guidelines have rarely been transferred consistently to a national level methodology or standard (Müller et. al., 2004). However, it is stated on the same report that almost all national experts agreed on the importance of user needs assessments in planning intermodal investments.

On the air side, most of the air traffic actors have no exact knowledge of passenger's expectations and needs. A study based on user needs was undertaken by AENA's Barcelona Airport Planning Group, with the purpose of understanding delay expectations of passengers and their perception of delay. The final results shown that passengers' expectations are higher than the assumed by industry managers (Cokasova, 2003a).

One can conclude that customer needs and expectations have to be taken more in account in future intermodal arrangements in order to provide the more approximate possible services to what the user expects. The permanent monitoring of customer needs and satisfaction of intermodal transport users has to be a reality. In 2004, Müller et. al. wrote that at that time, monitoring of user needs and satisfaction were only undertaken on a sectoral level, where each operator measured the needs and satisfaction of their own customers. The operators were not very inclined to share the information gathered by these studies in order to make a case for and to justify new intermodal investments. A solution presented

was the possibility of an investment, by national governments, into high quality data collection on user perception, needs and satisfactions of intermodal travellers (Müller et. al., 2004).

However, users have different needs depending on various factors, for example the purpose of the trip, gender, personality, or frequency of intermodal travelling. People with special needs should also be taken in account when deffining customer needs. The identification of different profiles is therefore necessary to determine the needs for each of them, in order to better serve every person who may be entitled to an intermodal journey.

3.2 Identification of Customers Needs

Making a multimodal journey in Europe creates spontaneous impressions which are globally negative and which encompass the following predominant themes: lack of information, problem of local currency at connecting points, necessity of carrying luggage at interconnections, on the spot information mainly in local language, risk of error at connection points. These negative impressions are fuelled and supported by mainly five factors:

- The absence of pre-travel multimodal information;
- The perception of each transport mode as hermetically separate;
- The scarcity of multimodal information during the journey;
- The inexistence of combined tickets;
- The lack of information and comprehension of the codes and idioms peculiar to each country and transport mode (EuroTraCS D61, 1997).

Connected with these factors are a series of user needs that need to be properly identified and studied. Some studies, projects, and papers that identified user needs in terms of intermodality and connection between modes of transport were found. On this section, a resume of the main customer needs referred on the mentioned studies is presented, with special reference to the ones considered more important.

First it is important to determine on what users' perception of the quality of mode transfers is based. According to GUIDE project (1998-1999), the three main elements determining user's perceived quality of mode transfers are:

- Route conditions;
- Characteristics of the places crossed;
- Activities and services provided (CARISMA, 2000).

On the SWITCH project Evaluation Plan, a list of six factors and issues were defined to consider whilst assessing user needs and identifying intermodal barriers:

1. Logistical and operational – timetables, journey times, average waiting time at interchanges (from the arrival of one mode to the time of departure of another);
2. Economic – cost of tickets and affordability;
3. Psychological and social – users' fears and feelings for personal security, the need to overcome language, cultural, physical or sensory barriers, feelings of social exclusion due to socio-economic status;
4. System information – information or instructions on how to operate ticketing machines;
5. Physical design – accessibility and pedestrian flow, vertical and horizontal physical obstacles between modes, availability of physical amenities, lighting, security cameras, ease of transfer, cleanliness, access to information, ticketing systems;
6. Local land planning, accessibility to places/centres of employment (services/industry) and services, leisure, shopping and other (SWITCH, 2001).

The COMPASS project defined four types of barriers to the cross border public transport. Not being necessarily an intermodal type of journey, these barriers are somehow connected to the ones that figure on intermodal journeys. A selection of the barriers that are connected both with intermodality and with customer needs was done and presented here. The four fields identified by COMPASS are: Information, Level of Service, Tariff, and Organizational, Legal and Institutional framework. The ones on this last field were found to be too connected with the cross border activity, and because of that are not transferable to intermodal issues on an obvious way. Only factors for the first three types of barriers are presented below.

- Barriers on information: language problems, availability of information, hardly understandable information content, etc;
- Barriers on level of service: too few lines, low frequency, too long transfer time, change of vehicles at the border, insufficient quality standard of vehicles, etc;
- Barriers on tariff: availability of full range of tickets (only selected types of tickets are available for the cross-border section, e.g. no multiple trip tickets, no weekly or monthly passes), complexity of the tariff system, no integration of the tariff systems, etc (COMPASS, 2002).

Also important to understand user needs in terms of intermodality is know which travel variables influence passengers' modal choice. Cokasova (2003a) grouped these variables in three main categories: time, expenses, and attractiveness and quality.

- Time – to travellers, time is more important than distance. Sensitivity to time varies mainly with the purpose and importance of the travel (business travellers tend to be more sensitive to time than economy travellers). Time can be split in two main parts: time travelled to the interchange and time spent at the interchange before the actual journey;
- Expenses – the majority of the passengers still looks for the least expensive modal choice, adjusting their needs with the prices. This variable is more significant to leisure travellers than to business travellers, although the latest figures show that business travellers, especially the individual business travellers (from a small company or working for themselves) are becoming extremely cost sensitive on very short haul flights or switching to low cost carriers;
- Attractiveness and quality – this is a variable gaining significantly more attention. Some examples about quality factors are passenger comfort, punctuality, influence from other transport modes, frequency, attractiveness of arrival and departure time and sensitivity of the transport mode to the weather conditions. When talking about passenger comfort the list of possibilities is huge. Just to mention a few and the more important, catering services, luggage handling, possibility to work on-board using lap-

top or talking on cellular phone, possibility to order taxi from board, magazines and different kinds of entertainment (Cokasova, 2003a).

IATA Project had the objectives of analyse the intermodality between air and rail and on one of its sections is focused on users' perspectives. It is referred on the project that policies have been changing from project managers and designers oriented view to a demand oriented view, taking in account demand needs (customer needs). Once again, the main modal choice factors were pointed out, also referring their effect on customers and market segmentation issues (table presented on Annex 1) (IATA Project, 2003).

CEN Workgroup (2003) defined a set of transport and mobility needs for intermodal travelers in terms of telematics:

- Information on timetables, fares, rules in the different European countries, so in the different languages;
- Easy comprehension of messages before, within and after the interchange areas a capability of messages to attract the attention of travelers;
- Easily available interchange possibilities among the different transport services;
- Quality and relevance of the contents of the performed messages;
- Easy support in planning the multimodal trip;
- Availability of information along the trip with real time and immediate information about any delays, also in transport modes other than the one which is used at a certain moment;
- Possibility to change the itinerary along the trip with the telematic support;
- Voice and data communication possibility along the trip;
- Possibility to buy tickets and pay them during the trip, not matter which is the chosen mode;
- Availability of other services concerning events in the place one is going to visit;
- Provide location-based warning/instructions in case of emergency/ natural disaster etc.;
- Support for global server-side personal information management for travelers in the planning and execution, feedback /feed forward phase;

- Availability of additional modal steps such as a booking a taxi at the end of the public transport modal phases.

Besides these, CEN also referred that public transport is, as the name implies, for the general public. A universal design or inclusive design must therefore be intended as a design which caters for the needs of all potential users and it must be remembered that travelers are people with different needs in terms of hearing, vision or physical. Accessibility to service facilities in society of today is taken for granted by all of us but yet, poor design of equipment as well as improper structure of service causes major obstacles to many users.

From the literature review made, it can be said that there are five main areas of needs for the intermodal traveler, concerned with:

- Security;
- Ticketing;
- Information;
- Baggage Handling;
- Interchanges (Infrastructure design and connections).

Each of these areas will have a more detailed description on the next sections.

Security

The White Paper (2001) says that the first transport user concern is security, and the intermodal traveler is no exception. Therefore, all the transport modes must guarantee a certain degree of security in order to not be excluded of the intermodal passengers' options.

Security is transversal to other areas of passenger needs, like Ticketing, Baggage Handling or Interchanges. On the ticketing area, for example, it is important that possible online transactions for the acquisition of intermodal tickets are secure. A secure baggage handling along the intermodal journey is also important to avoid baggage losses or damaging. Interchanges should be safe places and protected with security guards and CCTV systems, when possible.

On the MIMIC project, the fear of crime was presented as a serious deterrent to using public transport for most people. It was said that fear of physical attack and

violence and the danger of bicycle and car thefts are problems experienced at most interchange sites. Fear is often greater in the area near the interchange than within the interchange itself, where there are generally enough people present to provide a feeling of security (MIMIC, 1999). For an improving on intermodality at these sites, an effective security must be granted. MIMIC also presented some advices in terms of security at interchanges: "*good surveillance both inside and outside the interchange site; programs to train all staff employed in the interchange in personal care and assistance, and being approachable about fears for personal security; the use of CCTV (though passengers generally do not consider it a solution on its own); good lighting, both inside and outside the interchange; opening of shops and business activities in the interchange to make it a livelier and safer place*".

Ticketing

As it was said before, integrated ticketing is one of the purposed measures for improving customers' intermodality on the White Paper (2001) and therefore it has to be faced as one of their main needs.

Müller et. al. (2004) pointed out the fact that European intermodal travelers still have not their ticketing needs fully covered. Electronic ticketing systems are available on almost all, if not all, countries in Europe. The problem is that most smart card systems function over a relatively small area, they have few functions, and they don't always operate between all modes. They are therefore still not able to cover the needs of the intermodal long distance traveler.

Intermodal customers need an implementation of unified tickets, facilitating the use of all transport modes and reducing costs for travelers, as well as time spent queuing for tickets. A single ticket should allow travelers to use all transport modes in an area (MIMIC, 1999).

In terms of urban intermodality, some cities already have systems like the one mentioned before. In London, for example, if a traveler acquires the daily travel-card (also available for multiple days) he is entitled to travel both on the tube and buses along the whole day with the same ticket (Transport for London website). Also in Lisbon, with the *7Colinas* card, a similar system is available. These systems clearly promote intermodal travelling, since the possibility of combining modes of

transport to reach the final destination is given to the user without any additional charge.

The problem is for the interurban and international intermodal customer, where there is a need for more intermodal agreements between transport companies to enable a common reservation for the whole trip with a single ticket only.

Information

One of the more important factors for intermodal passengers is the information on their journey. There are two types of information and they are equally important, pre-trip information and information along the journey. The information along the journey is intimately related with the interchanges, so it will be also referred on the section about interchanges.

As it was said before, lack of information proved to be a serious barrier to intermodality. Usually, pre-trip information is lacking, and many potential users are intimated by the "unknown" or by the complexity of intermodal journeys.

Barros et al., on their paper on level of service evaluation for transfer passengers at airports (2007), pointed out some important information issues for this kind of passengers that is easily transferable for the intermodal traveler. According to a survey took while developing the paper, he concluded that the second most important factor to transfer passengers at BIA airport (the airport where the study took place) was the quality of the Flight Information Displays (FIDs). This also happens with the intermodal travelers, since they frequently search for information on the status of their trip in what concerns to the departure of the subsequent mode of transport. Especially on long distance intermodal trips, missing one of the modes of transport will have undesirable consequences, since the frequency of long distance travels is not always as high as the passenger would want. If the traveler has information systems available along the trip these situations may be avoided, or at least predicted on time to change for a different mode of transport that better serves customer needs.

Information that is easy to find and provides accurate and up-to-the-minute updates on their intermodal journey will be highly valued by the intermodal

traveler. The same conclusion applies to the quality of information at interchanges (guidance, signage, directions), which will be referred on the section about them.

MIMIC Project provided a series of recommendations in terms of intermodal information, both for pre-trip information, real-time information and information at interchanges. Information on expected duration of journey and frequency of connecting services at the interchanges are very important. This can be done with electronics or announcements, and with timetables clearly visible on board vehicles. Another important issue is that this information is provided in more than only local language, so that it can also serve foreign people that might use that mode of transport. Customers need personalized pre-trip information, telling them exactly where to start, the times of each link, and such useful information as platform or bus-stop numbers. Pre-trip information should be available as widely as possible (telephone, internet, televideo, radio bulletins, kiosks, etc.).

As for the information during the trip in urban journeys, vehicles should be equipped with information systems regarding intermodal changes, when their route serves important nodes of the transport network.

Baggage Handling

Another issue covered by the White Paper (2001) in terms of intermodal customers' needs is the question of baggage handling systems. Whether referring to private or business travels, the customers' first associations with baggage transport show that they are emotionally highly involved. Baggage seems to be a second identity and a part of their personality, which is at the same time felt to be a heavy weight. At a study about the importance of baggage, questioned people recalled situations where they felt handicapped owing to their baggage, including situations where business trips had become pointless because of lost baggage (EuroTraCS D41, 1997).

This is of major importance for the interurban and international intermodal customer, since the baggage carried on urban intermodal journeys is lighter or inexistent. The only component of urban transport that should be considered for this issue is the case of urban transport offering connections to large transport hubs (airports or HST train stations). On this case, urban transport vehicles should

offer enough space for the carrying of possible baggage that intermodal customers carry.

The case of baggage handling on intermodal journeys using Air and Rail modes of transport, in what concerns the customers' needs, has been widely studied on the EuroTraCS Project (EuroTraCS D41, 1997 and EuroTraCS D42, 1998). On this project, market and user needs were investigates at three levels:

- In creative workshops with intermodal passengers and experts;
- Telephone surveys of air passengers with check-in baggage;
- Conjoint studies in Germany and France to quantify the importance of components in baggage services and the benefits of individual components from the viewpoint to intermodal passengers with baggage and the willingness of potential user groups to pay for them.

From these investigations, it was concluded that the needs of travelers with respect to their baggage can be divided in four areas:

- Security for their baggage and guaranteed arrival;
- Freedom, convenience, relaxation for themselves;
- Lightness, freedom from worry, confidence;
- Indemnification for loss or damages.

Baggage and its transport is considered the negative dimension of travelling and is connected with a physic and psychic burden during the whole travel chain. On an air-rail intermodal journey, the part when the user is travelling by rail is considered to be the one that causes most baggage problems. This is extendable to all the modes of transport that access the airport, presenting problems such as lack of space in the vehicle, fear of theft, or handling problems while changing mode of transport.

On the EuroTraCS project some ideas for innovative baggage transport systems were given by the experts for multimodal passenger transport, matching very well the user needs formulated by the travelers at the workshops undertaken by the same project. These ideas were:

- Door-to-door baggage service (the drawback of this system is that travelers have to be at home at the time of collection and pack suitcases in time, earlier than before);
- Shift the point of check-in to an earlier interface in the journey;
- Information and control of location of baggage (intended to satisfy the security need of travelers and increase confidence in the system) (EuroTraCS D42, 1998).

Some examples of services that travelers are offered to make baggage transport to the airport easier and to avoid some (or even all) difficult interfaces were given on EuroTraCS. For example, in New York, Lufthansa customers can check in baggage at the city office, avoiding the inconvenient of having to carry the baggage to the airport on the day of the travel. A similar service is provided at Victoria Station, in London, where passengers can check in their luggage before the train journey and only have to worry about it when arriving the destination airport, after the flight.

Laplace et. al. (2005) also mentioned that the strong investments on rail access to main airports, especially in dedicated airport trains, favor the existence of intermodal agreements between air and rail operators allowing passengers to check-in for their flight at the rail station. However, some important conclusions regarding this issue were presented by Cokosova (2003b). On a study analyzing passengers' preferences in air-rail intermodal transport, the author concluded that 34% of the passengers inquired strongly deny willingness to spend money for luggage check-in at a railway station, 21% of respondents would pay extra charge for luggage to be delivered to their domicile, after they conducted their intermodal journey.

Interchanges

The quality of interchanges is probably the major need of the intermodal customer, because these have to gather conditions for almost all the other needs (security, baggage handling, or information needs, for example).

The EuroTraCS project (EuroTraCS D41, 1997) identified some of the problems related with baggage at airports that are likely to be extrapolated for the general interchange functioning. Among others, mobility problems were identified

regarding long walking distances and insufficient direction signs. As it will be seen next, the intermodal travelers need an appropriate interchange design and configuration in order to perform a seamless transfer between modes of transport.

Müller et. al. (2004) identified that deficiencies in the design, layout and functionality of interchanges may act as a barrier to intermodality. Customer needs are well known but often there are not accounted for properly. The connection between different modes of transport must permit short transfer times and serious hurdles are put up if the interchange does not meet the standards with regard to accessibility. The project also alerted for the need of personal security and comfort needs at the interchange being met.

On a survey undertaken on CARISMA project (2000), it was concluded that users judge transfer paths at interchanges in terms of:

- Length and walking time required to perform the transfer between modes of transport;
- Facilities offered for this purpose (escalators, lifts, etc.);
- Obstacles or unpleasant conditions encountered along the way.

On the same project it was also concluded that as far as the appearance and general characteristics of the interchanges are concerned, travelers were found to be indifferent to “aesthetics” while very sensitive to issues related to security and the activities existing within the places. Customers’ requirements for interchanges are still primarily or almost exclusively travel related, i.e. speed and simplicity of transfer. Optimizing intermodal transfer nodes would therefore have to involve mainly reduction of transfer time and only secondary an increased provision of activities and services such as shops and restaurants. Moreover the use of non-travel related services is suggested to be continued by the waiting time and consequently the mode of transport used. Thus users waiting for travel modes with lower frequencies of arrival and departure are more prone to use shops and other services than travelers using transport modes with higher frequencies (CARISMA, 2000).

Another project that addressed the physic design of infrastructures as a barrier to intermodality was the MIMIC Project (1999), where it is said that interchanges are

often not designed in a functionally optimal manner. In many cases the chosen design is the result of an "architectural competition", with the emphasis on the visual architecture of the building, the functionality taking a secondary role (e.g. poorly situated ticket offices, lack of lifts and ramps, lack of waiting areas). Sometimes distances to walk are not protected from rain or sun and exceed the walking distance which is considered to be acceptable. Level changes are not always provided with ramps, escalators or lifts, affecting on a high degree the mobility of passengers with special needs.

MIMIC also provided a set of recommendations to improve the physic design of interchanges for the use of intermodal customers, some of them being:

- When distances to be walked between modes exceed 200m, short-distance transport systems can be a solution;
- Protection from rain and sun should be provided along all walking links;
- Level changes should be avoided, but the installation of ramps, spacious lifts and escalators should be considered when these are necessary;
- Alternative secondary, "stair-free routes, with lifts or escalators, need to be signed;
- Comfortable and safe waiting areas are always needed, with good access to real-time information and such amenities as toilets and shops.

In what concerns information on the interchanges, these should be available on abundance and on different languages in order to serve the foreign intermodal travelers. Real-time information on delays, as well as on means' arrivals and departures, should be provided at any interchange site. Clear maps detailing transport routes/services are needed and should be available at stations and bus stops and visitor information centers. Staff at the interchange should be well-trained in providing information about all modes in the transport system and should be kept up to date with the current situation. Signalization needs to be clear, simple and color coded for an easy identification.

3.3 Travel Profiles

The referred customer needs have different magnitudes according to numerous factors, namely purpose of the trip (passenger type), geographical environment

and climate, living standard, cultural differences and others. Preferences and needs of passengers may also vary according to the hour of the day and according to the frequency of travels.

Cokasova (2003a) presented the results of a questionnaire undertaken in order to study the sensitivity of passengers to eight different travel factors (ticket price, price to/from airport/train station, travel time, time to/from airport/station, walking/waiting time, frequency, competition, on-board services), according to their travel purpose: business or leisure (economy). Participants were asked to assign the importance to each travel attribute on a 10-point scale and the results are shown on the next table (the higher the number the more sensitive passengers are to certain factor).

Table 3.1 – Results for Passengers' sensivity to travel factors (Source: Cokasova (2003a))

Travel attributes	Economy	Business
Journey Time	5.81	7.73
Ticket Price	7.53	3.56
Time to/from A/P or S	6.92	7.21
Price to/from A/P or S	4.92	3.13
Frequency	5.54	6.36
Walk/wait time	6.34	7.02
Competitiveness	5.20	4.08
On-board services	4.54	5.98

According to the results shown, passengers travelling for leisure purposes are most sensitive to the ticket price and the least sensitive to on-board services. On the other hand, business travellers give a higher value to journey time and are least sensitive to price to and from the airport or station. However, the author points out that this questionnaire covers a very specific group of people, with a high geographical sensitivity.

This difference between Private Travellers and Business Travellers was also studied on the EuroTraCS project (EuroTraCS D41, 1997) in what concerns baggage handling issues on intermodal journeys. In this respect, there are differences depending on the travel reason:

- Private Travellers, it is mainly the weight of the baggage and all connected mishaps and inconveniences that spoil the anticipation of their holidays and make the first and last day a torture. The traveller will have to recover from the train *"this shortens the holiday period, the first day is required for recovery"*;
- Business Travellers focus on the time problem and the eventuality of losing all baggage. Their tolerance towards problems is much smaller than that of private users. Everything must work right, one doesn't want to arrive sweating or in a complete rush. Arriving without baggage at a presentation or meeting equals a personal failure and can compromise the whole purpose of the trip.

On the SWITCH project (2001), users' categories considered, according to the types of journey, were:

- Commuting / education;
- Personal business (including shopping, health, social purpose, etc.);
- Holiday / day trip / business trip

After that, these groups were sub-categorized based on frequency of travel:

- Travellers who use public transport and services with regularity;
- Travellers who use public transport regularly but infrequently user services;
- Travellers who do not use public transport, are uncertain of the services, or who only infrequently use services.

Besides these groups, the accessibility audit considered the needs and requirements of disables persons with various impairments and of user groups whose mobility is, or might be restricted. SWITCH defined these groups as follows:

- The elderly;

- Persons using wheelchairs and pushchairs;
- Persons with heavy luggage;
- Pregnant women;
- Persons who are overweight;
- Persons who are particularly tall or short;
- Persons with visual and hearing impairments;
- Persons with learning difficulties.

The needs for elderly people were studied and defined by Müller et al. (2004). It is a fact that this target group has several special needs and requirements that have to be taken in account when investing in future passenger intermodality. In the UK, a qualitative DfT-funded research programme based on focus group conversations is a good example of the way the needs and requirements of this target group have been gathered. The following issues were revealed:

- The importance of accessibility at interchanges (more specifically the accessibility on foot is important due to problems with steps and limited access for wheelchair users);
- The lack of staff that can help elderly people at an interchange is seen as a weakness;
- Security and safety issues are getting more importance (e.g. the train is not favoured by elderly people due to overcrowded stations);
- The need of better information systems.

Travellers with special needs may be considered as one of the travel profiles to consider when planning intermodal arrangements. CEN Workgroup (2003) goes further and affirms that user needs should be defined taking into account needs of impaired people as a basis for standard requirements. The table is presented on Annex 2 the categories of impairment considered, descriptions of the physical impairment and related limitations to these people.

MIMIC (1999) also contains information on intermodal needs for the special users: "*Certain categories of passengers need special information (people with hearing or sight problems, people with learning difficulties). Acoustic signals and Braille maps can significantly help blind passengers. Good practice is given by the new*

underground stations on line A, recently opened in Rome (e.g. Musei Vaticani, Valle Aurelia), where Braille maps of the site and guided routes for blind people are available. Acoustic information for blind people can be found at most bus stops in Manchester".

Probably, the most complete characterization of intermodal users' profiles was found on the deliverable D61 of the EuroTraCS project (1997). This project divided intermodal travelers in seven categories compiling information like purpose of trips, frequency of intermodal traveling and personal characteristics. The categories defined were:

- The Experts;
- The Falsely-Experienced (Rebels);
- The Obsessed;
- The Investigators;
- The Intimidated;
- The Followers;
- The Calm and Collected.

A definition of the characteristics, strategies in dealing with multimodal journeys, spatial conduct, and specific needs for each of these profiles is given on the project report. Due to the length of this information, a table with all the relevant information was created and can be found on Annex 3.

4 Analysis of Trans-boarding Process

4.1 Introduction

The objective of this task is to analyze system behaviour when transport passenger modes with similar and different scales are crossed. To explore distribution passengers it is necessary to define the mechanisms of users' movements, including time, mode, and space of distributions between crossing networks.

This task is divided in four main stages. On the first stage, the analysis will focus on identifying information from literature and a set of case studies to define what is a

process and what types of processes exist, regarding the trans-boarding of passengers.

In the second stage, after the outcomes of these studies are known, there will be an in-depth analysis of the process of a model intermodal journey, focused on all the relevant activities to the developing of that journey, from the booking to the arrival at the final destination. This will be important for the understanding of the connection between different stages of the intermodal journey process and how the transfers between them are performed.

The third stage will be more focused on the trans-boarding of passengers itself, complemented with queuing theory elements and users distribution studies. The process will be described and analyzed and then, on the fourth stage, suggestions to the improvement of the trans-boarding process will be given.

4.2 Definition of process

A process consists of a sequence of interdependent and linked procedures or steps which, at every stage, consume one or more resources (employee time, energy, machines, money) to convert inputs (data, material, parts) into outputs. These outputs then serve as inputs for the next stage until a known goal or end result is accomplished [2]. The first step of defining a process is the establishment of its boundaries, which is where the process begins and ends and what is its objective. The beginning of a process starts with the necessity to obtain a determined objective, action that can be trigged by a person, another process, or work group. The process ends when the results get passed on to another person, process, or work group, or in other words, when the objective of the process is met [1].

The process to follow is as important as the results that are produced by it, since the final results are intrinsically connected to the way they were obtained. If a crucial step of the process is missed it affects the outcomes in a significant way, compromising their quality. Without a correct understanding of the process, it is hard to know how the results were achieved and if they are good or bad. If one thinks of the results as the final destination, then the process can be viewed as the means of transport and actions to be taken to get there, taking in account that

ideally the same means of transport and actions should be able to be used again, with a few modifications according to the desired destination.

Processes are applied to a variety of domains, from Science and Technology to Medicine, Biology or Psychology, not forgetting Business Activities and Computers. If we look deeper, also in everyday life processes are used, from the journeys to work to the confection of meals among all other activities of mankind. Basically, everything that has an objective to achieve is preceded by a process for achieving that objective. Processes itself are composed of smaller processes, such as defining the process architecture (the structural design of the process), managing the process (planning and monitoring the performance of a process) or modelling the process.

Process definition is probably the most important part of a process, since it lists what happens between the start and end points. It includes all the activities performed by each department, group, or person who are involved in the process. The definition of these activities, and also the time and place where they are performed, is crucial for the correct application of the process. Many processes do not stay in one department, but may span across several departments, so it is fundamental that each department knows exactly what to do and when to do it [1].

4.3 Intermodal Travel Process

On this section, the process of an intermodal travel will be described, analyzing in detail all the steps that compose it. For being the most common type of intermodal travels, the chosen journey to analyze was an Air-Rail journey. As it was referred before, every process has a goal, has specific inputs and outputs, uses resources, has a number of activities that are performed in a defined order, may affect more than one organizational unit, and creates value of some kind for the customer [3]. Therefore, the task to perform on this section is to identify all of these items when the process is an intermodal Air-Rail journey, in the optic of the passenger.

The goal of an intermodal journey (and of all journeys) is to reach the final destination as fast as possible, as cheap as possible, and with the maximum level of comfort and security possible. Given this goal, the process will be the sequence of activities that allow the passenger to do so. In terms of inputs, the travel process

has a particularity (common to the business processes) that is using information to tailor or complete their activities, which contrarily to the inputs on other processes is not consumed during its developing. Information is used as part of the process and may come from external sources, from customers, from internal organizational units and may even be the product of other processes [3]. The outputs of a journey are difficult to define, since there are no physical outputs that derive from it. However, information on how the different activities that compose the process of the journey occurred may be considered as an output, since these experiences are worthy to apply to other journeys of the same type. Finally, the resources used by the passenger to perform an intermodal trip are mainly two, time and money.

The activities that compose the process of an intermodal journey may be divided in three distinct groups: a) activities to perform prior to the journey; b) activities to perform during the journey; and c) activities to perform after the journey.

Referring to the first group of activities, the beginning of the process of an intermodal journey starts with the trigger to the realization of the journey, which may be moved by leisure, work, or personal motives. After the need of taking the journey is realized, the following stage for the passenger is to look for information on the different existing alternatives to reach the intended destination, choosing the one that offers the best service according to the passenger personal characteristics, the purpose of the journey, economic factors, and amount of time available to travel. This information may be gathered at travel agencies, ticket offices at train stations, bus hubs, or airports, but nowadays the most common way to do it is through an internet search. For the rest of the process description it will be assumed that the best alternative found was an Air-Rail intermodal journey. The final step on this group of activities is the booking of the trip, which similarly to the gather of information may be done at travel agencies, ticket offices, and most of the times using the internet. In some situations the booking of both the flight and the train are possible, but sometimes only the plane is available for previous booking. Some information is asked when the passenger is booking the journey, for instance if he is or not carrying any luggage, personal identification, among others. The sequence of activities pre-trip is represented on the scheme below.

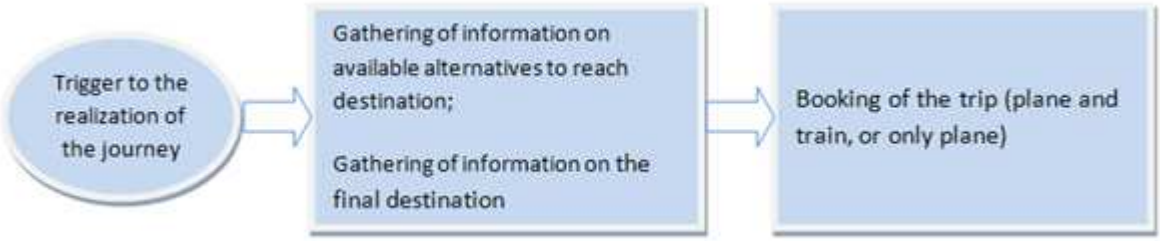


Figure 4.1 - Activities to perform before the journey

During the journey, as it was expected, is where most of the activities of the travelling process take place. These are represented, for the Air-Rail intermodal journey, on the following flow chart. The grey activities are the start and end point of the process, the green activities are activities that sometimes can be skipped, and the orange activity is the trans-boarding process, which will be analyzed in depth on the next section.

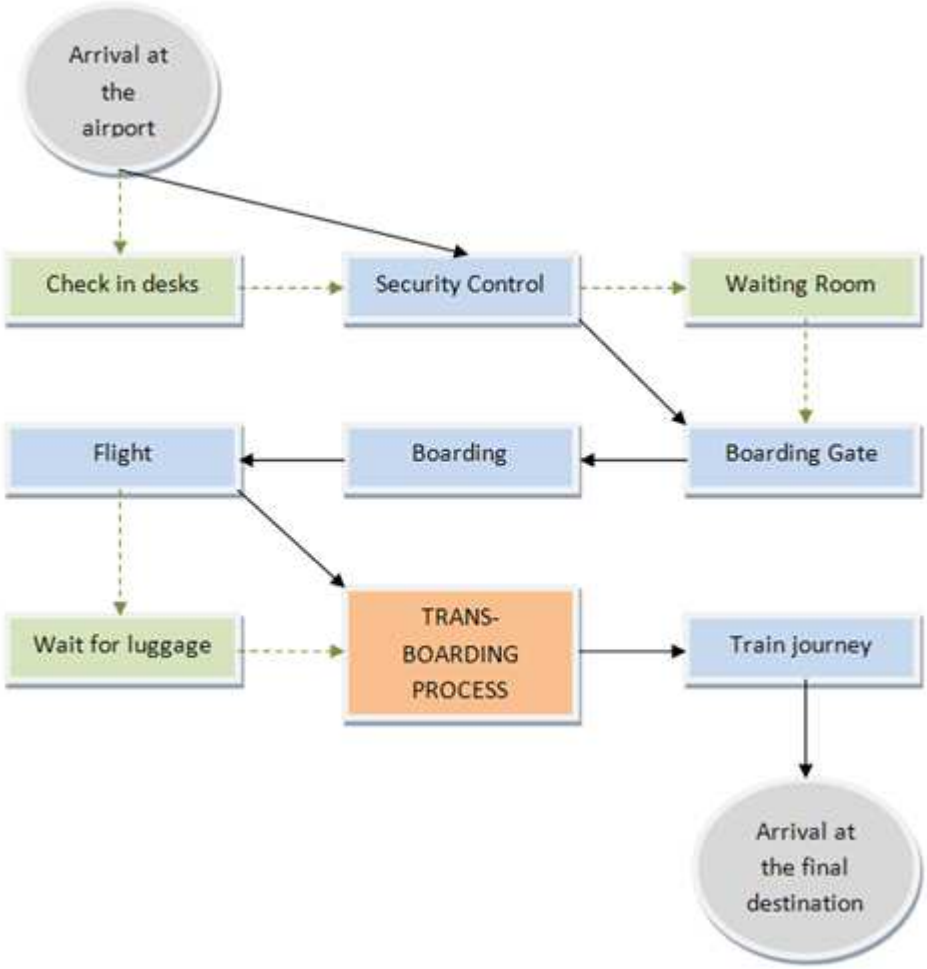


Figure 4.2 - Activities to perform during the journey

As it can be understood from the flow chart, the sequence of activities to perform during the journey starts with the arrival at the airport. When in the airport, the following step will depend on the luggage carried by the passenger and on the company that operates the flight, since there are some companies that do not require the passenger to go to the check in desks when carrying only hand luggage. The passengers that do not need to go to the check in desks go directly to the Security Control, where it is checked if the hand luggage or the passengers do not carry any items that are forbidden to carry on a plane cabin. The passengers that need to go to the check in desks also have to pass this Security Control, but only after checking in the luggage that cannot be carried inside the cabin.

After passing the Security Control there may be a waiting period if the passenger arrived earlier at the airport, which is described as "Waiting Room" on the flow chart (green activity). This period may be filled with multiple activities, from shopping at commercial zones inside the airport to eating at the restoration areas or simply waiting at the waiting room, where information on the flights is available. On the other hand, if the passenger arrives on time at the airport this activity may be skipped and the passenger goes straight to the boarding gate. The procedures at the boarding gate vary from company to company, but generally the identity of the passenger is confirmed and it is checked if the hand luggage fits the regulations for being carried on the cabin. What happens next is the boarding of the passengers, the correct storing of the hand luggage, and the attribution of seats, which may be or not pre-attributed at the moment of buying the tickets. This is followed by the flight itself, which does not have activities relevant to the intermodal travel process besides the possibility of having information on following means of transport. For example, some companies offer the possibility to buy tickets for subsequent means of transport, namely bus and train services to city centers on the destination.

Upon the arrival at the destination airport, if the passenger was travelling only with hand luggage, the step "Wait for luggage" is skipped. Otherwise, the passenger will have to wait for luggage at the luggage claim room before proceeding to the Trans-boarding process, which will be analyzed in depth on the next section, since it is the main scope of this task. After the Trans-boarding process is completed,

what follows is the train journey to the final destination, which is the final activity in the process of an intermodal Air-Rail journey, as it can be seen on the flow chart.

Finally, there are some activities that have to be performed after the journey is completed. These activities are exceptions, because if everything goes as predicted the end point of the process happens when the passenger arrives the final destination. However, if anything goes wrong with the passenger's luggage and it gets lost or transported to a different destination, more activities will occur on the process. The passenger has to alert the company responsible for the baggage handling process that his baggage is missing and the company proceed to its searching. After the luggage is found, the company is responsible to deliver it to the passenger at an address chosen by the passenger.

4.4 The Trans-boarding Process improvement

The trans-boarding process refers to the orange activity that is shown on the flow chart presented before and it represents the activities that happen between the arrival of the first mean of transport and the departure of the subsequent mean of transport (on the example given before, the landing of the plane and the departure of the train). A variety of activities take place in this period of the journey and they are crucial for the passenger final appreciation of the whole trip, so it can be said that if one intends to improve the passengers' perception of quality of an intermodal journey, the trans-boarding process is one of the most important activities to improve.

Once again, for a better understanding and a more visually attractive approach to the problem, the process will be described by a flow chart with the activities that are part of the sequence.

The activities represented on grey are the start and end points of the process, correspondently the "Landing of the airplane" and the "Boarding on train". The blue activities are the activities which the passenger must complete to perform the trans-boarding process and the green activities are the ones that in some specific situations may not take part on the process.

The trans-boarding between means of transport is intended to be as fast as possible. In order to improve the trans-boarding process one must understand

what are the main restrains to the smoothness of the sequence, which is in other words where the passenger losses more time. With that in mind, the sequence of activities presented before will be better described.

The sequence starts with the landing of the airplane, which is followed by a waiting period when the passengers are obliged to stay in the airplane until the staff transmits orders to leave the plane. There is nothing much to do against this, since there is no way to eliminate this waiting period or fill it with other activity. However, this period of time could be used to identify which passengers are entitled to a trans-boarding process following the flight and give them priority in leaving the plane to fasten the process. This identification could also be done during the flight instead of on the waiting period referred, using the waiting period to position the trans-boarding passengers near the exits of the plane.

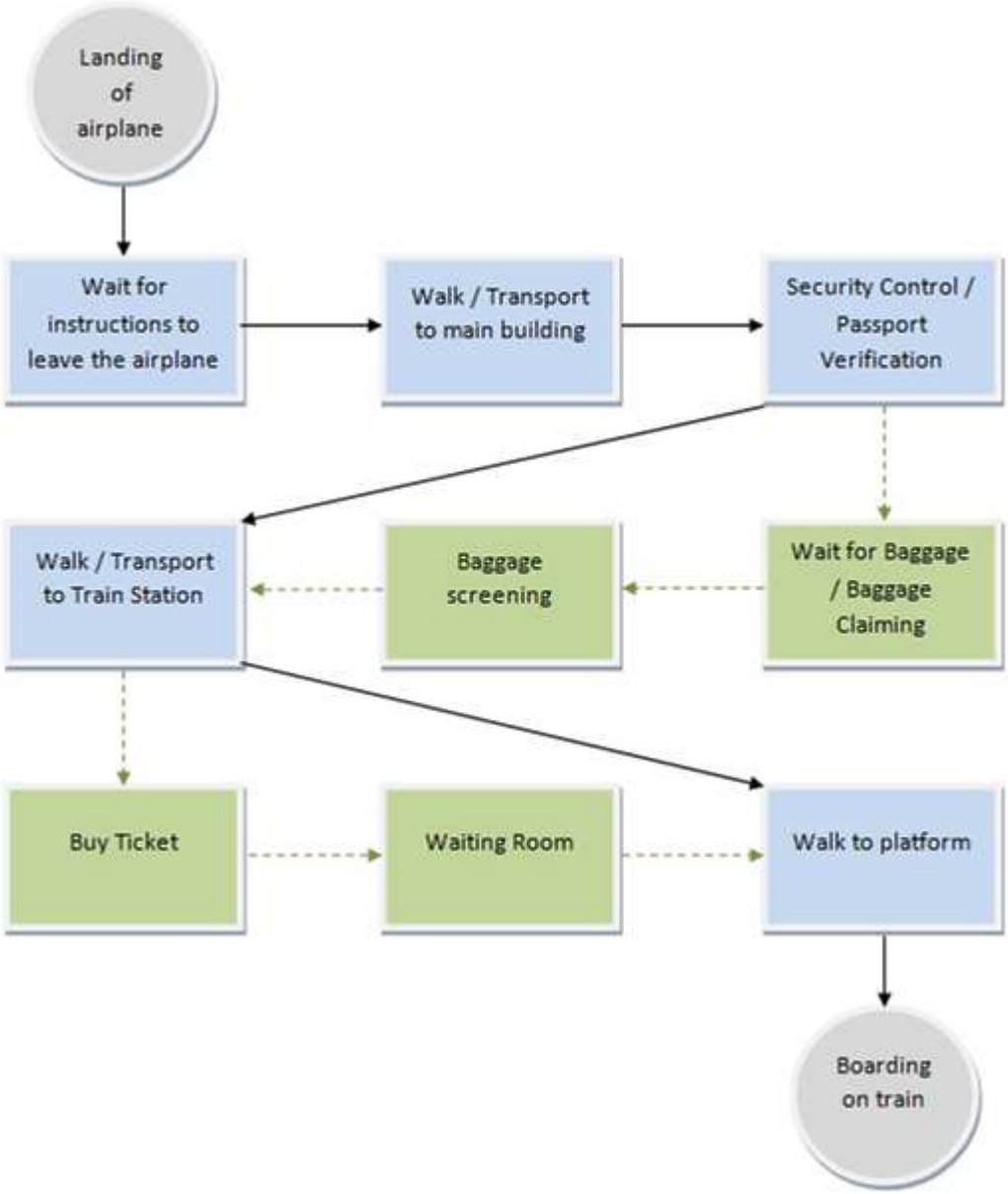


Figure 4.3 – Activities to perform during the trans-boarding process

"Walk / Transport to the main building" is the activity that follows. Most of the times the airplanes park as close as possible to the airport main building and the passengers walk to the building through jet bridges, but sometimes the airplane parking zone after landing is too far away from the airport main building, so the passengers must be transported by buses. Ideally, for a trans-boarding passenger, the better option would be the first because is the one that consumes less time. Therefore, if the identification of planes with more trans-boarding passengers was possible (for instance, when buying the tickets for a flight the passengers could provide information regarding if the flight is part of an intermodal journey or not),

a hierarchy of planes to park near the main building could be constructed, where the planes with more trans-boarding passengers would be the ones with priority to park near the main building.

Once the passenger reach the main building, they have to pass a "Security Control / Passport Verification", which will take more or less time according to factors such as countries of origin and arrival, number of control offices, number of flights arriving at that time of the day, and others. Of course the number of control offices must be coordinated with the number of flights arriving at each period of the day, but even with that in account the time lost in queues to passport verification and security control is sometimes significant. This might be a problem for a trans-boarding passenger with limited time to perform the movement between means of transport, so some alternatives could be provided. For example, there could be exclusive control offices for trans-boarding passengers already with ticket for the following mean of transport (otherwise there is no proof that the passenger is in fact performing a trans-boarding movement and everyone could use the exclusive control office).

If the situation of exclusive control offices is not possible (it may induce negative impacts on the level of service perspective of other passengers), the solution is to improve the Security Control process to its maximum, in order to provide a faster trans-boarding process. According to the arrival distribution, queuing theory can be used to provide the better service possible. As a system gets congested, the service delay in the system increases, and a good understanding between congestion and delay is essential for designing effective congestion control algorithms. Queuing Theory provides all the tools needed for this analysis [4].

The basis to understand Queuing Systems is the understanding of Little´s Theorem, which states that the average number of customers (N) can be determined by the equation $N = \lambda T$, where λ is the average customer arrival rate and T is the average service time for a customer. Considering the example of an airport where the passenger arrival rate (λ) doubles but the passengers still spend the same amount of time in the airport (T), this will double the number of passengers in the airport (N). On the other hand, if the passenger arrival rate remains the same but the

passengers spend the double of the time at the airport, this will also double the total number of passengers in the airport [4].

To further the understanding of a queuing system we have to dig deeper into the characteristics of the system that impact its performance. For the example above, queuing requirements of an airport security control office will depend upon factors like:

- How do passengers arrive in the security control office? Is it a small airport with less planes arriving (and consequently less passengers arriving and at determinate periods)? Or is it a large airport with constant arrival of planes and passengers arrive almost uninterruptedly?
- How much time do passengers spend at the security control office? Do passengers typically take the same amount of time? Or does the passenger service time varies with the type of passenger?
- How many security control offices does the airport have?

The above three points mentioned correspond to the three most important characteristics of a queuing system, respectively the Arrival Process, the Service Process, and the Number of Servers. Based on these characteristics, queuing systems can be classified by the convention A/S/n, where A is the arrival process, S is the service process and n is the number of servers. A and S can be any of following:

- M (Markov) – exponential probability density;
- D (Deterministic) – all customers have the same value;
- G (General) – any arbitrary probability distribution.

Through Queuing Theory, if one knows the characteristics of the passengers arriving and the arrival process, one can determine the ideal number of security control offices to have at an airport in the various periods of the day. In this way, an improvement of the security control system can be achieved, resulting in less time spent in the queues.

The two activities that follow the “Security Control / Passport Verification” activity are represented in green, which means they are not mandatory and may not occur

in some cases. The activity “Wait for Baggage / Baggage Claiming” only takes part of the process when the passenger is traveling with hold luggage and the activity “Baggage Screening” is only necessary on some countries with a higher security level. If the passenger is only traveling with hand luggage and if the country is one where baggage screening after the flight is not needed he may go directly to the train station (activity “Walk / Transport to Train Station”).

However, if the passenger travels with hold luggage, the activity “Wait for Baggage / Baggage Claiming” cannot be ignored, since sometimes it consumes a significant amount of time. A way to improve this situation for trans-boarding passengers is, similarly to what was proposed before, give some kind of priority to these passengers’ luggage. If the trans-boarding passengers identified their luggage as being a trans-boarding luggage, systems to put them out of the plane before other luggage could be created. A good possibility could also be the handling companies providing the transfer of the baggage directly to the subsequent mean of transport, saving a significant amount of time to the passenger and allowing the skip of this activity.

Upon the arrival of passengers, some countries require a screening of luggage before leaving the airport premises. On the case of a trans-boarding passenger arriving in one of these countries, the activity could be eased by giving priority to transfer passengers or having exclusive control offices for these passengers.

“Walk / Transport to the train station” is the activity that follows. The only way to improve this activity is to integrate the train station as much as possible with the airport, similarly to what happens in Barajas airport (Madrid), where the Metro station is part of the airport. Everything that fastens the connection between the two modes of transport should be used, like escalators, elevators, or treadmills, and it is important that information regarding the connection is available and correctly distributed along the way. When the train station is located at a non walkable distance, other services should be provided to get there, like for instance buses like the ones used when airplanes park far away from the airport main building.

Upon the arrival at the train station, the passenger needs to buy the ticket in case he has not bought it before the journey. Ideally, the ticket should be bought before the intermodal journey, in order to save time spent in possible queues for tickets at the train station, but this is not always available and some passengers are still reticent to use the internet for buying train tickets. Also, since it is a train journey that is part of an intermodal journey, there's always the possibility of a delay in the flight and subsequent delay on the arrival at the train station, which puts in risk the arrival before the train departure. Mechanisms should be created to face this fear of losing the train, like for example the possibility of using the ticket for the next train to the same destination after the one for which the ticket was valid. As it was said before, some train tickets are available for buying during the airplane journey, which would save the time spent at the queues at the train station. Using this method, passengers who do not use the internet to buy tickets would feel more comfortable and the fear of losing the train would be reduced because the information on the arrival of the plane is more precise. This method of acquiring tickets to trains should therefore be improved and be more comprehensive, offering a wider variety of destinations and services.

Despite of all these methods to buy train tickets before the arrival at the train station, some passengers will still continue to buy them only when inside the train station. The solution to improve the trans-boarding of these passengers at this stage is to improve the functioning of the ticket office, which is similar to what was said when the "Security Control / Passport Verification" activity was described. Additionally, the use of electronic ticketing machines should be enhanced and eased, installing more machines and with more user friendly software in order to serve all kinds of passengers. On the case of busy train stations and when it proves to be necessary, the use of exclusive ticket machines for intermodal passengers (the passengers had to insert a plane ticket or a code for intermodal travellers in order to use the machine) could be an option.

If the passenger arrives some time before the departure of the train, the activity "Waiting Room" is part of the process. There is nothing much to do against this or to improve this period of time, since the train will not arrive earlier and there is no other activity to perform, so the passenger can use the time to use the restoration

areas that might exist at the station or simply to relax at the waiting room. One important thing to mention is the existence of information related to the departure times of trains, which should be available at the key spots of the train station, to keep the passengers informed of how much time they have left until their train arrival.

The activity “Walk to Platform” takes action when approaching the departure time and the key element to improve this action is information regarding how to get to the platform and on which platform is the pretended train. If the information provided is adequate, there should be no problem with this step of the trans-boarding process. After this activity, the process is completed when the passenger enters the train.

5 Concept of Business Model

5.1 Business Model Definition

There is no generally accepted definition of the term “business model”. Diversity in the available definitions poses substantive challenges for delimiting the nature and components of a model and determining what constitutes a good model. Moreover, the business model term has been referred to as architecture, design, pattern, plan, method, assumption, and statement (Morris et al., 2003).

In this section we explore the existing business model literature since material treating of business models ranges from business model definitions, components, taxonomies, design tools, change methodologies to evaluation measures.

The mainstream appearance of the term business model is a relatively young phenomenon that has found its first peak during the Internet hype at the beginning of this millennium. A query in Business Source Premier, a leading electronic database for business magazines and scholarly business journals, shows that the term appeared in 1960 in the title and the abstract of a paper in the Accounting Review (Jones, 1960). It seems that the executives, reporters, and analysts who used the term “business model” never really had a clear idea of what it meant. They sprinkled it into their rhetoric to describe everything from how a company earns revenue to how it structures its organization (Linder and Cantrell 2000).

Before considering the definitions and usages of the expression business model we reflect on its semantics (Osterwalder et al., 2005). Both business and model, by themselves have a specific meaning and the combination mirrors many of the possible applications of the business model concept. Based on WordNet 2.0, the word model means "*a simplified description and representation of a complex entity or process"* and the word business "*the activity of providing goods and services involving financial, commercial and industrial aspects*" (Osterwalder et al., 2005). Putting this elements together Osterwalder et al. (2005) proposes that business model concept should go in the following direction: *A business model is a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm. Therefore we must consider which concepts and relationships allow a simplified description and representation of what value is provided to customers, how this is done and with which financial consequences.*

For Mansfield and Fourie (2004) a business model most commonly describes the linkage between a firm's resources and functions and its environment. It is a contingency model that finds an optimal mode of operation for a specific market. The evolving business model concept is derived from a quest for value creation driven by environmental developments and infrastructural opportunities.

Timmers (1998) defines a business model as architecture for the product, service and information flows, including a description of the various business actors and their roles and a description of the potential benefits for the various business actors and a description of the sources of revenues. Amit and Zoot (2001) describe a business model as the architectural configuration of the components of transactions designed to exploit business opportunities. Weil and Vitale (2001) says that is a description of the roles and relationships among a firm's consumers, allies and suppliers and it identifies the major flows of product, information and money, as well as the major benefits to participants.

Applegate (2001) perceives a business model as a description of a complex business that enables the study of its structure, of the relationships among structural elements, and of how it will respond to the real world. Magretta (2002) says that a business model is like a story that explains how an enterprise works.

Business models describe or prescribe more specifically how resources are combined and transformed in order to generate value for customers and other stakeholders, and how a value generating company will be rewarded by its exchange partners that receive value from it. Stähler (2002) reminds that a business model is always a simplification of the complex reality. Afuah (2004) describes a business model as a framework for making money. According to this author is the set of activities which a firm performs, how it performs them, and when it performs them to offer its customers benefits they want and to earn a profit.

The essence of a business model is in defining the manner by which the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit. It thus reflects management's hypothesis about what customers want, how they want it, and how the enterprise can organize to best meet those needs, get paid for doing so, and make a profit (Teece, 2010).

If we try to define what is the purpose of a business model, how it is used and also what are the major benefits for the companies, the answers are not easy to get but Osterwalder (2004) provides a clue to the first one of these questions: *"a business model describes the rationale of how an organization creates, delivers, and captures value".* A business model can be viewed as a collection of organizational roles, the system functionalities, detailed description of a mechanism, and relationships among parties. From some points of view, business models are an abstraction focusing on a particular aspect under study (Janssen et al., 2007). According to Keen and Qureshi (2006), there are two common themes underpinning the conceptualization of business models: the focus on value and a statement of the basic logic of the business. They argue that the logic of value-generation is the core of a business model and also assert that business models are a vehicle for addressing how to balance value between the customer and the provider.

There is no generally accepted definition of the term "business model". Diversity in the available definitions poses substantive challenges for delimiting the nature and components of a model and determining what constitutes a good model. Moreover,

the business model term has been referred to as architecture, design, pattern, plan, method, assumption, and statement (Morris et al., 2003).

Business models describe or prescribe more specifically how resources are combined and transformed in order to generate value for customers and other stakeholders, and how a value generating company will be rewarded by its exchange partners that receive value from it (Magretta, 2002). Conceptualizations of business models increasingly suggest that a firm can have several business models. Whereas strategy emphasizes competition, business models build more on the creation of value for customers (Morris et al., 2003). In that respect business models are typically developed from a more narrow perspective that a strategy. Business models relate to value chains (Porter, 1985), value streams (Davies, 2004), and value constellations (Normann and Ramirez, 1994) among multiple business actors. However, how business models are configured and combined in project business is largely unexplored territory (Wikström et al., 2009).

In other words, for business models, the quest is to identify the elements and relationships that describe the business a company does. Thus, the business model concept can best be understood as a conceptual view of a particular aspect of a specific company. The meta-model then defines the words and sentences that we use to describe this view (that consist of elements and relationships that reflect the complex entities that they aim to describe) (Osterwalder et al., 2005).

5.2 Several Authors Approach

In this section we explore the existing business model literature since material treating of business models ranges from business model components, taxonomies, design tools, ontological modelling, change methodologies to evaluation measures.

Table 5.1 summarizes the contributions of the most important business model authors.

Table 5.1 - Business Model Authors List (Source: Osterwalder, 2004)

Source	Definition	Taxonomy	Components	Representation Tool	Ontological Modelling	Change Methodology	Evaluation Measures
(Afuah and Tucci 2001; 2003)	x		x				x
(Alt and Zimmermann 2001)		x	x				
(Amit and Zott 2001)	x						
(Applegate 2001)	x	x					
(Chesbrough and Rosenbloom 2000)			x				
(Gordijn 2002)				x	x	x	x
(Hamel 2000)			x				x
(Hawkins 2001)	x						
(Linder and Cantrell 2000)	x	x	x			x	
(Magretta 2002)	x		x				
(Mahadevan 2000)			x				
(Maitland and Van de Kar 2002)			x				
(Papakiriakopoulos and Poulymenakou 2001)						x	
(Peterovic, Kittl et al. 2001)	x		x			x	
(Rappa 2001)	x	x					
(Stähler 2002)			x				
(Tapscott, Ticoll et al. 2000)	x	x		x		x	
(Timmers 1998)	x	x					
(Weill and Vitale 2001)	x	x	x	x			

The first column of the table name authors and year of contribution and the following columns reveal the major business model areas covered and whether a specific author has contributed to this area. The "definition" column shows if an author provides a short comprehensible definition of what a business model is. The "taxonomy" column indicates which authors propose a classification of business models. The "components" column points out authors that go beyond a simple definition and classification of business models by presenting a conceptual approach to business models, specifying what a business model is composed of. The "representation tool" column specifies authors that offer a set of tools or

graphical representations to design business models. The "ontological modelling" column indicates authors that use a rigorous modelling approach to business models and provide an ontology that carefully defines business model concepts, components and relationships among components. The "change methodology" column points to authors including a time and change component in their business model concepts. Finally, the "evaluation measures" column indicates authors that try to define indicators to measure the success of business models (Osterwalder, 2004).

Afuah and Tucci (2003) focus on business model elements, such as service and product innovation, the actors involved, the relationships between the actors, information and application architectures, and information and value exchange. They also state that each firm that exploits the Internet should have an Internet business model. They regard business models as a system of components (customer value, scope, pricing, revenue sources, connected activities, implementation, capabilities and sustainability) and the relationships between these components.

Afuah (2004) define the elements presented in Figure 5.1 as the components of business models.

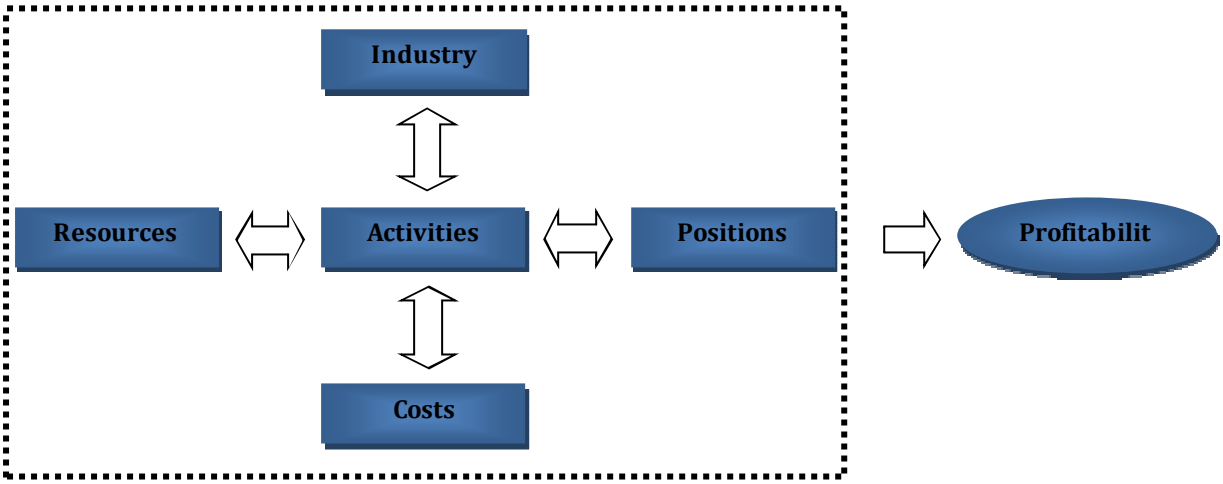


Figure 5.1 - Afuah Business Model Elements

Profitability of a business model, according to the author, depends on which activities the firm performs, how it performs them, and when it performs them to better position the firm relative to its competitors, build and leverage its resources

in performing activities, exploit industry factors, and keep costs low. Activities should be consistent with a firm´s positions and those that leverage a firm's existing resources or its ability to build such resources, can help the firm create and appropriate customer value. The activities a firm performs can also influence the competitive forces that act on the firm and those that take advantage of industry value drivers are also likely to strengthen a firm´s position. Engaging in activities such as total quality control and reengineering can keep a firm's costs low, regardless of whether the firm pursues a low-cost or differentiation strategy.

Amit and Zoot (2001) framework depicts the ways in which transactions are enabled by a network of firms, suppliers, complementors and customers. They approach the business model construct as a unifying unit of analysis that captures value creation arising from multiple sources. They argue for a cross theoretical perspective, concluding that no single theory can fully explain the value creation potential of a venture. The business model construct builds upon central ideas in business strategy and its associated theoretical traditions.

Successful change in one element of the business model will thus depend on corresponding changes in and/or realignment of other elements. Chesbrough and Rosenbloom (2002) research uses six common business model parameters as a structuring and analytical framework: value proposition, revenue mechanisms, value chain, value network, competitive strategy and target market. They propose that the analysis of business models should not be limited to a firm or a business unit level only and suggest that a firm can have several distinct business models.

Linder and Cantrell (2000) differentiate between three different types of models: the components of a business model, real operating business models and change models. They define a business model as an organization's core logic for creating value.

Magretta (2002) argues that there is both a distinction and relationship between strategy and business models. Business models describe the organisations activities and how to deliver value to the customer and strategy decides how the business model is utilised by considering competition and thereby stressing the need to position.

Mahadevan (2000) defines a business model as a unique blend of three streams that are critical to the business. These include the value stream for the business partners and the buyers, the revenue stream, and the logistical stream. Rappa (2001) defines a business model as the method of doing business by which a company can sustain itself - that is, generate revenue. For him the business model spells-out how a company makes money by specifying where it is positioned in the value chain.

In order to understand how a company realizes its business mission, Timmers (1998) adds a marketing model that is the combination of the business model and the marketing strategy of the business actor under consideration.

Like Timmers, Weill and Vitale (2001) define a business model as a description of the roles and relationships among a firm's consumers, customers, allies and suppliers and it identifies the major flows of product, information, and money, as well as the major benefits to participants. They offer eight atomic business models for classifying e-commerce Web sites. Instead of trying to specify a comprehensive list, these authors define eight "atomic" models. Specific models can be constructed by combining the atomic business models, in analogy with atoms (which can be combined to form molecules). These models include:

1. Content provider: Provides content (information, digital products and services).
2. Direct-to-consumer: Provides goods or services directly to the customer, often bypassing traditional channel members.
3. Full service provider: Provides a full range of services in one domain (e.g., financial, health, industrial chemicals) directly and via allies, attempting to own the primary customer relationship.
4. Value-net-integrator: Coordinates activities across the value net by gathering, synthesizing, and distributing information.
5. Shared infrastructure: Brings together multiple competitors to cooperate by sharing common IT infrastructure.
6. Intermediary: Brings together buyers and sellers by concentrating information.

7. Virtual community: Creates and facilitates an online community of people with a common interest, enabling interaction and service provision.

8. Whole-of-enterprise: Provides a firm wide single point of contact, consolidating all services provided by a large multiunit organization.

More recent studies present different proposals for the business models' components organization. Svensson et al. (2009), proposes a corporate model of sustainable business practices from an ethical perspective that may be divided into five separate but at the same time interconnected elements as follows (Figure 5.2).

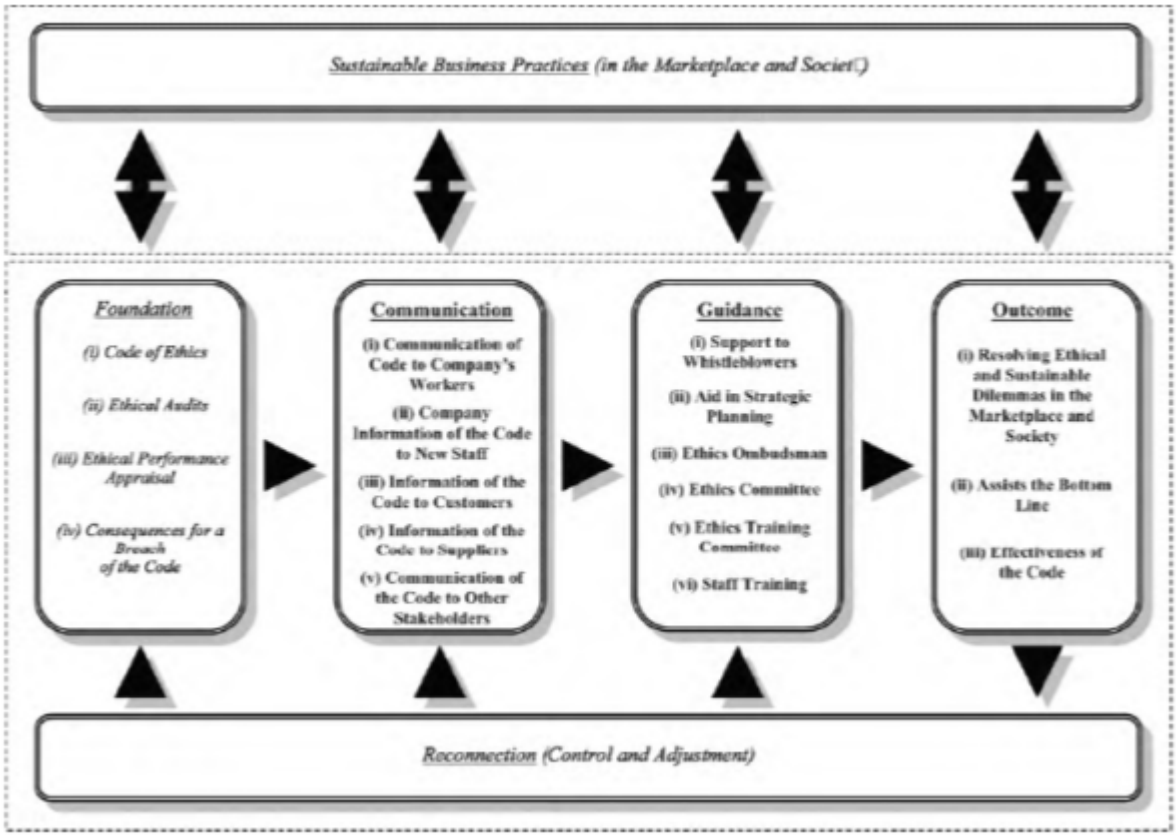


Figure 5.2 - corporate model of sustainable business practices (Svensson et al. (2009))

The **element of 'foundation'** consists of a subset of artefacts that guide companies in their efforts to manage and monitor sustainable business practices from an ethical perspective. There is a need for this element surrounds the ways in which companies try to inculcate the sustainable business practices from an ethical perspective. Without it there are no measures in place to make an adequate evaluation of organizational and staff performance. This element serves as a point of reference that the company and its staff should be able to relate to at the

strategic, tactical and operational levels of their sustainable business practices, and also a point of reference to other stakeholders in the marketplace and society.

The **element of 'communication'** consists of a subset of artefacts that may aid companies to inform stakeholders about their efforts in performing sustainable business practices from an ethical perspective. There is support for this element in which companies may inform or promote their sustainable business practices from an ethical perspective internally and externally. Without it there is no evident medium as to how and to whom it should be communicated. The way that the company chooses to interact or ignore the expectations and perceptions in the marketplace and society with respect to ethical concerns provides its own consequences.

The **element of 'guidance'** consists of a subset of artefacts that may support companies in their efforts to manage and monitor sustainable business practices from an ethical perspective. There is a need to guide the members of the company in different ways, they need assistance to determine what is acceptable and unacceptable sustainable business practices. Inevitably in any situation demanding an ethical response there will be ambiguity regarding what to do or what not to do on these occasions and in these circumstances. This element guides the strategic, tactical and operational sustainable business practices. It may be used to develop, manage and monitor the tactical decision-making of the company and related procedures. It does not provide a complete framework, but it pinpoints and sheds light upon some essential artefacts that need to be considered in corporate efforts to establish, maintain and/or enhance the sustainable business practices.

The **element of 'outcome'** consists of a subset of artefacts that may be used to evaluate sustainable business practices from an ethical perspective. Sustainable business practices are becoming increasingly influential in corporate efforts of being a good corporate citizen in the marketplace and society. Profit is the way that the company keeps score as to its success or failure. In capitalist economies the pursuit of profit is not seen as counterproductive, but as an essential feature of the ethos of the economic underpinnings of the systems that we have in place.

Wikström et al. (2010) performed an empirical study that explores the existence, relevance and differences of business models in project business. They investigate six project-based firms in order to identify and analyze the business models in project business. The elements were identified through the literature review and case study protocols and grouped into five overall categories: A. Value and flexibility, B. Organization, C. Innovation and growth, D. Competence and assets, and E. Relationships and collaboration. These categories focus on different aspects of the business model — its overall purpose, its organization, its future potential, requirements, and interaction with outside partners. The categorization thereby facilitates a fine-grained analysis and comparison of the business models in their sample. Table 5.2 presents the categories and the detailed description of each element.

Table 5.2- categories and the detailed description of each BUSINESS MODEL element (Wikström et al. 2010)

Element	Description
A. Value and Flexibility	Content of supply and its value adding.
Value Proposition	Impact on the investment as innovative technology, operating costs, functionality.
Investment effects	
Flexibility	How flexible is the business model and in what way is flexibility achieved.
B. Organization	In which organizational entity is the business model located or mainly used.
Organizational entity	Core units in business models organizational structure.
Organizational arrangements	
C. Innovation and growth	Innovations content of business model.
Nature of innovation	Growth achieved (scope and potential for additional sales).
Growth mechanisms	
D. Competence and assets	The competencies that the customer validates which give competitive advantage in the business model.
Distinctive competence	Specific competence that supplier emphasize in the business model.
Core competence	Most essential resources and capabilities.
Critical assets	
E. Relationships and collaboration	Degree of customer involvement and in which way in the specific business model.
Customer involvement	Amount and type of relationships.
Relationships	The character and purpose of the relationships (processual, investment focused).
Relational context	Mechanisms and dynamics collaboration and contracts.
Collaboration mechanism	

Shafer et al. (2005) identified four major categories for business model: strategic choices, value network, capturing value and creating value. They define an affinity diagram (Table 5.3) with the components of business models according to which category.

Table 5.3 - four major categories for business model components (Shafer et al. (2005))

Components of a Business Model			
Strategic Choices Customer Value Proposition Competences Princing Competitors Output Strategy Branding Differentiation Mission	**Value Network** Suppliers Customer Information Customer Relationship Information Flows Product/Service Flows	**Create Value** Resources/Assets Processes/Activities	**Capture Value** Cost Financial Aspects Profit

Voelpel et al. (2005) identify the value proposition as one of the basic elements of a business model since creating and offering new customer value proposition is the basis from which viable and successful business models can be created. Being the first to offer such value often gives a company "monopoly profits'' by achieving high returns before competitors start to imitate and catch up. A second component of a business model is the configuration (and reconfiguration) of value networks in creating and offering customer value proposition. The competitive landscape is constantly shifting due to forces such as globalization and technological advancements. The third element of a business model is the economic feasibility and profitably of the business model in sustaining the interests of the organization and its relevant stakeholders. Additionally, in the face of uncertainties, organizations need the necessary funding to continuously experiment with novel ideas and to discover new ways of doing business that keep invigorating and revitalizing the organization.

Kindström (2010) proposes six business models' parameters and their focus based on Chesbrough (2007) which are presented in Table 5.4.

Table 5.4 - six business models' parameters (Kindström, 2010)

Business Model Parameter	Description
Value Proposition	The offering that is presented to the customer stating the value created (typically consisting of both products and services) Key issues: Articulated offering, Visualization, Closer customer interaction, dynamic offering portfolio
Revenue Mechanism	The mechanism that is used to appropriate the value created (in the form of a revenue stream) Key issues: new revenue model
Value Chain	The internal resources, processes, and activities of the supplier Key issues: dedicated roles for service development, structure service development process, new reward system, extending the resource base
Value Network	The external network contributing to the creation and delivery of the offering Key issues: finding partners that can add value to the new offerings
Competitive Strategy	The position of the company marketplace and the offering (e.g. low cost) Key issues: branding, differentiation
Target Market	The identified complete target market/segment for the offering Key issues: new customer segmentation

Teece (2010) affirms that a provisional business model must be evaluated against the current state of the business ecosystem, and also against how it might evolve. To do so, there are a few questions that should be answered present in Table 5.5.

5.3 Osterwalder Proposal

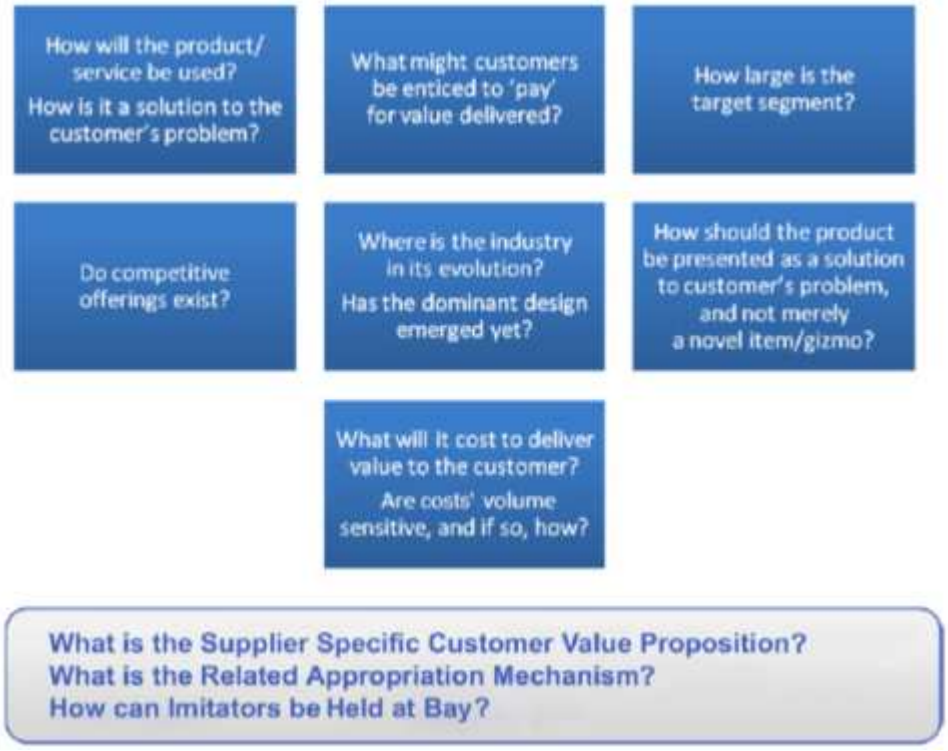
Osterwalder business model theoretical framework was the chosen approach to use on this project.

Osterwalder et al. (2010) presents a business model canvas that exposes the rational of how an organization creates, delivers, and captures value. They define nine building blocks for the model which are the following ones:

- Customer Segment – specifies for whom are the company creating value since an organization serves one or several customer segments;

- Value Propositions – it seeks to solve customer problems and satisfy customer needs with value propositions;
- Channels – Value propositions are delivered to customers through communication, distribution, and sales channels;
- Customer Relationships – are established and maintained with each customer segment;
- Revenue Streams – result from value propositions successfully offered to customers;

Table 5.5 - evaluated against the current state of the business ecosystem (Teece, 2010)



- Key Resources – the assets required to offer and deliver the previously described elements;
- Key Activities – activities, distribution channels, customer relationships and revenue streams that the value proposition requires;
- Key Partnerships – some activities are outsourced and some resources are acquired outside the enterprise;
- Cost Structure – the business model elements result in the cost structure.

In Figure 5.3 it is possible to observe the business model canvas that the authors suggest that every company should fill. This business model characterization is very complete but at the same time very simple to understand and use. That is the reason why we chose to explore the business model in transport sector according to this view of how a business model is fully characterized.

The author proposal becomes more detailed since he starts to specify each one of the nine buildings blocks.

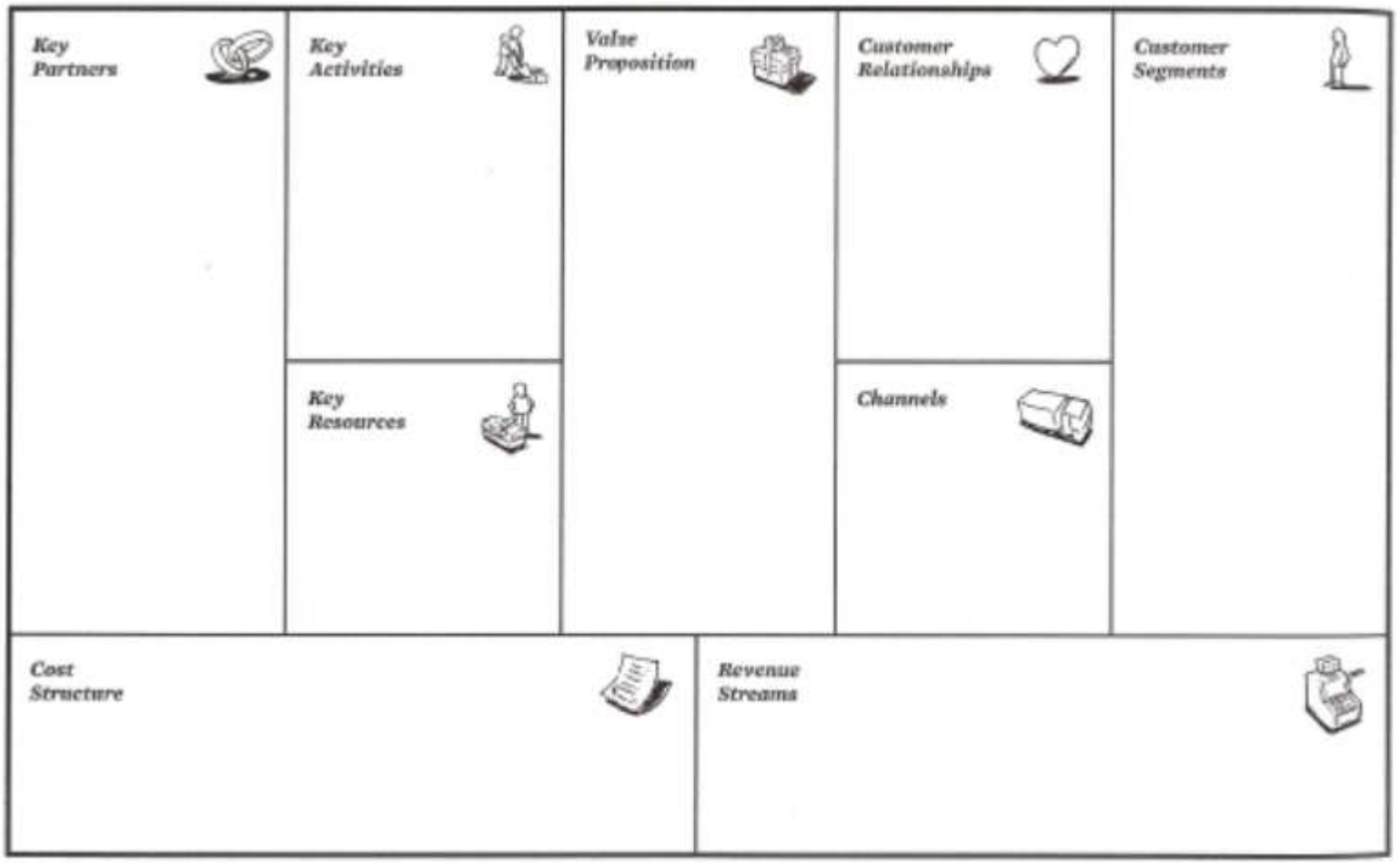


Figure 5.3 - Business model Canvas (osterwalder et al., 2010)

5.4 Theoretical Framework

Influence by the Balanced Scorecard approach (Kaplan and Norton 1992) and more generally business management literature (Markides 1999) Osterwalder suggests adopting a framework which emphasizes on the following four areas that a business model has to address (Osterwalder, 2004):

Product: what business the company is in, the products and the value propositions offered to the market;

Customer Interface: who the company´s target customers are, how it delivers them products and services, and how it builds a strong relationships with them;

Infrastructure Management: how the company efficiently performs infrastructural or logistical issues, with whom, and as what kind of network enterprise;

Financial Aspects: what is the revenue model, the cost structure and the business model's sustainability.

In Table 5.6 the author compares the pillars of the ontology for Kaplan and Norton (2000) and Markides (1999).

Table 5.6- Comparison between ontology pillars

Business Model Ontology	Balanced Scorecard (Kaplan and Norton 1992)	Markides (Markides 1999)
Product	Innovation and Learning Perspective	What?
Customer Interface	Customer Perspective	Who?
Infrastructure Management	Internal Business Perspective	How?
Financial Aspects	Financial Perspective	

Norton and Kaplan identify four perspectives of the firm on which executives must keep an eye to conduct successful business. Markides (Markides 1999) follows a similar path by providing a very simple recipe to business strategy. He recommends looking at the "who" the "what" and the "how" of a business. This means the first question executives must ask themselves is who they should target

as customers. The second question is about what products or services a company should offer. The last question is about how these services can be delivered best to customers.

The author split the four pillars of the business model ontology into nine interrelated business model building blocks or simply business model elements and these nine elements are the core of the ontology. In Table 5.7 is presented a synthesis of the business model elements and consist of value proposition, target customer, distribution channel, relationship, value configuration, capability, partnership, cost structure and revenue model.

Table 5.7 - Synthesis of the business model elements (Osterwalder, 2004)

Pillar	**Building Block of Business Model**	**Description**
Product	Value Proposition	A value proposition is an overall view of a company's bundle of products and services that are of value to the customer.
Customer Interface	Target Customer	The target customer is a segment of customers a company wants to offer value to.
	Distribution Channel	A distribution channel is a means of getting in touch with the customer.
	Relationship	The relationship describes the kind of link a company establishes between itself and the customer.
Infrastructure Management	Value Configuration	The value configuration describes the arrangement of activities and resources that are necessary to create value for the customer.
	Capability	A capability is the ability to execute a repeatable pattern of actions that is necessary in order to create value for the customer.
	Partnership	A partnership is a voluntarily initiated cooperative agreement between 2 or more companies in order to create value for the customer.
Financial Aspects	Cost Structure	The cost structure is the representation in money of all the means employed in the business model.
	Revenue Model	The revenue model describes the way a company makes money through a variety of revenue flows.

5.5 Building Blocks Description

Here we presents a more detailed description of the building blocks of the business model framework proposed by Osterwalder.

5.5.1 Customer Segments

Customers comprise the heart of any business model. Without (profitable) customers, no company can survive for long. In order to better satisfy customers, a company may group them into distinct segments with common needs, common behaviours or other attributes.

An organization serves one or several Customer Segments and there are different types. Here are some examples: mass market, niche market, segmented, diversified and multi-sided markets.

The questions that a company should make are: *For whom are we creating value? Who are our most important customers?*

5.5.2 Value Proposition

Value Proposition is the reason why customers turn to one company over another. It solves a customer problem or satisfies a customer need. Each Value Propositions consists of a selected bundle of products and/or services that caters to the requirements of a specific Customer Segment.

Value Proposition creates value for a Customer Segment through a distinct mix of elements catering to that segment's needs that may be quantitative (e.g. price) or qualitative (e.g. design).

The questions that a company should make are: *What value do we deliver to the customer? Which one of our customer's problems are we helping to solve? Which customer needs are we satisfying?*

5.5.3 Channels

Communication, distribution, and sales Channels comprise a company's interface with customers. Channels are customer touch points that play an important role in the customer experience.

Channels have five distinct phases and each channel can cover some or all of these phases. We can distinguish between direct and indirect Channels, as well as

between owned and partner Channels. The Channel phases are: awareness, evaluation, purchase, delivery and after sales

The questions that a company should make are: *How are we reaching our Customer Segments? How are our Channels integrated? Which ones work best*

5.5.4 Customer Relationships

A company should clarify the type of relationship it wants to establish with each Customer Segment which can range from personal to automated and may be driven by the following motivations: customer acquisition, customer retention and boosting sales.

We can distinguish between several categories of Customer Relationships, which may co-exist in a company's relationship with a particular Customer Segment: personal assistance, dedicated personal assistance, self-service, automated services, communities and co-creation.

The questions that a company should make are: *What type of relationship does each of our Customer Segments expect us to establish and maintain with them?*

5.5.5 Revenue Streams

If customers comprise the heart of a business model, Revenue Streams are its arteries. A company must ask itself, *For what value is each Customer Segment truly willing to pay?* Successfully answering that question allows the firm to generate one or more Revenue Streams form each Customer Segment.

There are several ways to generate Revenue Streams: asset sale, usage free, subscription fees, lending/renting/leasing, licensing, brokerage fees and advertising.

The questions that a company should make are: *For what do our customers currently pay? How much does each RS contribute to overall revenues?*

5.5.6 Key Resources

Every business model requires Key Resources which allow an enterprise to create and offer a Value Proposition, reach markets, maintain relationships with Customer Segments, and earn revenues. Different Key Resources are needed depending on the type of business model.

Key Resources can be physical, financial, intellectual or human.

The questions that a company should make are*: What Key Resources do our Value Propositions require?*

5.5.7 Key Activities

Every business model calls for a number of Key Activities and these are the most important actions a company must take to operate successfully. Like Key Resources, they are required to create and offer a Value Proposition, reach markets, maintain Customer Relationships, and earn revenues.

Key Activities differ depending on business model type and can be categorized as follows: production, problem solving and platform/network.

The questions that a company should make are*: What Key Activities do our Value Propositions require?*

5.5.8 Key Partnerships

Companies forge partnerships for many reasons, and partnerships are becoming a cornerstone of many business models. Companies create alliances to optimize their business models, reduce risk, or acquire resources.

We can distinguish between four different types of partnerships: strategic alliances between non-competitors, strategic partnerships between competitors (coopetition), joint ventures to develop new business and buyer-supplier relationships to assure reliable supplies.

The questions that a company should make are*: Who are our Key Partners? Who are our key suppliers? Which Key Resources are we acquiring from partners?*

5.5.9 Cost Structure

This building block describes the most important costs incurred while operating under a particular business model. Creating and delivering value, maintaining Customer Relationships, and generating revenue all incur costs. Such costs can be calculated relatively easily after defining Key Resources, Key Activities, and Key Partnerships.

There are two broad classes: cost-driven (minimizing costs) and value-driven (focus on value creation). Cost Structures can have the following characteristics: fixed costs, variable costs, economies of scale and economies of scope.

The questions that a company should make are: What are the most important costs inherent in our business model? Which Key Resources and Key Activities are most expensive?

6 Barriers for Improved Intermodality

HERMES project developed 11 case studies that can be grouped in three groups, being:

Airport cases:

- Faro International Airport, air/road, Portugal
- Antwerp Airport, air/road, Belgium
- Frankfurt-Hahn Regional Airport, air/road/(rail), Germany
- Stockholm Arlanda International Airport, air/road/rail, Sweden

Station cases:

- Gothenburg Central Station, road/rail, Sweden
- Avenida de America Interchange Madrid, road/rail, Spain
- Lleida-Zaragoza, road/rail, Spain
- Gare de Oriente Interchange Lisbon, road/rail, Portugal
- Part-Dieu Station Lyon, road/rail, France

Maritime cases:

- Corridor Peloponnese-Crete, road/ferry, Greece
- Port of Patras, road/rail/ferry, Greece

The current business models in operation at the case studies are described in detail in Deliverable 5. Therefore the interested reader is referred to that document. This Chapter aims to identify the fundamental barriers for improved intermodality in HERMES Case Studies. As such, for each case study, the barriers precluding the improvement of the intermodal transport services have been identified. The understanding of the barriers is necessary for the identification of

potential solutions (to be brought by the business models). The main barrier of each case study is presented in Table 6.1.

Table 6.1 - Main problem of each case study

Case Study	Main Barrier at the site
Faro International Airport	Lack of integration between the air and the land-based transport services
Antwerp Airport	Absence of transport connections
Frankfurt-Hahn Regional Airport	Lack of public transport modes
Stockholm-Arlanda International Airport	Poor public transport utilization
Gothenburg Central Station	Non-coordinated information to passengers
Avenida de America Interchange Madrid	Poor signaling, lack of physical integration, inadequate relationships between agents
Long Distance Bus (Zaragoza + Lleida)	Low integration between transport services, bad information or signaling, lack of physical integration and non-adequate relationship between agents
Gare de Oriente Interchange Station and connection with Linha do Norte Railway	Low quality service link
Part-Dieu Station Lyon	Absence of real-time information system to passengers/transport operators and terminal manager on the station, un-coordinated timetable between transport modes, low quality passengers flows, poor conditions for disabled people
Corridor Peloponnese-Crete	Alternative –optimised- network service solution for connecting the Adriatic corridor to Crete
Port of Patras	Lack of information, bad transfers, absence of integrated tickets, un-coordinated timetables between transport modes.

The Case Studies differ substantially at several levels, such as: types of modes of transport, element of analysis of the transport service (e,g,: terminal, corridor, etc.), geographical location, or legal context. Nevertheless, similarities between the problems affecting intermodal transport are visible and identifiable. Indeed, we have concluded that the barriers can be clustered in two groups of fundamental barriers or gaps. The gaps are:

- **Gap 1 - Low integration between transport services.**
- **Gap 2 – Inadequate intermodal transfer conditions.**

Gap 1 refers to the cases with no or poor integration between transport services. In these cases the transport operators operate in an isolated way, with no or low interaction with the others. Such absence of integration generates multiple problems, such as: non-coordination of schedules; absence of (short distance) service; lack of tariff integration, no joint marketing initiatives, incomplete information, or even lack of strategic alignment between agents. In this Gap we have identified the following case studies: Faro International Airport, Antwerp Airport, Frankfurt-Hahn Regional Airport, Stockholm-Arlanda International Airport, Long Distance Bus (Zaragoza + Lleida), Gare do Oriente Interchange Station, and the Corridor Peloponnese-Crete. As an example, let us look to the airport case studies (namely: Faro International Airport, Antwerp Airport or Frankfurt Hahn Airport) all refer the lack or poor integration between air transport and the land based transport.

Based on the description of the case studies, the nature of Gap 1 could be further decoupled into two categories as follows:

- **Missing Link:** whenever a there is a missing transport connection from the terminal to a destination site or vice versa.
- **Low Quality Link:** whenever a transport connection has a low frequency or huge travel times.

Table 6.2 summarizes the Gap for each case study that presents issues with links.

Table 6.2 - Case Studies with Issues with Links Solutions

Case Study	Issue with link
Zaragozza/Lleida	Missing link
Peloponnese	Missing link
Oriente	Low quality link
Faro	Missing link
Antwerp	Missing link
Frankfurt-Hahn	Missing link

The Gap 1 is a fundamental barrier that can be decoupled along two vectors: a *missing link* or a *low quality link*. Having identified the first fundamental barriers it is possible now to give example of solutions to overcome it. In this way, in the case of the missing link the solutions to overcome the barrier include a new activity, a new partner, a new route or even changes at the infrastructure. In what concerns, the low quality link the solution to overcome this barrier include a new or a change in the partnership between stakeholders, or incentives for partners to integrate.

Gap 2 refers to the cases with a poor or inadequate intermodal transfer conditions. In these cases the passengers feel more or less difficulties to transfer in an easy and efficient way between transport modes. As a consequence, the transfer process becomes lengthy and difficulty, besides reducing the quality and image of the public transport and of the intermodal transport services. In this Gap we have identified the following case studies: Gothemburg Central Station, Avenida da America Interchange Madrid, Part-Dieu Station Lyon, and the Port of Patras. As an example, the terminal stations cases all refer, amongst other, a main barrier as being the poor information to passenger. Consequently, they will find difficulties in transferring from one mode to another.

Based on the description of the case studies, the nature of Gap 2 could be further decoupled into three categories as follows:

- **Logical integration/Information:** refers to situations with a poor or non-existence information system to the passengers.
- **Governance:** refers to situations in which the institutional relationship between stakeholders precludes an effective management of the transport services operating at the terminal (for example: services with high rate of transfer passengers located in distance places)
- **Physical integration:** refers to situation in which the physical properties of the terminal make difficulty (e.g.: lack of elevators, stair bad placed, etc) for passengers to move around.

Table 6.3 summarizes the solutions for each case study that presents issues with nodes.

The Gap 2 is a fundamental barrier that can be decoupled along three vectors: a *logical integration/information, governance* or *physical integratio*n. Having identified the second fundamental barriers it is possible now to give examples of the solutions to overcome it. In this way, in the case of the logical integration/information barrier the solutions to overcome it include the introduction of vertical and horizontal signaling, display screens, or even automatic messaging systems. In what concerns, the governance barrier the solutions to overcome it include a reorganization of roles of the stakeholders or even changes in the legal framework. Finally, in what concerns, the physical integration barrier the solutions to overcome it include the implementation of new escalators or elevators, construction of ramps, or improvement of the existent spaces.

Table 6.3 - Case Studies with Issues with Nodes Solutions

Case Study	**Issues with nodes**
Gothenburg	Logical integration Governance
Arlanda	Governance
Avenida da América	Physical integration Information Governance
Zaragozza/Lleida	Physical integration Information
Lyon Part-Dieu	Physical integration Logical integration Governance
Port of Patras	Logical integration Physical integration Governance

Based on the identification of the fundamental barriers, in each case study a potential solution has been identified. The proposed solutions are described in

Table 6.4. Each solution was designed to overcome the respective fundamental barrier.

Table 6.4 – Proposed Solution for Improving Intermdality

Case Study	Main Barrier at the site
Faro International Airport	New flexible transport service integrated with air transport
Antwerp Airport	Enhance Public Transport service
Frankfurt-Hahn Regional Airport	Enhance access and egress by PT service/Revival Train Service
Stockholm-Arlanda International Airport	New intermodal services (intermodal transport to reduce environmental pressure)
Gothenburg Central Station	Maintain/Increase information quality and standard in station
Avenida de America Interchange Madrid	Smoother integration of the transport services
Long Distance Bus (Zaragoza + Lleida)	Improvement of terminals' information to customer
Gare de Oriente Interchange Station and connection with Linha do Norte Railway	New intermodal rail-road service
Part-Dieu Station Lyon	Improvement of passengers' flow by rearrangement of terminals' funtions and services
Corridor Peloponnese-Crete	(New) Integrated Transport Service (Western Peloponnese as a transit corridor')to Crete
Port of Patras	Improvement of terminals' information and cooperation between the modes

7 Prototypes of new business models

The main objective of HERMES project is the proposal of prototypes of business models. A prototype is a conceptual or theoretical business model that can be applied in a real world situation. The need for more than one prototype is related with the fact that each one is meant for overcoming a given barrier.

In the case of HERMES project, two fundamental barriers or gaps haven been identified, as such, two prototypes have been designed. These prototypes are now presented. The presentation of the prototypes of business models will follow the framework of Osterwalder for an easy interpretation. We concluded that to ensure the applicability and feasibility of a business model, not all building blocks need to

be defined. Instead, only a set of building blocks are required , the remaining ones can be tailored in function of the specific condition of the case study, provided they are in line and are compatible. The required building blocks are: value proposition, key activities, key resources, key partners and channels. In order to keep the prototypes as flexibility as possible (and thus to improve its range of applicability) we will only specify the necessary building blocks.

Business model are commonly utilized to describe the activity of a given company or organization. In the case of an intermodal transport service, we have multiple stakeholders with different perspectives and objectives. As such, there is the need to define the perspective from which the prototypes is designed. In the case of HERMES project the perspective is from the agent responsible for promoting quality in intermodality. This agent varies from case to case being necessary to identify it in each application. For example, in case of HERMES project, the agent responsible can be the:

- terminal manager (e.g.: Faro, Arlanda Stockholm)
- public institution or regulator (e.g.: Frankfurt Hahn)
- transport operator (e.g.: Ferry Operator to Kalamata)

We now describe for the Prototypes of Business Models for each of the required building block. Figure 7.1 and Figure 7.2 present the Prototypes of Business Model in the framework proposed by Osterwalder.

7.1 Value Proposition

The fundamental building block of a business model is the **value proposition**. Value Proposition creates value for customers through a distinct mix of elements catering to that segment's needs that may be quantitative (e.g. price) or qualitative (e.g. design).

In the case of Prototype for Gap 1 the value proposition can be described as: *to improve the passenger's quality of transport or reduce price and to achieve benefits to the society, through a better intermodality promoted by intermediary agents*.

In case of Prototype for Gap 2 the value proposition can be described as: *to improve the passenger's quality of transfer service through an integrated approach to the transfer process.*

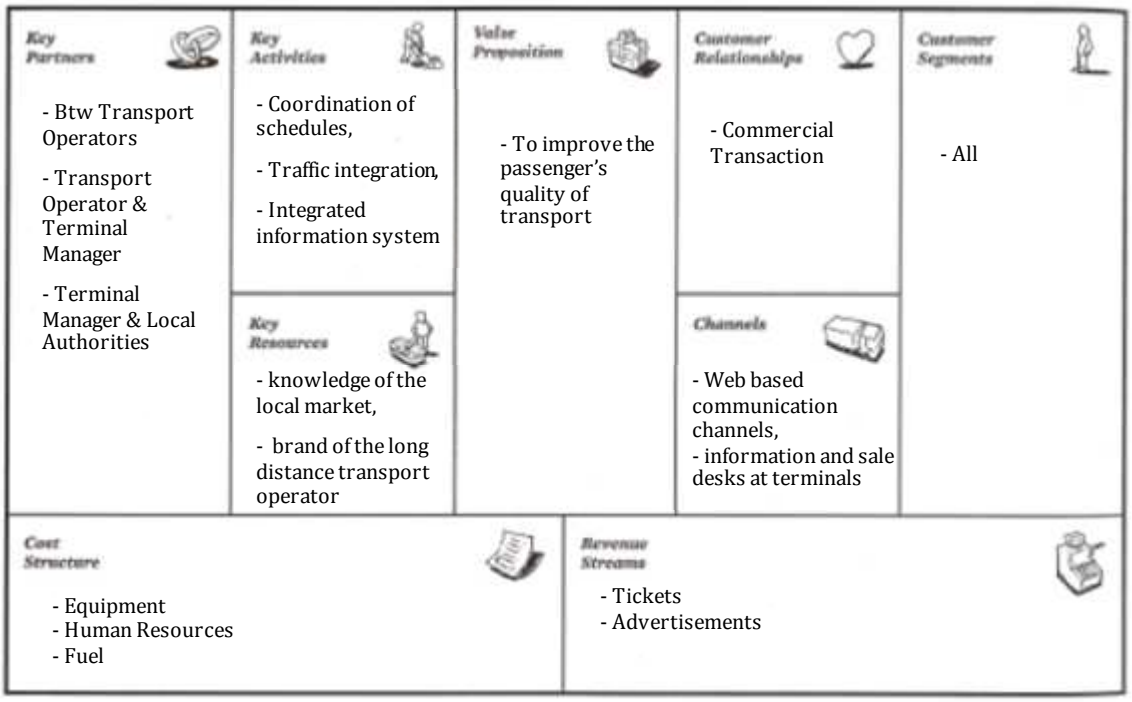


Figure 7.1 – Prototype Business Model Gap 1

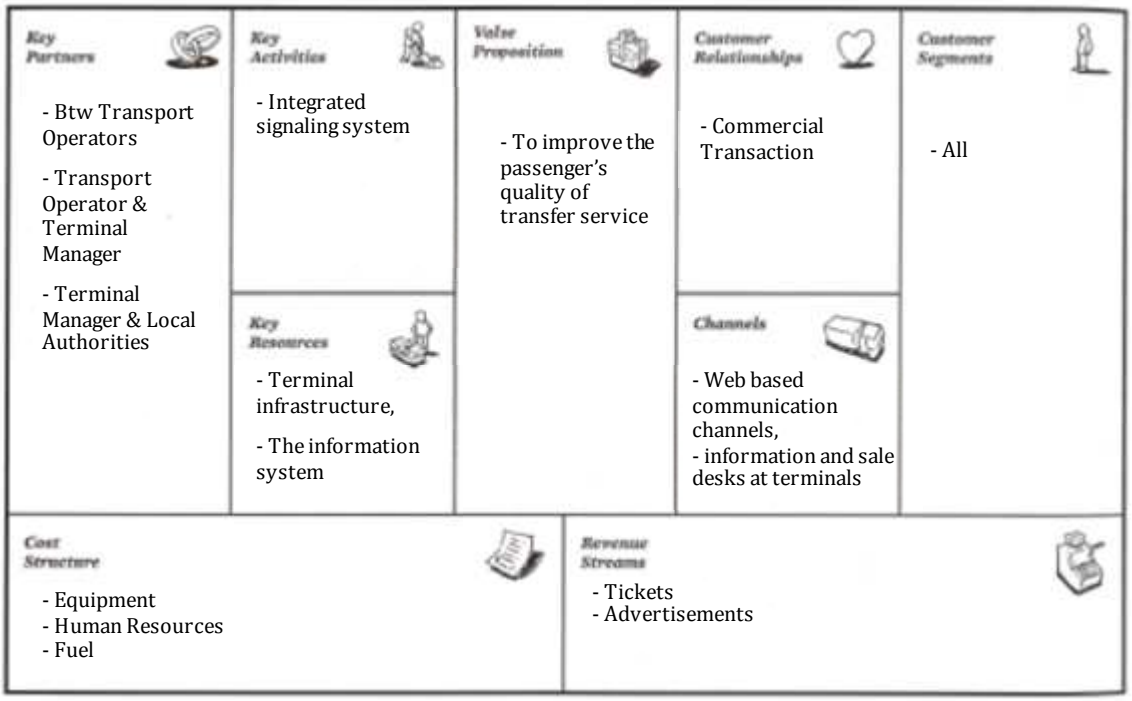


Figure 7.2 – Prototype Business Model Gap 2

7.2 Key Partnerships

The **Key Partnerships** refer to the relationships and agreements established between companies. Along with the value proposition, the Key Partnership is another fundamental building block. The reason is well-known and it is related with the fact that partnerships are the cornerstone of any intermodal transport service. Therefore, without adequate partnerships we cannot expect high quality intermodal services. There are multiple partnerships, ranging from simple informal agreements until fusions or joint ventures. The specific degree of partnership depends on the conditions of the case.

This building block is similar in both Gaps and it should include: *partnerships between transport operators, partnerships between transport operators and the terminal manager, partnerships between terminal manager and the local authorities.*

7.3 Key Activities

The **Key Activities** refer to the most important actions a company must take to operate successfully.

In the case of Prototype for Gap 1 the key activities should include: *coordination of schedules, traffic integration,and integrated information system*.

In case of Prototype for Gap 2 the key activities should include: *integrated signaling system.*

7.4 Key Resources

The **Key Resources** allow an enterprise to create and offer a Value Proposition, reach markets, maintain relationships with Customer Segments and earn revenues.

In the case of Prototype for Gap 1 the key resources include: *knowledge of the local market by the short distance transport operator (this operator knows the local market must better than the long distance transport operator, such knowledge is a valuable resource), brand of the long distance transport operator (the long distance transport operator is usually more known then the short distance transport operator, such recognizance is a valuable resource)*.

In case of Prototype for Gap 2 the key resources include: *the terminal infrastructure, the information system.*

7.5 Channels

Channels comprise a company's interface with customers. Channels are customer touch points that play an important role in the customer experience

This building block is again similar for both Gaps and it should include: *web based communication channels, information and sale desks at terminals*.

7.6 Cost Structure, Revenues Streams, Customers Segments and Customer Relationship

These building block are considered not necessary for the design of a prototype of business models. Instead they must be defined case to case, but necessarily must not enter into conflict with the other building blocks.

In Figure 7.1 and Figure 7.2 these building blocks are filled in only as example. Other conditions and factors may be used, as long as they are aligned with the necessary building blocks.

8 Conclusions

This Deliverable summarises the work developed in Work Package 2 (WP2) of HERMES project. WP2 aimed to develop prototypes of business models for improved interconnectivity and intermodality.

The development of the prototypes of business models was based in an iterative methodological approach. The iterative approach was supported on the current body of knowledge on some domains and on the inputs from the advisory board The Case Studies were the main source of information for the development and validation of the prototypes of business models.

The analysis to the current business models of the Case Studies enabled the identification of the *fundamental barriers* that preclude an improved quality of the intermodal transport service. The *fundamental barriers* or *gap* are barriers that are present in all Case Studies. Two types of gaps were identified being:

- Gap 1 - Low integration between transport services.
- Gap 2 – Inadequate intermodal transfer conditions.

Prototypes of Business Models were then developed to overcome these gaps. As such, two prototypes were designed. The prototypes of business models provide guidance on which aspects of the intermodal business is necessary to adjust to overcame the respective fundamental barriers and thus to improve the quality of the intermodal transport service

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10 Annexes

10.1 Annex 1

Extensive analysis in transport research literature has been devoted to determinants of customer mode and travel choice. The nature of these elements and their outline impact are summarized in the table below:

Element	Effect on Customer	Market Segmentation issues
Information	Awareness of options, and availability of ticket distribution is an important initial condition of market competition and access	There are a wide variety of different channels available to different markets, influenced by country, demographics, etc.
Price	Demand falls with increase in price	Business markets show lower price elasticity than leisure markets
Access/Egress Time	As with journey time, demand increases as the journey time for a given journey reduces	Business markets show higher time sensitivity than leisure markets. Also more willing to pay to reduce this time (e.g. taxi)
Journey Time	Demand increases as the journey time for a given journey reduces	Business markets show higher time sensitivity than leisure markets
Frequency	Demand increases as service frequency increases	Frequency has more importance for business markets than leisure markets, which are often prepared to change itinerary to secure lower price.
Connection Issues at interchange points	The transfer time and inconvenience necessary within and between modes is a significant deterrent factor, often valued twice as importantly as the .in vehicle. time	Leisure markets are generally more accepting of making changes between modes, if it secures lower price. However where there may be other factors (age of travellers, family groups, luggage, foreign language issues) some leisure markets may be rather more against the idea of making connection changes
Comfort	Higher levels of comfort are preferred, and generally traded off against time or price	The level of comfort perceived will vary both by importance to individuals and by the ranges of products offered by operators
Service integration	Synchronisation of service	The importance of integrating connections

	provision between modes or between operators results in higher usage	varies by the proportion of O&D versus transfer traffic on routes
Relative attraction of modes	There are certain inherent preferences for modes, which are taken in to account in overall choice	Preferences are likely to vary by individual
Security/reliability/ delays	These and similar factors act to accentuate or reduce demand according their importance by mode	The importance of these factors varies by individual types of markets

10.2 Annex 2

Category of impairment	**Description of the physical impairment and *related limiting conditions***
Reduced Vision Vision impaired	Poor sight – limited sharpness in vision/area of vision/orientation Blind *Lighting conditions, contrasts, glare, standardization location, logical architectural* *solution, design, obstacles in the road/hazards. "Leading line", tactile surface, signs,* *staircase leading line, glass markers, sounds.*
Reduced Hearing Hard of hearing	Reduced hearing, hard of hearing Deaf *Background noise, acoustics, hearing aid, read lips- good lightning condition, visual signs, information, minimum of noise, "inductive coupling", sound insulation,* *loudspeaker quality, "induction coil in handset", optical warning system*
Reduced Movement (Mobility impaired)	Walking problems Reduced sensitivity in hands and arms Wheelchair users (Reduced sensitivity) (Heart and lung disease) *Functionality, space, broad passage, remove obstacles, stairs plus ramp /elevator,*

	short walking distance, easy to open doors, no twisting, flat areas of movement avoid *steps, slide-safe, toilet.*
Environmentally challenged Allergic	Allergic asthmatic, eczema, Asthmatic *Right building materials, regulation of inner climate, cleaning, plants with low pollen,* *ventilation, smoke free, avoid humidity, limited areas for animals, food variations*
Psychologically/mentally cognitively challenged	Lower abstraction level, language difficulties, orientation *Written, symbol and picture, easy to grasp, separate different messages, leading line,* *recognizable areas, logical placing and functions and orientation*

10.3 Annex 3

The Experts	Characteristics	Mostly business travelers, who are experienced, usually in a hurry, functional and well-organized
	Strategy in dealing with a multimodal journey	- The journey is planned and timed; - It is mapped out in a travel plan - There is attempt at maximal energy saving
	Spatial Conduct	- Few orientation problems; - Prefer to ask the "first member of staff encountered" rather than use the information terminals, which are considered too slow; - Hardly any cases of verification or "going back to check"; - Prefer carry-on to check-in luggage.
	Specific needs	"*Time is money*" - Real-time information concerning problem situations; - Information concerning the time required to complete various stages of the journey; - Times of departure and frequency of various forms of public transport from multimodal site to town centre; - Access to this information before the journey for maximum efficiency during preparation stage (receptive to multimedia); - Information counters providing general information about the town, upon arrival at airport in a foreign country; - Grouped ticket plane/public transport - the latter being a multimodal open ticket.
The Falsely-Experienced	Characteristics	Frequent travelers, mostly private individuals (not excluding professionals), who tend to resist the rules

(Rebels)		and regulations of the multimodal universe, and consider themselves already experienced travelers. Their relationship with travel companies/authorities is one of mistrust.
	Strategy in dealing with a multimodal journey	- Seem not to be able to build up on their previous experiences, each new journey puts them in the position of a novice traveler; - Instinctively look for personal solutions; - Are usually disorganized, act on instinct, sometimes spending considerable energy in order to just assert themselves and to find themselves back in a position of an independent traveler.
	Spatial Conduct	- These travelers tend not to see what they are supposed to, and to exclude perfectly clear information sequences from their field of vision; - Make incessant attempts at developing micro-skills or personal tactics: parallel routes, questioning of intuitive informants, observation of other passengers;
	Specific needs	- Multiple and diversified information sources in order to avoid a feeling of " dragooning"; - Sufficient repetition of information - reassurance of having made the correct choice; - A human presence which has a " taming " effect and facilitates the relationship with the authorities, calming the spontaneous tendency towards recrimination, providing an impression of being looked after personally, a sign of consideration and attention to each traveler as a person; - Indication that the company/authorities are anticipating their needs and going out to meet them, particularly in the initiation of the use of automatic information systems (which are regarded as a sign of

		being abandoned).
The Obsessed	Characteristics	Whether they travel for pleasure or business, these travelers always expect the worst and exaggerate the preparation stage of a journey in an attempt to ward off ill fortune. For them, there is never enough pre-travel information, and the slightest detail is an object of precaution.
	Strategy in dealing with a multimodal journey	Anxious to do everything themselves, they buy the tickets themselves and integrate into the course of the journey the possibility of dysfunctions. Their requirements, and in particular previous negative travel experiences, leave traces which teach them a lesson, " once bitten, twice shy " ... They tend to " ritualize " their journeys around a certain number of habits : if I haven't managed to do such and such a thing, the journey won't be a success. This is therefore a type of customer whose loyalty is particularly difficult to establish.
	Spatial Conduct	Usually early arrivers, they pay particular attention to written information and notice whenever there is a missing link in the information chain. They prefer visual aids to audio, and pay attention to every information "signal" emitted by the authorities, reading everything available.
	Specific needs	- Very evident search for reassurance throughout the journey, so that the actual experience corresponds exactly to the intermodal journey originally planned. - Effectiveness of a European marking system which would allow the marking-out of a journey from door to door. - Vital importance of certain services (which it is necessary to be able to locate immediately) without which the journey will be experienced in an anxious

		and frustrated frame of mind : chemist, post office, toilets, press, etc. (the services correspond to the demands of ritualized behavior patterns).
The Investigators	Characteristics	Curious, and aware of their deficiencies, they are ready to learn and are receptive to information in order to be able to organize themselves. Each experience is methodically and logically built on.
	Strategy in dealing with a multimodal journey	Anxious to learn, they look less for precise answers than for the aids with which they can find the answers themselves: maps, timetables, connections, etc. They plan their journey with the knowledge that they can always rely on the authorities to provide answers to their questions if necessary.
	Spatial Conduct	- Take the journey step by step, checking at each stage that they have made the correct choice. - In order to be able to relax physically and mentally, they locate places in advance and calculate the exact amount of time available to them. - Regularly seek to situate themselves in terms of both time and place - Look for isolated corners away from noise, hustle and bustle, in order to reorientate, to take their bearings, to make choices, etc.
	Specific needs	- Aids providing them with the possibility of selecting their own multimodal combination. - Comprehensive tourist information desks with all the necessary documentation, justifying the instinctive trust they have in the authorities. - Markers along the journey allowing deduction and extrapolation. - Explicit maps, to scale, with indications of orientation and length of time necessary to go from A to B.

The Intimidated	Characteristics	Usually private individuals travelling for pleasure rather than business, they are inexperienced, very anxious, particularly worried about their luggage, confused when a problem occurs. Often older than the average traveler, they require direction and assistance. This requirement is often justified by the following situations, implying varying degrees of disability: Elderly; Many pieces of luggage; Complete inexperience; No command of the language; Mobility difficulties; etc.
	Strategy in dealing with a multimodal journey	Essentially passive strategy, where any initiative is left to the authorities, to the airport/station management and to the airline/rail company, via frequent requests for psychological and material assistance. Anxiety can lead to panic and irrational behavior resulting in a misjudgment of the situations to be dealt with.
	Spatial Conduct	- Very mediocre ability to locate, many mistakes. - Request for human assistance (porters, other travelers) even when the information is clearly visible (scotomisation). - Search for official (institutional) sources of information and signs leading to them. - Distressed obsession about certain aspects of the journey : escalators, lifts, stairs, customs, etc.
	Specific needs	-Personalized assistance with the reassurance of knowing how and where to find it, even before leaving home. -Clear indication of official services. -Advance warning of approaching bus/train stops to allow time to get ready to alight, to collect luggage together and to move towards the exit.

		-Assistance with the use of automatic machines, which they are reluctant to try, (they automatically prefer the telephone or written information). -Usefulness of a detailed door to door travel plan.
The Followers	Characteristics	Cannot stand the solitude of a journey and the idea of their only relationship being with the airline or rail company. Even when alone, they travel in a group ... and need the support of "what the others do" (the flock). For essentially personal reasons, these travelers have got into the habit of joining organized trips and are in need of a social link; they feel uneasy due to the "inhumanity" of busy connecting places.
	Strategy in dealing with a multimodal journey	Do not make any specific plans because they " rely on the others " to get along, preferably on the authorities which is considered as distant and coercive. This search to be part of a group constitutes a way of contesting authority.
	Spatial Conduct	- Are not globally receptive to the signals put out by the authorities. - The other travelers, forming an " ephemeral tribe ", are preferred as sources of information : there are those who speak the same language, those who were in the same plane, etc. - Even if it means getting lost, the "follower" prefers to follow the advice of another traveler rather than to ask an official employee. - Are particularly sensitive to public announcements which are seen as an "assembly sign" for all those who are like me.
	Specific needs	- The assertion of the relevant authority in its role of dealing with crowd movements, particularly in the use of public announcements which travelers are

		forced to hear. - Much repetition, in order to avoid losing the way. - Badges worn by all passengers booked onto the same flight (sign of recognition leading to a relationship of mutual support).
The Calm and Collected	Characteristics	Be they experienced or not, journeys do not affect their calm, they look for just the necessary amount of information and trust the authorities to inform them. They are quiet and methodical.
	Strategy in dealing with a multimodal journey	Active strategy of taking the situation into their stride with a minimum of planning in advance and a few personal tricks. A number of stages in a journey, following on from each other, does not create any anxiety.
	Spatial Conduct	- Their relationship with the authorities (and with themselves) is one of trust. They pay great attention to the signs made available to them, and to their logic. Very visual, they take the necessary time to read the messages. - Occasionally check, without being obsessed by the idea, that they have made the correct choice. - Are able to situate themselves well geographically because they create a mental image of the space in which they are moving (visualization). - Occasionally ask other travelers for information.
	Specific needs	- Notice boards with easily legible messages, due to the size of the lettering and that of the boards themselves. - A minimum amount of purely essential pre-travel information, integrated if possible into the travel documents/ticket. - Confirmation of having made the correct choice at key points.