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focus in customer design preferences

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Eindhoven University of Technology,
Faculty Architecture Building and Planning
Construction Management and Engineering
NS I NPC

Eindhoven University of Technology
Prof. dr. ir. W.F. (Wim) Schaeter
Ir. E.G.J. (Erik) Blokhuis

NPC
Ir. R.S. (Ralph) Luijt
Ir. S.H. (Saskia) Bosman

Ir. P.H.H.J. (Piet) van Drunen

T.P.J. (Thijs) Cloosterman
0497759
t.p.j.cloosterman@student.tue.nl
+3161 652 93 69
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Technische Universiteit Eindhoven
Faculteit Bouwkunde
Den Dolech 2 I 5612 AZ Eindhoven
Postbus 513 I 5600 MB Eindhoven
Tel. +3140 247 91 11

NPC
Stationshal 15 I 3511 CE Utrecht
Postbus 2202 I 3500 GE Utrecht
Tel. 088 671 21 46

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Management Summary

In 2005, the NS (Dutch Railways Group) and Prorail conducted a research on the experience of time spent by railway passengers in the whole transport chain (NS 2005). Regarding the quality of the time experienced at railways stations, the research clearly showed that Dutch railway stations performed sub optimal. One of the conclusions of the research was that the decentralised focus and multiple, often conflicting, stakeholder interests in the development process were the cause of this current state. The NS, one of the major stakeholders in this development process, is ready to change this situation and recently declared in its annual report that it has devoted itself to developing high quality railway stations, which satisfy the demands of the customer (NS 2007).

A future vision about railway station quality has been developed by initiating new railway station concepts as ‘NS Regiopoort’ and ‘NS Wereldstations’. However, knowledge about a solid design approach to achieve this future vision of a high quality railway station is absent. At this moment, Leiden Centraal is a live 1-to-1-scale test facility to test new design principles. A theoretical support can help the current more practical trial and error approach of the NS to generate insight in the essential required design aspects. This research thereby focuses on a very specific part of the railway station: the rail terminal.

The purpose of this research is to help the NS firstly to answer the question about what the essential design aspects of a successful customer focused rail terminal design are and secondly to find an answer to the question of what design aspects should be prioritised in the design process. To be able to answer the two research questions, this research is divided into four separate research parts. First, an explorative qualitative research has been conducted in part one. Second, part two designs an analysis tool and conducts two specific in-depth literature studies. Part three introduces a case and a related expert survey. Finally part four describes the conclusions and suggests practical implications by introducing validation data and recommendations which can be applied in the NPC ‘Circle of Five©’-tool which is used to focus the design process.

Part one indicated relevant trends which influence the needs of the future customer and future functional demands of a rail terminal by using an explorative qualitative study. Two dominant trends emerged from this study: future railway stations (and thus also rail terminals) will have to process more passengers and secondly, they will have to offer a more diverse range of non-transport related services. These trends are then translated to functional requirements for a rail terminal by describing the impact of the trends on the ‘node function’ and the ‘place-function’ of a rail terminal. Due to the increase in demand of ‘node-functionality’ and ‘place-functionality’ a stressed situation will result in a situation where both functions claim a more prominent place in terminal design. This calls for an integrated design approach: space for a vast design where both functions are designed in parallel is simply not possible anymore. A more integrated approach in terminal design will lead to a situation where both place and node function will be able to generate customer value. Peek (2006) stresses the fact that in order to create customer value at rail terminals, two different kinds of customers will have to be satisfied: the passenger and the shopper: they form the starting point of the whole value chain at a railway station.

To find the best design compromise in serving both customers (the best service environment), this research has chosen to analyse the design wishes of customers of two narrowly related industries where the two customers are clearly present and which show great similarities in spatial characteristics. To analyse the design desires of the passenger, an in-depth literature study on the customer design preferences of airport passengers has been chosen. To analyse the desires of the shopper, an in-depth literature study on customer design preferences of shopping centre visitors has been applied. Both studies provide considerable amount of relevant data. To be able to analyse the customer design preferences of the two service environments,
general model was first designed which could analyse the wishes of a customer in a random service environment. This model was applied on the relevant studies of both airport and shopping centre literature sources. The result yields two structured lists of customer desires concerning their service environment. Since a rail terminal will have to satisfy both types of customers (passengers and shoppers), the two lists are combined to form one total list of twenty-four relevant design aspects of the service environment of a rail terminal. This list enables us to answer the first research question.

This list can be considered as too comprehensive and a 1-to-1 implementation in the design process would not lead to the desired focused design approach this research aims for. To narrow the focus, professionals were consulted to ascertain the value of the design aspect in achieving maximum customer satisfaction in the design process. By introducing a case ‘Den Dolech Central Rail Terminal’ which demonstrated the mounting pressure between the place and node function, two groups of professionals were consulted to give their opinion on what design aspects should receive a priority status in the design process (e.g. to which aspects financial resources and space should be allocated). The consulted professionals represented two industries and were chosen for their expertise and clear vision on customer satisfaction: the retail industry and the transport sector.

Data collection occurred by means of an online expert survey via a specially developed site: www.theshoppingterminal.com. Sixty-four professionals were approached and agreed to participate in the survey. A final response rate of 72% was achieved. The data results were used for a two step analysis. First, the data provided input for analysing the ‘hierarchy in design aspect preferences’ to achieve customer experience per specific respondent group. This resulted in two rankings of design aspects which are visualised in a hierarchic overview, inspired by the Maslow’s pyramid: the bottom design aspects are the most essential in generating customer experience. Second, the interrelations between the scoring of the two expert groups were analysed. The two rankings groups gave each design aspect a double scoring (passenger score, shopper score) and these scorings were combined to develop a 3x3 matrix. In this matrix (‘the Priority Matrix’) all the twenty-four design aspects were divided into six types of design aspects: essential design aspects, strategic design aspects, common design aspects, dominant design aspects, tactic design aspects and perfection design aspects.

The priority matrix showed very concentrated results along the centre diagonal line. This means that both professionals valued each design aspect fairly the same. In the centre of this line, the largest number of design aspects can be noticed: 10 common design aspects. The priority matrix generated three essential design aspects: spatial logic, wayfinding and state of maintenance. These aspects can be considered as most important in creating customer experience at rail terminal. To enhance passenger experience on a rail terminal three strategic design aspects (compactness, availability of space and circulation) are very important. To enhance shopper experience on a rail terminal one strategic design aspects (branding) is of importance. No dominant design aspects were measured. This could be regarded as a positive point in the design process since large discrepancies between expert rankings could indicate a potential cause for conflict. Relatively large discrepancies were measured at six design aspects: circulation, PA system and acoustics, security environment, seating facilities, productivity and availability of concessions. Statistical analysis however could only confirm significant relevant discrepancies in the scoring of the first four aspects.

Results were used for practical implications by firstly verifying the experience-based predictors of NPC’s Circle of Five©-location scan. Twenty-seven of the seventy-five predictors have been verified and several important recommendations to extend the
scan have been suggested. Secondly, results from this study helped NPC professionals to increase the accuracy of their location scan by suggesting specific scoring weights per predictor.
Samenvatting

In 2005 deden de NS en Prorail gezamenlijk onderzoek naar de tijdsbeleving van treinreizigers in de vervoerketen (Prorail & NS 2005). Hierbij kwam duidelijk naar voren dat stations in de gehele vervoersketen met betrekking tot de belevingskwaliteit ondermaats preseteerden. Een conclusie van de studie was dat een decentrale focus en verschillende, vaak tegenstrijdige belangen van de betrokken actoren in het ontwikkelingstraject hier verantwoordelijk voor waren. De NS, een van de meest prominente deelnemers in dit ontwikkelingstraject is klaar voor een kwalitatieve verandering en verklaarde onlangs in haar jaarverslag het doel na te streven om kwalitatief hoogwaardige stations te ontwikkelen welke inspelen op de behoefte van de klant (NS 2007).

Een eindvisie over de kwaliteit is mede door initiatieven als ‘NS Regiopoort’ en ‘NS Wereldstations’ reeds geschetst. Waar het echter aan ontbreekt is de kennis over een gefundeerde benadering in het ontwerpproces om dit einddoel, een hoogwaardig kwalitatief station, te bereiken. Momenteel dient Leiden Centraal als 1-op-1 test faciliteit om te bekijken hoe een succesvol station ontworpen kan worden. Een theoretische onderbouwing kan de huidige praktische benadering van de ontwerpproblematiek dan ook ondersteunen. Hierbij richt dit onderzoek zich op een specifiek onderdeel van het stationsgebied: de rail terminal.

Het doel van dit onderzoek is om voor de NS ten eerste antwoord te vinden op de vraag wat de essentiele ontwerpasspecten van een rail terminal zijn om in te spelen op de behoeften van de toekomstige stationsgebruiker en ten tweede om antwoord te vinden op de vraag welke van deze aspecten een hogere prioriteit in het ontwerpproces dienen te krijgen om zodoende een doelgericht ontwerproces te kunnen doorlopen. Om antwoord op deze vragen te kunnen geven is het onderzoek verdeeld in een viertal delen. Hierbij wordt allereerst in deel 1 een exploratief kwalitatief onderzoek toegepast. In deel twee wordt vervolgens een analyse tooi ontworpen en twee diepte literatuurstudies uitgevoerd. Deel drie introduceert naar aanleiding van een case een expert survey. Deel vier beschrijft vervolgens de conclusies en doet praktische aanbevelingen door het valideren en verbeteren van de NPC ‘Circle of Five’ tooi welke wordt gebruikt om het ontwerpproces te concentreren en te stroomlijnen.


Om te achterhalen wat het beste ontwerpcompromis is om beide klanten te dienen (meest aantrekkelijke consumptie-omgeving), heeft dit onderzoek ervoor gekozen om twee industrieën te analyseren waar deze twee klanten zeer nadrukkelijk aanwezig zijn en waarbij de ruimtelijke kenmerken overeenkomen met die van een rail terminal. Om de behoeften van de reiziger te analyseren is gekozen voor een dieptestudie betreffende de ontwerpwensen van passagiers op luchthavens. Om de behoeften van de winkelende consument te analyseren is gekozen voor een dieptestudie betreffende de ontwerpwensen van
winkelende klanten in een winkelcentrum. Beide studies kenmerkten zich door de aanwezigheid van een rijke hoeveelheid aan relevante data. Om vervolgens de wensen van beide klantgroepen gestructureerd te kunnen analyseren is er allereerst een model gecreëerd welke de wensen van een algemene klant in een consumptie-omgeving in kaart kan brengen. Dit model is vervolgens toegepast op relevante literatuur bronnen van beide klantgroepen. Het resultaat zijn twee gestructureerde specifieke lijsten van klantwensen betreffende het ontwerp van hun service-environment (resp. de luchthaven terminal en het winkelcentrum). Aangezien de rail terminal beide soorten klanten moet behagen zijn de twee lijsten samengevoegd tot één totaallijst van vierentwintig relevante ontwerpaspecten van een rail terminal. Deze lijst stelt ons in staat antwoord te geven op de eerste onderzoeksvraag.

De betreffende lijst was zeer omvattend en 1-op-1 toepassing in het ontwerpproces zou niet leiden tot de gewenste geconcentreerde ontwerpenadering welke dit onderzoek nastreeft. Een focus is vervolgens verder aangebracht door de analyseren wat het belang van ieder ontwerpaspect was in het creëren van een maximale klantbeleving. Om hier inzicht hierin te krijgen is toeniadering tot het bedrijfsleven gezocht. Middels het introduceren van een case, Den Dolech Central Rail Terminal, welke de toekomstige druk van de functionele claims nabootste, werden twee groepen professionals benaderd om hun mening te geven over welke ontwerpaspecten prioriteit moesten krijgen (m.a.w. meer financiële middelen en oppervlakte). De professionals bestonden uit twee industrieën die geacht werden een duidelijke klantgerichte visie hierover te hebben: de retail industrie en de transportsector.

De data werd verzameld met behulp van een online enquête die via de site www.theshoppingterminal.com aan 64 professionals werd aangeboden. 72% heeft aan de enquête deelgenomen. Vervolgens is gestart met het analyseren waarbij twee stappen te identificeren zijn. Allereerst is het de data van de enquête gebruik om de hiërarchie te meten tussen de individuele ontwerpaspecten per consumentengroep. Dit heeft geresulteerd in twee specifieke lijsten van ontwerpaspecten (een van de retail industrie, een van de transport sector) welke zijn gevisualiseerd middels het toepassen van de Maslow theorie: de basis van de pyramide vertegenwoordigt de meest essentiële ontwerpaspecten om een positieve klantervaring te creëren. De tweede stap in het analyseren onderzocht de relaties tussen het scoringsgedrag van de twee groepen respondenten zelf. Ieder ontwerpaspect is namelijk gewaardeerd door de twee groepen en de resultaten zijn gebruikt om een 3x3 matrix te ontwikkelen. In deze prioriteiten matrix, (de Priority Matrix') zijn alle vierentwintig ontwerpaspecten ingedeeld in zes soorten ontwerpaspecten: essentiële ontwerp aspecten, strategische ontwerpaspecten, gemeenschappelijke ontwerpaspecten, dominante ontwerpaspecten, tactische ontwerpaspecten en als laas te perfectie ontwerpaspecten.

De prioriteitenmatrix laat een grote concentratie nabij de diagonale middenas zien. Dit betekent dat de experts van de twee verschillende groepen veel ontwerpaspecten hetzelfde waarderen. Daarnaast kunnen rond het middenpunt van deze lijn ook de meeste ontwerpaspecten gevestigd worden (10 gemeenschappelijke ontwerpaspecten). De prioriteiten matrix laat drie essentiële ontwerpaspecten zien: ruimtelijke logica, wegbewijzering en onderhoudsstatus. Deze aspecten kunnen gezien worden als meest belangrijke ontwerpaspecten om een positieve beleving te genereren op een rail terminal. Om specifiek in te spelen op reizigersbeleving zijn drie strategische ontwerpaspecten van belang: compacte layout, beschikbaarheid van ruimte en een goede circulatie. Om specifiek in te kunnen spelen op reizigersbeleving is het van belang om branding mee te nemen in het ontwerp. Interessant is verder om te constateren dat er geen dominante ontwerpaspecten naar voren komen. Dit kan als positief gezien worden aangezien grote discrepanties in de ranking van de experts konden wijzen op een potentieel conflict in het ontwerpproces. Er zijn echter wel zes ontwerpaspecten die een relatief grote discrepantie laten zien: circulatie, akoestiek en
omroepsystemen, beveiliging, zit faciliteiten, productiviteit en aanbod aan concessies. Een statistische analyse gaf hierbij significante relevante discrepantie aan bij de eerste vier aspecten.

De resultaten van de analyse zijn ook gebruikt voor praktische doeleinden. Dit is allereerst bewerkstelligd door het valideren van de meeteenheden van NPC's 'experience based' Schijf van Vijf-locatiescan. Zevenentwintig van de vijfenzeventig meeteenheden zijn bevestigd en een aantal aanbevelingen voor uitbreiding van het aantal meeteenheden is gedaan. Daarnaast kunnen de resultaten van deze studie NPC professionals helpen in het inschatten van het belang van de meeteenheid bij een locatiescan door specifieke weegpunten per meeteenheid voor te stellen.
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Abbreviations

IATA  International Air Transport Association
       International Air Transport Association
NS   Nederlandse Spoorwegen
       Dutch Railway Group
NPC  Voorheen NS Project Consult
       Former NS Project Consult
NS MOA NS Marktonderzoek & Analyse
       NS Market Research & Analysis
LOS  Service level
       Level of Service
VROM Ministerie van Volkshuisvesting Ruimtelijke Ordening en Milieu
       Ministry of Housing, Spatial Planning and the Environment
V&W  Ministerie van Verkeer en Waterstaat
       Ministry of Transport, Public Works and Water Management
FAA  Bureau van de Amerikaanse luchtvaartautoriteiten
       Federal Aviation Administration
ACI  De wereldwijde overkoepelende organisatie van luchthavenbedrijven
       Airports Council International
OV   Openbaar Vervoer
       Public transport
OVCP Openbaar Vervoer Chipkaart en Poortjes
       Public transport chip card and controlled access
Pax. Passagiers
       Passengers
Acknowledgements

October 2007. Finding a research topic seemed quite a challenge. As I approached Eindhoven railway station by train to discuss several research possibilities with my portfolio mentor Piet van Drunen, I wondered why the railway station district of Eindhoven was such an unattractive area. It didn’t make sense because it was so valuable for so many people. During the meeting with Piet later on, I decided that I wanted to know more about railway station development. Steps followed quickly and soon I was introduced to Ralph Luijt and Saskia Bosman of NPC. We shared the same vision on the valuable future of railway stations and immediately started a research project.

Conducting this research has been a great experience. I have learned a lot of things about the extremely difficult challenge of developing a railway station, got to know many interesting people and saw up close how a company fought for its identity. I would like to grab this opportunity to thank the people who assisted and supported me along the way.

First of all, I owe a large debt to my graduation committee. I render thanks to Wim Schaeter and Erik Blokhuis for the scientific monitoring of my thesis, their guidance and assistance during the graduation process and their stimulating comments. I am also very grateful to Ralph Luijt and Saskia Bosman. Their contagious enthusiasm on railway station development, their expertise and their personalities were a continuous boost along the way. I thank NPC for their warm welcome and for providing me the flexibility to conduct this research and run a business at the same time. I would also like to thank ‘the three wise men’, Piet van Drunen, Bert van Eekelen and Hans Kleine. They helped me to start my thesis by asking the right questions and always responded to my call, regardless busy time schedules and appointments.

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Thank you all.

Thijs Cloosterman
Utrecht, December 2008
Chapter 1

"A station must be a safe and attractive place, an area for living, working, learning and recreation".

Aad Veenman
President NS

Introduction

This chapter introduces three important parts. First the strategic context of this research is introduced. This context persuaded me to dive into the complex and challenging world of railway station development. In the second part of this chapter NPC, the subsidiary of the NS, the NS itself and NS Poort will be introduced. NPC is the company where this research has been conducted from January till November 2008 and NS Poort is the company this research advises. At the end of this chapter a reader’s guide is introduced which can be used as a guide through the whole report.

1.1 Strategic Context

Ask a person if he knows how the NS makes its money and “ticket sales” will probably be the answer. Although a railway service is a necessary precondition for NS profitability the real money is made somewhere else… It’s not just the ticket! One could draw a parallel with the aviation industry: the average profit margin of airliners is about 0-2%. The airport industry on the other hand has a general profit margin of about 5% (BCG 2004). Since railway service revenues are decreasing (NS 2007) and ticket prices are under state control, the future of a more profitable NS will not be found by merely operating railway services.

The railway station, a potential profit engine

A railway station is no longer a place where trains just halt and passengers transfer. According to Meinhard von Gerkan “The Railway station has become the nucleus of the city”. This increase in the role a railway station has in a city has resulted in a revolution in railway station functionality. Railway stations do not only serve passengers; they can
offer a city much more. According to Kandee (2002), "the stations appear to be more than people-processors. They can influence people’s lifestyle".

With more than 1.1 million journeys on the NS network on a day and the fact that 75% of Dutch inhabitants live in a 5 Km. radius of a NS railway station (NS 2007), the railway station forms an important element in many people’s lives and is a crucial element of the many cities’ centre. Here, the railway station has not become part of the city’s centre, but the city centre has become part of the railway station and thus railway stations become destinations at itself. Kandee (2002) describes this integration as follows: “it is evident that many grand stations in the Unites States, Great Britain, and Japan begin to look like shopping districts that become tourist attractions”.

For NS, the importance of the railway station is also increasing rapidly. Contrary to the revenues on rail services, which do not show potential growth, its own hub development company NS Poort realised an increase of 11% in revenues in 2007². Servex, the NS Poort retail daughter increased its sales from 150 Million Euro’s in 2002, to 255 Million Euro’s in 2006. Retail revenues in 2008 are projected to surpass 300 Million Euro’s³. Railway station development clearly pays off and shows great potential for future business.

**Concession ahead!**

Due to European privatisation regulations, the NS Railway Group has the right to operate the main railway system till 2015. Then, new operators can join the bid for the new concession and rail operators like Arriva, Syntus, Connexxion, DB, SNCF and Veolia can acquire the exclusive right to operate the main rail network from 2015. Although the NS has developed a clear strategy to acquire the new concession, it also has to think about a future without passenger services on national lines. In this scenario, the development of railway station areas could very well become one of the main activities of the NS company. The recent NS reorganization anticipates on this scenario by making a clear division between four operating fields: passenger service (NSR), Fleet management and Maintenance (NedTrain), hub development and operation (NS Poort) and rail infrastructure and construction (Strukton). By dividing the NS group in four clear business units, one unit (e.g. NS Poort) can operate individually. If the NS wants to survive the scenario where they lose the bid, a clear focus on hub development (railway stations) is expected.

**Current situation**

The Dutch railway stations are currently in a very turbulent business environment where customer demands are changing rapidly. According to newspaper DAG "We spend more time on dining, shopping leisure activities at railway stations."⁴. If NS wants to be a successful railway station developer, it will have to specialise in designing high quality railway stations to facilitate these new activities.
The quality standard of a railway station is important because, as with any building, a railway station can influence a person in his decision making process. As Kotler mentions, this influential power can be quite dominant: "in some cases the place, more specifically the atmosphere of the place, is more influential than the product itself in the purchase decision" (Kotler 1973).

Dutch railway station customers however do not value railway station that well. The appearance of Dutch railway stations does not meet the standards a passenger expects. A study on customer perception of time spent during the whole train journey, valued the time spent on railway stations as three times the real time and also value it the least interesting part of the whole journey (Figure 1-1 and 1-2).

This is particularly concerning when one considers the fact that the time spent on railway station is responsible for nearly a quarter of the total appreciation of the whole train service (Figure 1-3). The importance of a well designed railways station is evident and in order to attract future customers, railway station quality will have to rise.

The NS is aware of the outdated quality her railway stations offer and is taking action. Increasingly, the focus within the NS organization is aimed at satisfying customer desires. As van Balken (NS) mentions in NS Toekomstvisie: "Customers are key in success" (NS 2006-1). Several research initiatives on customer desires have already been conducted, including on by Mark van Hagen (2003). In this study the desires of the railway passengers have been thoroughly analyzed. This resulted in the definition of several conditions which are essential in satisfying these NS customer desires: "the customer desire pyramid". Appendix 1 demonstrates the model in more detail. Peek (2006) describes "the customer desire pyramid" of Van Hagen for railway passengers on railway stations as follows:

"The base of this pyramid consists of the basic requirements of safety and reliability, which cover half of the valuation of the performance (safety is an absolute prerequisite). In a society characterized by a shortage of time (de Ridder, 2006) speed is a primary demand of customers. When the requirement for a fast and efficient transfer is met, the customer's secondary wish is that the transport is easy, i.e. straightforward and without a lot of inconvenience. In addition, customers expect a certain degree of comfort at the station. Covered waiting rooms and shelters and other
amenities need to be provided to passengers. Finally, the journey should be a pleasant experience. Visual features such as the architectural layout, the colours and materials used, (day) light and transparency determine the ambience and affect the overall customer’s experience”.

The challenge for the NS today is to offer a comfortable and pleasant experience at railway stations. The design of the railways stations can play a very important role and knowledge about the design elements, which can stimulate a positive customer perception of the railway station quality, is relevant. This study focuses on assisting NS Poort to acquire knowledge about the design principles of high quality railway stations.

1.2 Business profiles

The NS Railway group is a very complex and extensive organization. It is not merely a railway company that operates the Dutch main rail network. The NS Group serves many foreign markets in railway station operation and consultancy and, as this sub paragraph will show, has many different business units. After a short summary of the NS Group and NS Poort, NPC is introduced: a consultancy and project management firm where knowledge is the most valuable asset.

1.2.1 NS at a glance

Every day NS handles 4,700 trains in the Netherlands over a heavily-used rail network. The company manages 379 Dutch railway stations and develops public transport hubs. Every day, more than 230,000 people buy something in one of its shops or hospitality outlets. Working with partners in Germany, Belgium and France, NS also transports passengers to major European cities. Besides offering services to Dutch passengers, the NS and its partner Serco also provide transport in Great Britain in the Liverpool area (Merseyrail) and in northern England (Northern Rail), carrying in total 330,000 passengers a day via 500 stations.

The sole shareholder of the NS Group is the Dutch State. Since 2005, the role of the company shareholder has been fulfilled by the Ministry of Finance. NS Group’s activities are divided into the following four segments: Passenger Services, Fleet Management & maintenance, Hub Development & Operation, and Rail Infrastructure & Construction. These segments consist of one or more business units, each of which is run by a team of directors. Appendix 2 shows the organizational chart of the NS Group. NS operates in three segments: passenger services, hub development and operation, and rail infrastructure & construction. Within the passenger services segment, NS Reizigers is responsible for transport operations in the Netherlands and the associated sales and service activities. Nedtrain handles the maintenance of the trains in the Netherlands. NS Hispeed is responsible for cross-border passenger services, to which will soon be added the responsibility for high speed services in the Netherlands. NS subsidiary NedRailways handles rail passenger services abroad. In the hub development segment, NS Poort handles the management and commercial operation of the Dutch stations and the developments around these stations. The rail infrastructure & construction segment is handled by the NS subsidiary Strukton, a leading company in the rail construction and maintenance market (NS 2007).
1.2.2 NS Poort

NS Poort aims to develop, operate and manage stations and the areas around stations, thus creating pleasant, lively and sustainable locations where people enjoy passing the time, living, shopping and working and where businesses are anxious to establish offices. NS Poort will either carry out the operations itself or direct those operations. The goal is to create added value for a wide range of customers: passengers and passers-by who make use of the station, the trains and other forms of transport; shoppers; and those buying or renting property. NS Poort handles these operations in such a way that it contributes to the strengthening of rail travel's competitive position.

NS Poort has five subsidiaries: Servex, NS Fiets, Passenger Terminal Amsterdam, NPC and OV-fiets. NS Poort operations can be divided into four core business activities: Development, Hospitality/retail and associated chain operation, Operational property management and Asset management (NS Poort 2008). Appendix 3 shows the organizational chart of NS Poort. More information about NS Poort and NS business performance is provided by Appendix 4.

1.2.3 NPC

NPC is the in-house project consultant of the NS (formally known as NS ProjectConsult) and advises and supports the NS on many operational, tactic and strategic levels. NPC has five offices: the head office in Utrecht and four regional offices in Amsterdam, Eindhoven, Rotterdam and Zwolle. At Utrecht, the head office is divided in two separate departments: ‘Consultancy’ and ‘Expert centre’.

NPC specializes in the development of (semi) public spaces, in the field of logistics and mobility, safety and security experience, housing and real estate. This research is written for the Consulting department of NPC. Figure 1-4 shows the Matrix organizational chart of NPC. Three kinds of departments can thus be recognised: Regional offices, Consultancy and Expert Centre. Three operational fields can be distinguished:

1. Consultancy concerning hub development
2. Project management
3. Project realization

NPC defined a 3x3 matrix where the operational fields are linked to the activities of the departments:

Source: www.nspoor.nl Accessed on November 5th 2008
NPC consulting activities concern integral business cases, integral contracts and agreements, integral list of requirements, design and advice supervision and a location scan, called the circle of five (NPC 20086). NPC does not only manage NS and Prorail related projects. Its knowledge on semi public places like railway stations can also be applied abroad (South Africa and Sweden) and outside the traditional railway business (public places in healthcare: hospitals).

6 Source: www.npc.eu Accessed on October 26th.
1.3 **Reading guide**

This research consists of four main parts (Figure 1-5). Part one introduces trends which impact the future demands a rail terminal will have to satisfy. These trends will result in new functions at railway stations, the second chapter of Part one discusses this topic.

Part two concerns itself about Customer Design Preferences. In the first chapter a general model for analysing customer preferences in service environment design is designed. This model is used in chapter six to analyse design aspects of passengers at airports and customers at shopping centres. This analysis results in a detailed overview of design preferences of future rail terminal customers.

Part three introduces a focus on the design preferences. By consulting an expert panel, design aspects are ranked and are divided into different priority groups.

Part four answers the two research questions and provides several practical implications. In the second chapter a discussion and personal reflection is provided. The Appendices can be found in the supplementary document.
Chapter 2

Railway stations can be viewed from many perspectives. Key is use the appropriate one.

Johannes Zondag
Prorail

The Research

This chapter introduces the basic principles of the research, conducted at NPC. Paragraph 2.1 will discuss the design of the research. First, the main problem this research will be addresses. This results in a two folded research objective with two main research questions. Paragraph 2.2 introduced relevant definitions of concepts. Every main concept will be briefly discussed to clarify the scope of the research. To demonstrate this research' relevancy, paragraph 2.3 finally elaborates about the social, business related and scientific motives to conduct this research.

2.1 Research design

This paragraph discusses the design of the research. In the beginning of the research process, in February 2008, a research proposal has been designed. This research proposal contains a general research approach. As more knowledge accumulated, the document has been adjusted and has eventually transformed into this paragraph.

2.1.1 Research problem

As the introduction figures 1-2 and 1-3 show, current Dutch railway stations hardly satisfy the needs of contemporary railway station users. The causes are due to the fact that Dutch railway stations were originally designed to support one function: facilitating the passenger in transferring between different transportation modes. Over the years, new functions were introduced, resulting in an unstructured and indistinct situation. The current state of Dutch railway stations therefore offers great opportunities for improvement: future trends can be utilised to win back the rail passenger. In doing so, the railway station will have to service more functions than its sole original transferring role: railway stations will have to give its customers what they want.
This requires a new focus on the design process. If NS wants to take advantage of the upcoming trends, railway stations have to fundamentally change in design. Not anticipating on the shifting demands of railway station passengers could have a severe impact on future NS profitability. As the introduction illustrated, railway stations play an important role in the total perception of journey quality of a railway passenger. Low appreciation of railway stations will result in fewer passengers willing to pay for a train ticket (since alternatives are more attractive) and less people will spend time at the railway station for non-travel related activities.

This poses a specific challenge for the NS, since they also operate the commercial activities on railway stations. NS has clearly stated that it wants to develop railway stations which provide a more attractive environment for travelling and spending time (NS 2007). The problem during the redevelopment process is however that many stakeholders are involved and no clear leadership function is defined. A Prorail and NS 2005 study describes the situation as follows:

The co-operation between the many stakeholders at a railway station is often a sluggish process. Short term commercial stakes and long term management plans can collide. A lack in a central approach to railway station design and a focus on soberness and profitable exploitation has lead to a shredded image of the railway station. (NS 2005)

This almost inevitably creates a complicated situation regarding the design of the railway station. Every stakeholder pursues its own goals and this could result in a very indistinct situation where a sub-optimal level of design quality. The NS is one of the main stakeholders in the design process of a railway station and has a strong ambition to create more attractive railway stations. Although their vision about a high quality railway station is quite clear, knowledge about the specific crucial elements in the design which make a railway station more valued are rather limited. In order to develop a focussed design we have to develop more insight in design elements which the end-user of a railway station values. By taking their preferences as a starting point, the focus is clear and personal stakeholder agenda's are eliminated. This research focuses on a specific element of the railway station, the rail terminal. This main research object will be defined in paragraph 2 'Definition of concepts'.

Concluding the following definition of the research problem can be defined:

Lack of knowledge on design requirements of an attractive rail terminal and focus in the design process have resulted in a sub optimal quality rail terminal environment at Dutch railway stations which dissatisfies contemporary and potential railway station customers.

2.1.2 Research objective

Since the appreciation of the time spent on railway stations is low, the NS, a major stakeholder in the development process of a railway station, wants to develop detailed insights in ways to enhance the customer perception at the railway station. This research therefore focuses on the requirements of a successful rail terminal design which can satisfy the expected customer needs at future railway stations. The objective of this research is two folded:
The first objective is to develop insight in the design criteria of the rail terminal, which are required to satisfy the future railway station customer. The second objective is to make recommendations on which design criteria have to be preferred in the design process to enable a focused efficient design process.

2.1.3 Research questions

In order to develop detailed insight to achieve the research objective and make recommendations for the design process, this research defines two central research questions. The main research questions arise from the research objectives and can be formulated as follows:

1. **What design aspects of future rail terminals are essential in order to satisfy the demands of future railway station customers?**

   The first main research questions can be unravelled by formulating the following sub questions:
   
   1. Who is the future rail terminal customer? (Part 1)
   2. What does this customer value in rail terminal design? (Part 2)

2. **What design aspects of future rail terminals should be preferred in the design process?**

   The second main research question will be answered in Part 3.

2.1.4 Research approach

To be able to answer the research questions, this report consists four parts. Each part consists of several chapters.

Part one will use an explorative qualitative study. Relevant information, needed to perform this study is will be acquired by an extensive desk research. The libraries of Eindhoven university of Technology, Delft University of Technology an NPC provide the initial basic information. Part one answers the first sub question of the first main research question.

In part two, an in-depth study on three specific topics will be performed. Internet databases (SpringerLink, ScienceDirect, Taylor & Francis, Scopus and J-store) will provide the relevant studies, needed to support a in depth study. University libraries will also be consulted in this part. The three in-depth studies will result in the answering of sub question two.

Part three will uses an expert survey to focus the design aspects. An expert panel will be consulted via an internet site to ascertain information, needed to prioritise the design aspect list. This information will then be processed by SPSS and the results can give us an answer to the second main research question.

Part four will present the overall results. First the two research questions will be answered, and second, relevant recommendations will be made. The recommendations will concern NPC's Circle of Five©.
2.2 Definition of concepts

The multi-interpretable character of many concepts involved in this research requires for a clear definition of terms. First, the definition of the main object of this research is defined: the rail terminal. Second we will discuss the railway station customer and finally, the main stakeholders in the design process are introduced. This research is relevant to them all.

2.2.1 The rail terminal

Like airports, railways stations are building complexes with many different areas in several large spaces (Edwards 1990). In defining the boundaries of the rail terminal we can use an intra-extra terminal approach: intra-terminal is included in the rail terminal area and extra-terminal is not included. The boundaries of the intra-terminal space, or rail terminal are defined by several spaces. These spaces have different owners. First there is the public area outside the railway station. This, usually square-type, space in front of the terminal is often property of the local municipality (A). Although the interaction between terminal and public space in front of the terminal is important, it is not considered in this research. The second extra-terminal areas are the railway platforms (B). The platforms are property of Prorail and reaching them requires a level change. The third extra terminal spaces surrounding the rail terminal area are the adjacent real-estate buildings (offices and housing) (C). The offices and housing units do not necessarily depend on the rail terminal and have other entrances. Figure 2-1 shows the rail terminal.

This research considers the service environment of a rail terminal. Bitner (1992) refers to service environments as a ‘servicescape’ and describes it as a place where customers are subjected to “the effect of atmospherics, or physical design and decor elements. It includes all the objective factors controllable by the service provider that facilitate customer actions during the service encounter and enhance their overall service quality perception”. Turley and Milliman (2000) refer to servicescapes as facility-based environmental cues, or “atmospherics”.

Figure 2-1: The rail terminal
This Bitner’s definition of a servicescape is leading in this research. The service environment can be very powerful since research suggests that “the physical setting may influence the customer’s ultimate satisfaction with the service” (Harrel & Hutt 1976 and Anderson 1980).

**Service environment:**

*physical design and decor elements. It includes all the objective factors controllable by the service provider that facilitate customer actions during the service encounter and impacts the overall service quality perception*

Once we have stated the boundaries of the rail terminal and the definition of the service environment, it is important to know what activities are present inside this rail terminal. According to research by van Hagen and Peek (2001) on customer experience, rail terminals can be divided into two different areas, a ‘fast-area’ and a ‘slow’ area. Appendix 5 defines these areas. In short the fast area is transfer related and is the area at a rail terminal where passengers transfer from different transport modalities. The slow area is the area at a rail terminal where the focus is less travel related and passengers are more open to experience related factors of the rail terminal, like terminal ambience. The passenger switches from ‘stress-mode’ to a more ‘relaxed-mode’ (NS 2003). Here a more commercial program is available to spend time.

The NS also developed a design vision (“NS Vision stations” NS 2006-2), in which the two areas of a rail terminal are divided into three basic functional domains: the entrance domain, the lodging domain and the travel domain. Appendix 6 elaborates about these functional domains. The rail terminal in this research entails the entree domain and the accommodation domain:

**The Entrance Domain:** This domain is the first domain a potential railway passenger will experience. This domain consists of three basic activities. Orientating on the location of the trains, services or shopping areas (1). Acquiring information about the railway services (2) and last, navigating: defining the most effective route to the destination (3). This domain had a dominant logistical function.

**The Lodging Domain:** This domain has a primary task to make the staying of the railway passenger on the railway station more pleasant. The Lodging domain gives the time spend on railway stations a useful function. This area can be indicated as the main commercial space of the railway station with retail, banking facilities and (social) meeting places.

The rail terminals in this research can be found at large and very large railway stations. In the Netherlands, a total of 386 railway stations are used by the NS and four other small transport companies7. Between these railway stations, many differences occur. The NS identified 13 identification criteria to divide the 386 railway stations into six categories (De Bruyn en van Hagen, 2002). The six typologies are as follows:

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As mentioned, the 'top two' railway stations can be considered as the most valuable railway station for the NS. This is for two reasons: First, they serve the largest amount of passengers, resulting in considerable ticket income (together, Type 1 and Type 2 produce 55% of the total Dutch passenger volume). Second, they are also the most interesting places for commercial activities (direct retail sales and rents). It is at these railway stations where the needs of future terminal customer have to be met: they can generate substantial revenues for the NS Company.

### 2.2.2 Rail terminal customers

Railway stations provide a service to many different parties: transport companies, retailers, offices, governmental institutions and to consumers of services (Edwards, 1998). The most essential customers at railway station are the consumers of transport and retail services (Ross, 2000, Peek, 2003). The value chain begins with their decision to consume a service. These consumers are mainly railway passengers. Although city residents also use the railway station for various non-transport related services and as a passage to other city districts, their numbers are considered insignificant. The railway station passenger, and more specially the rail terminal customer forms the primary customer in this research and the customer’s perception of the service environment is leading.

### 2.2.3 Relevant stakeholders in the design process

Railway station development in the Netherlands has a few unique characterizations. First the high intensified railway network and urban fabric makes railway station development on of the most complex and difficult forms of urban development. Second, many actors are involved during the development process and third, there is no true owner of the project. In making decisions during the design phase of development the last two items are particularly relevant and can responsible for many discussions and delays. Since many actors are involved with each its own interests, and no clear project owner, an overall research on the focus of the design can thus be useful. This research focuses on the ability of the rail terminal to serve its customers, which is eventually the overall target of all terminal stakeholders, The following stakeholders are relevant in the design process and can benefit from the knowledge that is acquired in this research.

The Metropolitan Planning, Public works and Water Management (Ministry of V&W): The Ministry of V&W focuses its policy on national infrastructure, mobility and transport. Its plans and projects are ascertained in so-called MIT’s (multiple year program infrastructure and transport.). The main goals of V&W are to protect the Netherlands against water and to ensure secure connections of international quality. Accordingly, the ministry’s mission statement is: reliable with water, progressive in connections.

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The metaphor “Building on a post stamp” has often been used, referring to the small building parcel usually available in inner-city redevelopment projects (BAM, 2006).
Prorail: The ministry of V&W executes its policy via Prorail. Prorail is part of the Ministry and owner of the railway tracks and railway station platforms in the Netherlands. Prorail has devoted itself to deliver sufficient capacity, reliability and safety on the railway network. Prorail is the process manager in Dutch railway station developments and maintains the Dutch railway network. In the design process of a railway station, Prorail defines the basic elements of a railway station, finances this development and ensures maintenance as well (in co-operation with NS).

Local Municipalities: Railway stations and local municipalities are closely related. Besides the fact that railway stations can have a large impact on the city's image, local municipalities usually own many grounds around the rail terminal (e.g. the adjacent square). The municipality is responsible for local traffic and transport policy is often the initiator of inner-city urban development projects. Since it has different ways to acquire financial means for railway station development (e.g. own taxes, financial resources of the Dutch government) they can be considered as an important stakeholder in the redevelopment process.

The Dutch railway Company NS: The NS provides the main passenger rail service in the Netherlands. Daily, 1.1 Million passengers use the services of the NS. As the introduction already mentioned, NS has four main business units: 'NS passenger transport', Rolling stock management & Maintenance (NedTrain), 'Hub development and operations' (NS Poort) and 'Railinfra and construction'.

NS Poort operates all the 386 railway stations in the Netherlands and is a major player in the retail industry. Its core activities consist of investment management (asset management), urban development, operational real-estate management and retail exploitation. It develops real estate on the railway station itself or in the direct vicinity. Revenues generated by NS Poort are relayed back to the core business of rail transportation. The retail part of NS Poort is called Servex which has numerous retail formulas such as AH to-go, Kiosk and Swirls. Its turnover have has grown spectacular from 150 MIO in 2002 to 300 MIO in 2007 (Retailtrends, 2007). According to Jan Kooiker (Managing Director Servex), "Servex expects to increase her turnover with tens of millions euro's" and the future role of Servex is (considering the stakes) likely to increase.

2.3 Motivation

The motivation to conduct this research on terminal design is threefold:

2.3.1 Social relevance

First, there is a social relevance to unravel factors that satisfy the needs of passengers. As mentioned in the introduction railway stations hold a prominent location in the city centre (Kandee, 2002). More than a million public transport customers use a railway station on a daily basis. 1.1 million of them are railway customers (NS 2007). Many people work on or nearby railway stations and because of its central location and many city residents live nearby the railway stations. This important and extremely valuable location in the Dutch society however does not show its potential value. Reality shows a place where urban life is hardly or partially possible. It looks like the original design of
the railway station district mainly focuses on facilitating the arriving and departing railway trains, not on serving its customers. A more technical approach is used here. A new customer focused approach to railway station design is desired which can positively influence the lives of millions of people.

2.3.2 Business relevance

Second, from a businesslike perspective, it is relevant to conduct research on customer design requirements. The NS is interested in ways to effectively increase the quality of time spend on railway stations. NS Research (NS 2005) indicates that the railway station itself is highly important in the customer’s perception of the overall quality of the whole transport chain. A higher consumer rating on railway station quality influences the decision making process when choosing a transport mode. A railway station that offers a high level of quality to its customers is likely to attract more passengers. Insight in the design aspects of a successful service environment at railway stations is therefore essential in NS strategy to achieve the prospected rate of annual passenger growth of 3% (NS Annual Report 2007) and increase its retail revenues.

Furthermore, the development of the Dutch High Speed Link\(^1\) (HSL) offers opportunities for the NS to expand business. All of the top six railways station in the Netherlands will be redeveloped and a more airport terminal like design will be applied on Amsterdam Zuid, Breda, Rotterdam, Amrhem, Den Haag and Utrecht Central. A new design concept will also be applied: NS Wereldstations\(^2\). This is a retail concept where commerce and transfer are intensively combined. Leiden Central Station will be a real time, 1 to 1 test case of this new vision. The testing is in a premature phase and Leiden can be considered a trial and error test-case facility to verify successful design aspects. Research is therefore welcome on the complex integration process of multiple functions in railway station design.

2.3.3 Scientific relevance

Finally, there is a scientific relevance to conduct this research. Little evidence is found on the existence of research which combines the commercial and transfer function in designing a railway station. A small amount of research (Bertolini & Spit 1998 and Peek 2006) give however some guidance. Regarding terminal design, much information is available on airport terminal design (Fodness & Murray 2007, Correia et al. 2007, Barros et al. 2007, Rhoades et al. 2000, Lemer 1992). From a commercial perspective several important literature resources are available to ascertain shopper’s perception on shopping centre quality (Verbunt 2005, Dirks & Janssen 2003, Ng 2003, Turley & Milliman 2000, Bell 1999, McGoldrick 1992). The combination of these two specific fields of research can add valuable knowledge about the design criteria of a successful service environment and help professionals to design better, more convenient, high performance rail terminals.

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\(^1\) High Speed Link: Hoge Snelheids Lijn
\(^2\) NS Wereldstations: The NS have developed generic a retail concept for six major railway stations. Leiden Centraal is currently a test case. In this retail-concept, five ‘experience’ worlds are defined. See Appendix 8 for a brief description about the concept.
Part one.

Future functions

The rail terminal of tomorrow will have to satisfy different customer needs. This chapter analyses trends which will impact customer demand and projects these trends on rail terminal functionality. First a brief introduction is given on the history of railway station functionality. It explains the design of current railway stations and ends with the focus of future rail terminal design. Second, major trends are introduced which will have an important impact on the desires of tomorrow's customers. The second chapter introduces relevant theory on railway station functionality and illustrates the great potential of a new rail terminal functionality.
Chapter 3

"My interest is in the future because I am going to spend the rest of my life there".

Charles F. Kettering
American engineer, inventor of the electric starter, 1876-1958

Trends

To understand the contemporary state of railway station designs, a short introductory summary of the history of railway station development in the Netherlands is given (§3.1). Second, paragraph two describes relevant major trends which will impact rail terminal designs of tomorrow.

3.1 A brief orientation

Railway stations have been developed over the years for various reasons. This paragraph briefly introduces three centuries of Dutch railway station development. Each century has its own specific reasons (or rejections) to invest in the quality of railway station design. At the end of the paragraph, the 21st century vision is stated, and forms a red line through this thesis.

3.1.1 19th century: Means of competition

In the early days of the Dutch railway station development (1839), the first railway operators De Hollandse IJzeren Spoorweg-Maatschappij (HJSN), and the Nederlandsche Rijnspoorweg-Maatschappij (NRS) viewed railway stations as a means of competition (Douma 1998). The main purpose of developing the imposing ‘royal’ red-brick creations was to underline solidarity, reliability and comfort of rail transportation. The large investments in railway station design however didn’t last long. After fierce competition, which almost resulted in the bankruptcy of both operators, a law was passed in 1863 that created a fund for constructing all rail infrastructure. During the next 20 years, standardized Calvinistic architecture, designed by Dutch public works engineers was the result.
From the 1880's a strong growth in railway use could be noticed. Railway transportation encountered little competition from other forms of transport and railway operating became a very profitable business. The two largest railway operators in 1885, The HIJSM and the 'Staatsspoor' continued to invest in their railway stations. The results are impressive: Amsterdam Central Station (1889), Groningen (1893) by the Staatspoor and Den Haag Holland Spoor (1893) and Haarlem (1908) by the HIJSM. The world could now see how profitable the railway business was.

3.1.2 20th century: National policy

After two decades of prosperity, the 1920's introduced difficult times for railway transportation. The fierce competition of a new modality, the car, and the eccentric location of railway stations created a harsh climate to operate in a financial feasible way. The two main operators, Staatspoor and HIJSM, tried to work in partnerships which eventually resulted in the "NV Nederlandse Spoorwegen" (the current NS Railway Group).

During the 1930's, the economic malaise created many restrictions in the development of railway stations. Only a few stations were developed, being employment projects (Amsterdam Muiderpoort, Amsterdam Amstel 1938-1939). The Second World War, which shortly followed, resulted in the destruction of many of the railway stations, creating a great redevelopment challenge (Douma 1998).

This specific redevelopment challenge, the reconstruction of a new railway infrastructure, including railway stations, received priority status. A logic choice, since a solid infrastructure was crucial for enhancing economic growth (Banister 2001, Priemus et al 2001). This resulted in an impulse in railway station design and development. The new railway stations got a monumental quality since the vision of the NS was that the stations were the representation of the company (Douma 1998). But after the climax of Tilburg (1965, see figure 3-1), the situation changed dramatically for the NS. The Dutch coal mines in Limburg closed (which cancelled a highly profitable business) and transportation by rail again endured fierce competition of the car (and truck).

The consequences for railway station development were two-folded. First, sober architecture was applied. Minimal investment resulted in railway stations with very low level of experience. The second consequence was the first steps in 'a joint development' in railway station development. Both Den Haag Central Station and Utrecht Central Station are railway stations with a large secondary function (or should one say primary) are the result. Not everybody was enthusiastic about this movement. To some it highlighted "the downfall of Dutch railway station Architecture" (Douma 1998).
1998). However, in the 1980’s the NS recovered and more financial means were available for railway station design. This resulted in a new growth in railway station developments. The privatization of the Dutch railway company shortly followed in 1995. The next paragraph will discuss the topic thoroughly.

3.1.3 21st century: Customer experience

The privatization of the NS in 1995 was a very important moment regarding the development of railway stations: it created more freedom to focus on the function of railway station design (Hoedjes 2006). Railway stations didn’t have to be a costly transport node, it could also be a place where additional value could be offered to passengers and value could be captured. Just like the aviation industry, the ‘landing zones’ of trains could be very profitable for the NS. In short a summary of the privatization agreement with special attention to railway station development is given in Appendix 7. Two clear and relevant examples of this new generation of railway station design are the ‘NS Wereldstations’ and ‘RegioPoort’ (Regional hubs).

NS Wereldstations I The World stations will be developed at the six National Key Projects13 (Breda, Utrecht, Amsterdam South, Rotterdam, Den Haag and Arnhem). Currently, Leiden Central station is appointed as a test facility. The railway stations will have a different design and program than standard NS-stations have. All these railway stations are places where international trains like the ICE and the Thalys will halt and therefore a more international appearance is chosen. "The railway stations will receive the appearance of an international airport. Passengers and other consumers will be able to shop and spend quality time (dining, events and entertainment) at railway stations and even residential functions are possible"14. An integral part of the new station design will be the realization different ‘worlds’ where shops, housing, cultural facilities and offices are all integrated. The shell of the railway station will become an attractive destination by itself.

NS Regional Hubs I The ‘Regional Hub’ concept is currently under development. In the near future, the NS is willing to invest 2 billion Euros in projects to develop special regional railway stations. The purpose of the project is to alleviate the congested Randstad urban region of cars by introducing hubs where car users can transfer to rail transport as means of entering the congested Randstad urban region, and so saving valuable time. With high frequency, fast railway connections to large railway stations and an alternative program (Child day care, shopping and car maintenance) the ‘Regional Ports’ will offer car users a new comfortable way of transport in the future. Railway station Veenendaal is currently the first test station and according to Bert Meerstad of NS the test is already a great success with 50 percent more railway users.

These new NS development initiatives are boosted by socio-economical trends. Paragraph four will address these trends.

13 New Key Projects: projects for the development of large high speed railways stations in the Nederlands. The high speed rail connecting will connect from north to south (Amsterdam - Breda) and West to East (Utrecht, Arnhem). The purpose of the New Key Projects is to enhance the economy in and around the rail station and to strive for a international and national attractive place for work, living and recreation (source www.vrom.nl).

3.2 Major trends in Dutch the railway industry

Dutch railway company NS faces a highly turbulent but interesting future. Several trends indicate that the difficulties following the years after the privatization are history and that the odds are in favour of the rail transportation industry. This creates opportunities to develop new high quality railway stations. This paragraph discusses these trends. First, the main trends which increase the popularity of railway transport are introduced. These trends will have an impact on the amount of potential new passengers railway stations will have to cope with. Second, the trends in consumer behaviour are briefly studied. Together, the first and second paragraph illustrate a window of opportunity for new attractive high quality Dutch railway stations.

3.2.1 Trend 1: Expected growth in potential passengers

Recent NS figures show a 3 to 5 percent growth in passenger movements over the last two years (NS 2007-1). This percentage is impressive but can even be higher. Future growth in passenger volume can be stimulated by two important developments: passengers are offered a better value offer and institutional policies promote the use of public transport.

Development A: Better Value Offer

Railway transportation can offer more value because of four main factors.

First, it is becoming a more interesting alternative to access the heavily congested Randstad urban region. This highly congested area has a serious transport capacity problem (Min V&W 2001, 2004, 2006) and will, according to The National Mobility Monitor (2007) not solve its congestion problem in the near future. Therefore transportation by train is gaining an essential competitive advantage: it saves crucial time.

The second factor which stimulates the value offer of railway transportation is the increase in rail capacity and frequency. After claiming the possibility of increasing the density of train movements on one railway track substantially in 2007 (Prorail 2007) a new type of passenger friendly service could be possible in the near future: travelling without a timetable. Prorail uses the comparison with a metro system: every ten minutes the possibility to travel. This new approach to railway transportation will give passengers more freedom of choice and will stimulate growth in passenger volume.

A third factor, which will generate a significant increase in offered value to passengers, is the development of services that enhance the quality of the whole transport chain. The NS Business card is a good example. The card allows business passengers to conveniently plan their journey by rail as an alternative to car transportation. The card is gaining momentum; Athlon car rental offers its customers a possibility to combine the use of the lease car with the NS business card. (Athlon 2007, NS 2007-2). The OV fiets concept and the participation in Greenwheels' are two other successful initiatives to complete the whole transport chain: transport modalities are becoming more and more complementary.

Factor four stimulates the value offered to passengers because of the shifting public opinion on climate change. Thanks to numerous studies and recent movies such as "Inconvenient Truth" (Paramount, 2006), the production of CO₂ is becoming a dominant factor in choosing the transportation mode. In deciding which transportation mode to choose, 50% of the train passengers claim to be influenced by the environmental issues (NS 2006-1). This certainly favours use of train services since one kilometre by car produces on average two times as much CO₂ emissions (NS 2006-2).

Development 1 Institutional policies on stimulating use of public transport.

Railway transportation also offers governmental agencies important possibilities to execute their policy. Many institutional policies of Dutch governmental agencies favour therefore the usage of public transport:

The Ministry of Transport, Public works and Water Management (V&W) promotes the use of rail services to fight the increasing traffic congestion (especially in the Randstad urban region) and the pollution produced by car transportation. One of the ways V&W executes its policy is via Prorail. Prorail has devoted itself to deliver sufficient capacity, reliability and safety on the railway network (Prorail 2008).

The ambitions in spatial planning of The Ministry of Housing, Spatial Planning and the Environment (VROM) requires that cities will have to increase in density (VROM 2004). Cities have to grow inside predefined lines, drawn around the cities contours, the so-called ‘red lines’ (Movares 2004). In doing so, railway stations are seen as a critical flywheel in inner-city regeneration: instead of dividing the city, railway stations are seen as a crucial element in inner city integration. VROM therefore invests in the quality of railway stations and this will hopefully benefit the rest of the city centre. VROM Projects like the New Key Projects will especially impact the quality of railway stations and their cities. VROM set three main requirements for these stations. New Key Projects must become attractive transport hubs, ‘passengers’ palaces’ and urban meeting places (VROM 2006). Although only six large railway stations in the Netherlands are New Key Projects, the conception of stations as inner-city regeneration flywheels can generally also be applied for railway stations in medium large cities.

3.2.2 Trend 2: Growth of the experience economy

The notion that railway passengers are sole transport related customers is completely outdated. Every railway passenger is essentially a consumer of several services, offered at railway stations. When analysing the customer behaviour of a railway passenger a trend towards an experience economy can be noticed. According to Van Dyck (2007) this ‘new’ economic sector is developing rapidly. The reason for this development is a result of the continuous increase in wealth of consumers. After having satisfied the most essential material needs (e.g. food, clothes), consumers want more unique experiences. Coffee at home is different from coffee on a terrace in Venice. Since a continuous growth in the Netherlands enabled consumers to spend more on experience, the consuming habit has changes dramatically, also at railway stations. This explains simple terminal design of the late sixties where little effort has been spent on designing experiences at railway stations since consumers simply didn’t have the financial resources (and needs) to spend their money on. However, as the Dutch economy grew, consuming habits as a result changed, and the ‘Experience economy’ entered the stage.

changing of consuming habits towards 'experience'-based consumption. According to De Ridder, a railway customer buys a certain product, based on his or her consumer behaviour. This behaviour is based upon a set of reasons; the consumers drivers. During time, these drivers alter. According to De Ridder (2006) three drivers dominate the future consumer behaviour: growing wealth, changing value pattern and the strive to empowerment. These new drivers result in specific needs for consumers (amusement, learning, escape from reality and aesthetics).

Five striking developments of De Ridder's research on consumer behaviour are relevant regarding the consumption pattern of railway terminal customers (Table 3-1):

<table>
<thead>
<tr>
<th>Consuming 'old'-style</th>
<th>Consuming 'new'-style</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possession of goods and services</td>
<td>Experience of goods and services</td>
</tr>
<tr>
<td>Focused on basic needs and material goods</td>
<td>Focused on immaterial aspects and values</td>
</tr>
<tr>
<td>Consuming is necessity</td>
<td>Consuming is fun</td>
</tr>
<tr>
<td>Money more important than time</td>
<td>Time more important than money</td>
</tr>
<tr>
<td>Sustainability doesn't play any significant role</td>
<td>Role of sustainability is increasing</td>
</tr>
</tbody>
</table>

Table 3-1 | Trends in customer consuming patterns

In developing railway stations that create more value for railway station passengers, the first four elements of De Ridder's research are particularly focused on providing passengers with more valuable services. They want new experiences, new goods since their basic needs are satisfied, they want to be entertained and the time spend on railway stations should be well spend. These are the demands of the future customer and also the demands which the rail terminals will have to satisfy.

3.3 Summary

Dutch railway stations were developed to meet their functional requirements at that moment. This resulted in a diverse composition of railway stations were architectural style and functional design constantly were influenced by external effects such are economic fluctuations and social changes. Today, the new concepts of the NS (Regional Ports and National Key Projects) are the kick off of a privatised NS Company searching for ways to create more value for its customers by understanding and facilitating future trends by a high quality terminal design. These particular trends have been analysed and will impact rail terminal design in two ways: railway terminals firstly will most have to cope with a considerable increase in the amount of passengers and second rail terminals will have to offer more services since the rail terminal customer of tomorrow will demand more quality in services offered during the time they spend at the terminal.
The New Customer

The trends described in chapter three have serious consequences for the functions offered at a rail terminal: they influence the needs of the future rail terminal customers and have an impact on the processing capacity. These trends will have an impact on the behaviour of future rail terminal customers and the services a rail terminal will have to offer to satisfy them. Paragraph one discusses the impacts of the trends on terminal customers. The future customer will have different needs and will impact the functional design of rail terminals (§4.2) and will result in interesting opportunities to create value (§4.3).

4.1 Trends and the rail terminal customer

The rail terminal customer is a customer group with diverse travel and consuming patterns. Like at airports, students, elderly, business people and tourists use the same terminal building. The different characters present on a railway station make the design process a complicated challenge. To be able to understand the different types of passengers at its rail terminals, the NS conducted a research on the various types of passengers and their values (NS 2006). Previous to the study, the NS thought that 75% of its passenger on railway stations were merely interested in getting for A to B and didn’t value commercial activities. A short summary of the research results finding proves different: Although the transfer function is the reason of existence of the rail terminal, 75% of the passengers want to use one of some commercial services of the rail terminal (NS 2006).

NS research on its customer preferences defined six types of passengers, each with its own specific wishes and values: Appendix 9 shows their profiles in more detail. There is one striking fact for research purposes: most rail
terminal customer values transfer functions and commercial services as well. This means that terminal design will have to cope with both customer preferences.

When considering the trends as discussed in chapter three, rail terminals will first of all have to offer sufficient transfer quality to the rail terminal customer. This could be difficult since future trends indicate a large increase in demand. The processing capacity will have to be able to cope with a large grow in passenger numbers. Second, rail terminals will have to offer enough commercial quality. The shopper in the customer will demand more services and future terminals will have to be able to deliver these services properly.

4.2 Functions at rail terminals

Railway stations originally served one function: a halting place for trains. As the industry evolved (see previous chapter) more functions were added. Paragraph 4.1 clearly concludes that future customers have explicit transfer and commercial demand. This will have an impact on the functions which will have to be offered at future rail terminals.

In understanding the functions a railway station offers today and will have to offer tomorrow, we will use the place-node theory of Luca Bertolini and Tejo Spit, which was published in their 1998 book Cities on rails. The place-node theory argues that a railway station, as a geographical entity, has two basic, though partly contradictory, identities. A railway station is a node: a point of access to railway trains and (increasingly) to other transportation networks such as trams, busses and metro networks. At the same time, railway station functions as a place: a small specific section of the city with a concentration of infrastructure and also with a diversified collection of buildings and open spaces. We use their theory on railway station functionality for the analysis of the rail terminal since both functions are also present.

Although the complex interaction in functions at a small urban site is apparent in many urban situations, Bertolini and Spit argue that this subject has received little attention in research on railway station development:

"Both the practice and the theory on railway station redevelopment demonstrate inadequate understanding of the ambivalent nature of the railway station location, as well as of the interactions between its two connotations" (1998).

The lack in dual perspective could be responsible for a poor quality of railway stations, like is often the case in the Netherlands. Here, a highly accessible transportation node usually attracts many railway passengers, resulting in an economical basis for commercial activities. However, since space is very scarce on most railway stations, the transportation node can have a dominant functional role. This can diminish the possibilities of a railway station to perform its place function adequately. Bertolini mentions that "The complex node-place interactions form the core issue of railway station redevelopment today" (Bertolini & Spit, 1998). To be able to understand the functional ambivalent character of railway stations, both functions are first introduced.

4.2.1 The Node-function

The node-function of a railway station can be defined from two perspectives: the 'network view' and the 'transfer view'. Nodes in networks are those places in networks, frequently used by passengers (Bertolini & Spit 1998). Gert
Joost Peek confirms in his 2006 publication ‘Locatie synergie’ that nodes can be viewed from a pure network point of view and adds that the nodes can be regarded as a link between and in several networks. Main aspect of this view is the hierarchy the node has in the network: a railway station generates value for the railway station in offering as much as possible links to other networks.

When concentrating on the railway station’s urban location, Peek (2006) introduces a second, and for this research, more relevant description of the node function of a railway station: the transfer view. Railway stations can be seen as a location of public transport where different modalities and thus passengers, concentrate to interchange. This transfer function is focused on reducing the ‘interchange-resistance’ (Vanderwaard 1989 from Peek 2006). The function does not only include linking multiple transport modalities in an efficient manner, it also means providing transfer related facilities such as ‘to-go’-retail to make the transfer more pleasant (Van Hagen & Peek, 2003).

Example 1 The Dutch railway station Utrecht Centraal can be considered as an important node. From a network perspective it offers railway passengers a very large amount of destinations (Figure 4-1). From a transfer view, Utrecht Central station offers interchange facilities: a large terminal building is connected to bus, car, tram and railway transport and offers passengers a smooth transfer between the transport modalities.

4.2.2 The Place-function

The ‘Place’-function of a railway station is a concept with is difficult to define. Regarding railway station development, it and can be approach for several angles. Bertolini and Spitz geographical approach describes the place function of a railway station as “a piece of the city incorporating the station - on what is sometimes called the station neighbourhood of the station district” (Bertolini & Spitz 1998). They identified four approaches in defining ‘the railways station as a place’: the walkable radius, functional-historical elements, topographic and the development perimeter. According to Bertolini, all definitions have its drawbacks. Bertolini argues that the definitions do not allow for a flexible delimitation of the railway station area and he proposes a combination of the approaches mentioned above: “Railway stations as a ‘place in the city’ are all the built and open spaces, together with the activities they host, contained within the perimeter designed by a ‘walkable radius’ centred on the railway station building, as mentioned to take account of case-specific physical-psychological, functional-historical and development features (Bertolini 1998).”
For this research purposes, we stick to the general rail terminal definition given in chapter two. This is because the definition lacks a focused functional description we need for our research. Peek’s research (2006) about synergies between the two functions of railway stations provides a valuable contribution about the precise description of the place function of a railway station. According to Peek, the place function of a railway station can perform two specific ‘place’ functions: an urban centre and a place of interaction.

A place for interaction
The function of urban centre is aimed at bringing more economical wealth and spatial quality to the city. In this view a railway station is part of the urban fabric of a city. It facilitates various services for (surrounding) city residents. Due to a complete focus on transport related services in the past however, this function has largely been neglected (Peek 2006). The second ‘place’-function is the ‘meeting place’. Peek identifies this function of a ‘meeting place’ as a contribution to the individual freedom of choice of the user. Richard Florida’s ‘Theory of the Creative class’ (2002) views these central urban meeting places essential places of interaction in cities since they facilitate the information exchange of the creative class (the class which is according to Florida the engine of the post modern economy). The offering of a certain level of ‘quality of space’, is according to Peek, essential. This ‘quality of space’ is however not easily to describe. Trip (2004) developed a rather broad and general list of qualities, needed to develop this quality. He argues that the quality of space depends on many aspects such as the functional mix, availability of specific facilities and public safety. In this research, the function of an urban centre and a meeting place are both integrated in the place function of a railway station, especially in a rail terminal:

An urban centre
As an essential element in the city centre, rail terminals can provide valuable services to city inhabitants such as shopping and leisure facilities. Restaurants and bars (Figure 4-2) could facilitate the second function of a railway station terminal building: a vivid meeting place where interaction is everywhere.

Figure 4-3 | Place function of a railway station: opportunities to interact and availability of urban services
Example I Once again, the Dutch railway station Utrecht Centraal can function as an example. From an 'urban centre' perspective it offers valuable services to the inhabitants of Utrecht. Many shopping facilities (e.g. flower store, liquor store, pharmacy, book store) are present at the rail terminal and many small bars facilitate the meeting function (De Tijd, Cafe Centraal and Burger King).

By using the relevant functional approaches, introduced above, the final functional definition of rail terminal functionality can be given:

The rail terminal is the place at a railway station where passengers can easily interchange from different forms of transport, where passengers can meet and interact and where urban functions are supplied.

4.2.3 Spatial tension

Every railway station is in fact a continuous clash between the two functions Bertolini and Spit (1998) introduced. In some situations one of the two functions prevails and will dominate the railway station terminal layout. Bertolini & Spit introduce a model to visualise the individual space and node function and the interrelationship between them. This model is shown below in figure 4-4. In this model five ideal situations can be distinguished.

![Figure 4-4 | The place-node model of Bertolini (From Peek 2006)](image)

Along the middle diagonal dotted line (1), areas are presented where the node and the place are both equally supported: a state of balance is present at the railway station. At the top of the white dotted line are railway stations
where the interaction between the place function and the node function create a so-called ‘tension’ (2). At these railway stations the intensity and diversity of transportation flows and urban activities is optimal. This indicates that the transfer function is well developed (strong node) and that this has been realised in a high qualitative environment (strong place). However, these railway stations are also locations where the great concentrations of flows and activities can result in a situation of conflicts between multiple, extensive claims on a limited amount of space and result in a complex design challenge:

"The property development ideal of maximum intensity of land use and the transport development ideal of maximum flexibility for infrastructure adaption and expansion have to find here a difficult synthesis (Bertolini 1999)."

At the bottom left corner of the figure of the middle line is a third ideal-typical situation (3), represented by the ‘dependent’ areas. The struggle for space is minimal. The demand for transportation services from area residents, workers and other users and the demand for urban activities from travellers are both so low that supply can be held in place only by the intervention of external factors. The reason these railway stations still exist in the Netherlands is often because the Dutch government asks the NS to continue investing in these non-profitable railway station because of their social relevance (van Bakel 2001). But, according to van Bakel, this situation happens less often after the privatization of the Dutch railway sector in 1995.

Finally, two ‘unbalanced’ situations can be identified according to Bertolini (1999). On one side- at the bottom right of the diagram- are the ‘unsustained nodes’ (4): areas where transportation facilities are relatively much more developed than urban activities. On the other side - at top left of the diagram- are the ‘unsustained places’, where the opposite appears. Here, the place function is too dominant at the railway stations location. Peek mentions as an example a railway station in a historic centre of a highly dense built city. The ‘unbalanced’ -locations are ‘particularly interesting’ (Peek 2006), because a strong tendency can be expected that the will develop into the more balanced ‘equilibrium’ stage.

4.3 Future trends and rail terminal functionality

Future passenger demands will result in a different functional order at rail terminals. This research focuses passenger demands at large rail terminals. These rail terminals are located in a heavily populated area (important place) and have considerable passenger processing capacity (important node). Therefore these rail terminals could be located in the top right corner of Bertolini & Spil’s ‘Interaction of functions’-model: the rail terminal is part of the railway stations in the stressed area.

Yet old rail terminals are often designed with a dominating node-function or have a more dominant place function due to their historic background and location (unsustained node). Due to trends indicated in chapter 3, it is very plausible that rail terminals of large railway station will have to process more passengers (node function) and offer more functions as a attractive place (place function). If future rail terminal design is applied properly, a shift to the balance line in the top corner of the place-node model could be the result. A rail terminal could become:
"A place where both functions are intensely supported and due to the tensed situation are completely integrated" (Peek 2006). See figure 4-5.

To be able to perform in the top right corner of the place-node model, rail terminals will have to be able to integrate their place and node function. This will demand an adjustment of their focus in design principles.

However, a successful integration of necessary place and node functionality can result in a very profitable business. This is because the reconfiguration of railway station functionality impacts the value creation process at railway stations. First we will look at a value creation model which concerns the railway station itself. Peeks 'static value chain'. Second, the impact of the trends is will also influence the value creating capacity of a whole railway station area (railway station and direct vicinity). This influence can be best described by Priemus and Koning's (2001) Dynamic value chain-model.

4.3.1 The static value chain, short time direct revenues

Peek (2006) designed a specific model to analyse the value creation at railway stations. The model indicates the stakeholder involvement in the railway station value chain and the value they create (Figure 4-6).

A brief summary of the model is given as follows:

"Two dominant location related branches are present in inner-city railway station development: transport-oriented activities ('Node') and accommodation oriented activities ('Place'). Both branches can be divided into three types of value chain participants (or stakeholders): 'The investor', investing in infrastructure or real estate, 'The operator', ..."
investing in accommodation or transport functions and 'The end-user', which consumes the functions (the rail terminal customer). These three types of actors are related to each other via internal user relations. The operator uses the infrastructure or the real estate and pays a certain fee for that. This same relationship can be seen between the consumer and the operator: the consumer pays a certain fee for the use of the transport or accommodation function of the railway station (Source: Peek 2006).

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Node</th>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investor</td>
<td>Infrastructure</td>
<td>Transport functions</td>
</tr>
<tr>
<td>Exploiter</td>
<td>Tracks, Bus lanes</td>
<td>Use</td>
</tr>
<tr>
<td>Customer</td>
<td>Railway/bus service</td>
<td>Rent Concessions</td>
</tr>
</tbody>
</table>

Figure 4-6 | The static value chain of Peek (Source: (source Peek 2006)

Concerning the Dutch Railway operator NS, four main ways of value capturing can be identified.

1. Fee on transport, NSR
2. NS retail services, NS Poort, Servex
3. Retail rent of external concessionaires (usually a percentage of the retailer’s sales), NS Poort
4. Real estate development (external property), NS Poort

As mentioned in chapter two, this research concentrates on customer preferences and at a rail terminal. Two forms of value can thus be created (and captured) for the terminal customer: the delivery of transport related services or retail related services.

**Rail terminal customer and transport related services**

The most obvious service is the sales of train tickets. This purchase creates value because a passenger wants to travel and the NS captures this value by receiving a certain fee. The rail terminal can enhance the perceived quality of this purchase by creating an environment which supports the node-function (e.g. process the passenger with minimal interchange barriers to the train). Since prices on railway fares are fixed (to a certain degree) this particular form of value creation is limited in its future potential. However, with the ambitions of the Dutch government to achieve a staggering 5% annual growth in passenger volume (resulting in 100 million annual passengers (V&W 2007), rail terminals will process much more passengers and thus will eventually be able to create and capture more value.
Rail terminal customer and retail related services

The second form of value creation on railway stations occurs when a rail terminal user decides to consume place-related services such as retail services. By consuming for example an ice-cream value is created because of the customer receives its ice-cream. Value is captured by the concessionaire when he receives the fee from the customer. Retail revenues are passed on to the real estate company (NS Poort at Dutch railway stations) in the form of rent or go directly to Servex, the NS subsidiary and exploiter of various successful retail formulas which are focussed on to-go retail (‘AH to Go’, ‘Kiosk’, ‘Swirls’ and ‘de Broodzaak’). The NS is aware of its potential and is currently developing a overall retail concept for its large rail terminals: ‘NS Wereldstations’. Below is a brief summary of the concept.

NS is currently developing an overall retail concept to increase revenues at her rail large terminals, called ‘NS Wereldstations’. These ‘airport-style’ rail terminals will have to facilitate more commercial facilities for railway station users who consider the railway station as a place, not as a node. The current state of the development program is particularly interesting regarding this research. NS Poort approach on testing the ‘Wereldstation’-concept is largely experience based and currently, Leiden Central station (fifth largest railway station) is redesign into the new more retail focussed ‘Wereldstation’- concept. This research approaches the testing of future functions on a pure literature base. The combination of the results of the two studies could form a profound base for future rail terminal development.

Considering the two trends introduced in chapter 3, this part of the value chain offers much potential to generate more value for rail terminal customers. The first future trend (the increase of potential passengers) can attract many more potential consumers at rail terminals, resulting in a larger potential turnover for rail terminal retailers. The second trends could be even more important. Since terminal customers can and want to spend more on leisure activities (like shopping) and want to be entertained at rail terminals, the mission of the rail terminal retailer is clear: give the terminal customer the experience he or she wants and supply him or her with new products, services and experiences he desires.

The combination of the fact that a terminal customer has a larger spending budget and more needs and the fact that its numbers will rise in the future makes the focus on the development of the place-function from the dynamic value chain perspective clear:

The development of more retail facilities will not only fulfill the demands of future trends concerning consuming demand. Peeks dynamic value chain (2006) also illustrates that this could also be rewarding considering the value capturing potential and since the NS can capture the value in three ways: revenues of Servex, rents of concessionaires and profits from real estate developments. Future terminal design thus has to develop its commercial capabilities.
4.3.2 The dynamic value chain, long term indirect revenues.

The static value chain made it clear that the rail terminal customer and the NS both benefit from the increase of retail activities at rail terminals. The terminal customer satisfies its needs and the NS creates valuable turnover. But from a broader city perspective, with a long term approach, servicing more retail activities and processing more passengers can be even more rewarding.

The static value chain of Peek (2006) is purely focused on the location itself. The dynamic model of Priemus and Koning (2001) concentrates on the role a railway station plays in its urban context and uses a more ‘long term’ approach. Their dynamic value chain model clearly shows a cyclic process were continuous growth is possible. Priemus and Koning do however only focus on the original function of a railway station: the node function. According to previous research by Bertolini & Spit (1998) this is not the only function a contemporary railway station has.

The Dynamic Value chain is thus revised: more use of public transport will generate more retail revenues at rail terminals and this will lead to the creation of more financial resources to invest in the quality of the rail terminal itself. This will create an increase in real estate value of the rail terminal and its surroundings. This increase in value translates into impulse in the city economy and generates an urban renewal impulse. Eventually this attracts more visitors and tourists, generating more companies, jobs and as a result buying capacity. This will increase the demand in transport. More demand in transport will increase the utilization of public transport (e.g. railway services) and also increase retail turn-over at the rail terminal (Figure 4-7).

![The Dynamic Value chain of an OV-Terminal](image)

The Dynamic Value chain is a continuous loop and its message is clear. By attracting more passengers to rail terminals, eventually the real estate value of the rail terminal and surrounding buildings (often property of NS) will increase. This is a process which can take many years but eventually the city, the NS and the rail terminal customer all benefit.
4.4 Summary

NS research shows that customers value transfer related and commerce related services and the impact of trends will result in a greater desire in both transfer and commercial services. Railway stations serve customer desires by facilitating two functions, a 'node-function' and a 'place-function'. Future trends will have an impact on both functions. Large rail terminals will have to process more passenger volume and have to satisfy different retail services. If rail terminal design facilitates these trends, the delivery of more and new functions can push the railway station to a situation where a railway station can be seen as an attractive node (fast interchange, many destinations) and an appealing place (place to interact, urban quality).

This increase in functionality will create tension between the two functions. This demands a balanced design approach where much effort has to be made on integrating the two main functions. Like Carlos Ventura\textsuperscript{16} mentions, a railway station will have to be:

"A mix of shopping centre and a station, not the two concepts side by side, but both functions merged together in the same building. The result is a station integrated with the city, not just a shopping mall."

This effort can be very rewarding since both the static and dynamic value chain show great opportunities is creating more value at railway stations. The most important question in this process is: How can rail terminal design help in attracting more rail terminal customers? Part two will try to answer this question by figuring out what the rail terminal customer values in terminal design.

\textsuperscript{16} Carlos Ventura: Commercial Director ADIF (Rail station development Congress, 12-14 nov 2007)
Part two.

Customer Design Preferences

This chapter delivers the design elements rail terminal customers prefer at a rail terminal. This is done in three steps. In chapter five a model for analyzing the needs of a customer at a service environment is constructed. Once we can determine how customers perceive a service environment we use the model on two narrowly related service environments to learn about the rail terminal customer preferences in terminal design (chapter 6). Eventually the final model will be presented in the third chapter of this research part, chapter 7.
Customer Perception

How does a customer perceive its environment? This chapter is about the environment a customer finds itself in during the process of consuming a service; 'the service environment'. Bitner (1992) refers to it as the 'servicescape' and describes it as a place where customers are subjected to "the effect of atmospherics, or physical design and decor elements". The service environment can be very powerful since research suggests that "the physical setting may influence the customer's ultimate satisfaction with the service" (Harrel & Hutt 1976 and Anderson 1980).

This chapter will give an overview of a selection of scientific resources that have described various determinants of quality perception of service environments. The literature review is approached from a more psychological perspective and thus concentrates on the micro-level of the individual. Central in the research is the sequential stimulus-response model that will be discussed in paragraph 5.1. Second, different models on environmental stimuli will be discussed (§ 5.2). Paragraph 5.3 elaborates on the Fodness and Murray model, a model which is designed for analyzing airport terminals and makes an important diversion in types of service offered at service environments. To understand how customer choices can be structured paragraph 5.6 hands us theory on Multi Criteria Models (MCA). Eventually in paragraph 5.7 a model is designed which can analyse the preferences of customers at a service environment: the Customer Preference-model (CP Model).

5.1 Environmental stimuli

According to Kotler (1973), during the purchase decision, the state of the environment, or the atmosphere of a place, can be more influential than the product itself. Based on the early research in environmental psychology, Kotler (1973) took a narrower perspective by focusing on consumer behaviour and the effects that the physical environment has on it. In addressing this, Kotler pointed out that the physical environment in which a product is purchased is an important
part of the total consumption package. The term ‘atmospherics’ was introduced to describe this new focus of research. According to Countryman & SooCheong (2006), Kotler continued to suggest that there are certain settings where the physical environment will have a greater influence on consumer behaviour and purchase decisions. The importance of the environment where a service is consumed increases if one or more of the following occurrences are present: (1) the number of competitive outlets has increased; (2) product and/or price differences are small; and (3) the product/service entries are aimed at distinct social classes or lifestyle buyer groups (Karam 2005).

This chapter concerns about the way the built environment of a rail terminal can influence the perception of quality of a terminal customer. To be able to understand how the built environment is related to the purchase decision of terminal customers, this research first introduces relevant theories on environmental psychology.

The environment a railway passenger experiences is a complex set of different (visual) elements which ultimately impacts the persons perception of the whole service. Researchers have struggled to understand these complex elements and their impact on human behaviour. In their effort to define environmental psychology, Mehrabian and Russell (1974) described it as “the direct impact of physical stimuli on human emotions and the effect of physical stimuli on a variety of behaviours, such as work performance or social interaction”. They conceptualized their study into the MR-model. Mehrabian and Russell’s (1974) conceptual framework describes the impact of the environment on humans and premises that behavioural responses to environmental stimuli are mediated by emotional states. (van ’t Hof 2008). Figure 5-1 shows the model. The conceptual framework of Mehrabian and Russell is based on the more general stimulus-response (S-R) model17.

![Figure 5-1] The conceptual framework of Mehrabian and Russell (1974)

However, much of the elements, responsible for the physical stimuli were unclear to Mehrabian and Russell. They stressed the importance and the need for describing or defining the physical environment by identifying those elements or dimensions that make up the physical environment (Countryman & SooCheong 2006). In ‘Objects of Desire’, Dennis (2005) discusses the MR-model from a shopping centre perspective. Dennis indicates that environmental stimuli are things like ‘store image’ and ‘atmosphere components’ such as layout, design, colours, music and odours. The emotional states are personal emotional states like pleasure or arousal which these stimuli create. Dennis views that the behavioural response of customers results in the approach or avoidance of the customer to consume a certain good or service at a certain place. This can easily be measured by the time spent at a shop, the money spent, the number of items bought and the intention to revisit (Dennis 2005). The NS is familiar with the MR-model. NS study ‘Stations in beeld’ (NS 2005) describes three elements of the MR-model as follows:

- Stimulus: The quality of the space, measurable by all the customers senses.

17 The S-R model holds that responses emerge as a result of stimuli and the way in which those stimuli are processed (van ‘t Hof 2008)
• Organism: Experience of quality of the service.
• Response: Behavioural effect (approach-avoidance) and forming of perception.

This research is about the physical clues, measurable by all the customer’s senses. We call this ‘The environmental stimuli’ and it primarily concerns the design aspects of the rail terminal. These design aspects will influence the perception of the service environment by the terminal customer and eventually generate a behavioural response. This response can be the decision to avoid the rail terminal (e.g. because it’s too hot or unsafe) or to approach the terminal and spend time at the terminal. This research assumes that spending time at rail terminals will result in the consumption of goods and or services (e.g. newspaper, coffee and books). This research will thus use the following interpretation of Mehrabian and Russell's conceptual framework (Figure 5-2):

![Figure 5-2 | The respecified model of Mehrabian and Russell](image)

Environmental stimuli are part of a wider range of determinants which decide the customer’s perception of service quality. To be able to understand what these environmental stimuli entail, the next paragraph will elaborate on several general scientific resources that have described various determinants of quality perception of a service.

### 5.2 Perception of service quality

Marketing and psychology literature show a vast amount of suggestions and methods in analyzing the perception of the quality of a service. According to Brady and Cronin (2001), the conceptualization and measurement of service quality perceptions have been the most debated and controversial topics in services marketing literature to date and full understanding of service quality perception is not yet available. Furthermore, Parasuraman et al. (1994) state that there has been considerable progress on how service quality perceptions should be measured. However, Brady and Cronin point out that little advance on what should be measured has been made. In other words, what defines the quality of the encountered service?

The perception of service quality is based on multiple dimensions (Carman 1990). Although many studies have tried to define those dimensions, till today there is no general agreement as to the nature or content of the dimensions. However, according to Carman, "It is general accepted that service quality evaluations are highly complex processes that may operate at several levels of abstraction"(1990).

Many researchers have been conducting studies on service quality perception. This paragraph gives a review of relevant research models on service quality perception by starting with the general theory of Grönroos (1984) and ends with Fodness and Murrays hierarchical structure for service quality expectations (2006). This model will be of great importance for this research.
5.2.1 Nordic model

The foundation of service quality theory can be found in the product quality and customer satisfaction literature. Early conceptualizations (Grönroos 1982, 1984, Parasuraman, Zeithaml, and Berry 1985) are based on the disconfirmation paradigm employed in the physical goods literature. This literature suggested that quality results from a comparison of perceived performance with expected performance, as is reflected in Grönroos’s Nordic Model (1984). Grönroos identified two service quality dimensions, as shown in Figure 5-3. "Functional quality” represents how the service is delivered; that is, it defines customers’ perceptions of the interactions that take place during delivery. ‘Technical quality’ reflects the outcome of the service act, or what the customer receives in the service encounter. The technical and functional qualities create an image. The ‘Expected service’ and the image created by the quality eventually produce the ‘Perceived service’. (Brady & Cronin 2007).

![Figure 5-3] The Nordic Model of Grönroos (1984)

5.2.2 Three component model by Rust and Oliver

The Grönroos Nordic model is a very general approach on quality perception and in order to specify the elements in more detail, Rust and Oliver (1994) designed a three component model, built on the model of Grönroos. In their model they claim that all perception of service quality is based on customers’ evaluation of three dimensions of the service encounter: (1) the customer-employee interaction (i.e. functional quality of Grönroos), (2) The service environment (Bitner 1992) and the service outcome (i.e. technical quality.). Figure 5-4 shows the ‘Three Component Model’ of Rust and Oliver:

![Figure 5-4] The three-component Model of Rust and Oliver 1994.
This research focuses on service environment during the consumption process. The customer-employee interaction (e.g. information attendant or Kiosk employee) and the service outcome (the quality of the railway journey of a coffee) are not considered in this research. They do not have a direct relationship with the built environment and this research will focus on the built environment by introducing Mary Jo Bitner's 'Servicescapes'.

5.2.3 Bitner's service environment: Servicescapes

Servicescapes were introduced in 1992 to structurally approach and unravel the relevant elements of the built environment in the perception of service quality. For services that require customers to be present in the service "factory" for extended periods of time, Bitner (1992) theorized that the facility itself – the 'Servicescape' - has a significant influence on overall service encounter quality perceptions. The servicescape includes all the objective factors controllable by the service provider that facilitate customer actions during the service encounter and enhance their overall service quality perception (Fodness & Murray 2007).

Research has documented the influence of the physical environment on service quality perceptions in many different service related branches like restaurants (Rys et al, 1987) and retail stores (Dabholkar et al., 1996, Brady and Cronin, 2001). Because rail terminals require passengers' physical presence and often significant time commitment, the physical environment of the railway stations can thus influence perceptions of the overall quality of the service encounter. Fodness and Murray clarify this principle by citing Bitner's description of a negative encounter with an airport servicescape:

'... assume that a traveller enters an airport and (1) is confused because he or she cannot find signage giving directions to the assigned gate and (2) is emotionally distressed because of crowds, poor acoustics and high temperatures. Here the servicescape directly impacts the traveller's evaluation of the quality of his of her airport experience (Bitner 1992, p.61) ...'

Bitner’s Servicescapes consist of three basic elements (Figure 5-5):

- Spatial layout and functionality
- Signs, symbols and artefacts
- Ambient conditions

We will discuss the basic elements briefly.

![Figure 5-5 | Bitner's Servicescapes (1992)](image-url)
**Spatial Layout and Functionality:** Because service encounter environments are purposeful environments (i.e., they exist to fulfill specific needs of consumers), spatial layout and functionality of the physical surroundings are particularly interesting regarding this research. ‘Spatial layout’ refers to the ways in which machinery, equipment, and furnishings are arranged, the size and shape of those items, and the spatial relationships among them. ‘Functionality’ refers to the ability of the same items to facilitate performance and the accomplishment of goals. According to Bitner, with the exception of some research on retail store layout, crowding and use of orientation aids, ‘surprisingly little has been published about the effects of spatial layout and functionality on customers in commercial service settings’ (Bitner 1992).

In self serving environments like railway stations spatial layout and functionality of the environment are highly salient to customers: they must perform on their own and cannot rely heavily on employees to assist them. If the tasks to be performed are very complex, efficiency of spatial layout and functionality will be more important than when the tasks are mundane or simple. When customers are under time pressure, (and this is a likely situation at railway stations) they will also be highly conscious of the relative ease with which they can perform their tasks in the environment.

Spatial layout and functionality are closely related to each other. According to Fodness and Murray (2007), it makes intuitive sense that these two concepts should be very closely related because they capture how well the layout (e.g. rail terminal layout) ‘facilitates’ the performance and the accomplishment of goals.

**Signs & Symbols:** Many items in the physical environment serve as explicit or implicit signals that communicate about the place to its users. Signs displayed on the exterior and interior of a structure are examples of explicit communicators. They can be used as labels (e.g., name of company, name of department), for directional purposes (e.g., entrances, exits), and to communicate rules of behaviour (e.g., no smoking). Signage can play an important part in communicating firm image. Direct clear signage can enhance the customer friendliness of passengers in finding their way to their train. But, large commercial related signage can also signal the vast amount of available shops in the railway station, adding to the customer friendliness of railway station shoppers.

Other environmental objects may communicate less directly than signs, giving implicit cues to users about the meaning of the place and norms and expectations for behaviour in the place. Quality of materials used in construction, artwork, presence of certificates and photographs on walls, floor coverings, and personal objects displayed in the environment can all communicate symbolic meaning and create an overall aesthetic impression (Bitner 1992).

**Ambience:** Several authors have identified ambient conditions as a factor that affects perceptions of and human responses to the environment. Ambient conditions include background characteristics of the environment such as temperature, lighting, noise, music, and scent. As a general rule, ambient conditions affect the five senses. (Bitner 1992)

Limited number of empirical studies in consumer research confirm that ambient factors may influence customer responses. For example, in studies of restaurants and supermarkets, it has been illustrated that music tempo can affect pace of shopping, length of stay, and amount of money spent (Milliman 1982, 1986). In another study, familiarity of music played in a department store setting was found to affect shopper’s perceptions of how long they
spent shopping; when the music was unfamiliar to subjects, they believed they had spent more time shopping (Yalch and Spangenberg 1988).

Although ambient conditions are difficult to measure, they can have serious impact on the perception of service quality by customers. Fodness and Murray (2007) state that in service settings, ambient conditions have been found to have either stressful or relaxing effects on customers. At railway stations, passengers can for example be stressed by loud music or bright white light (which blind the passenger). Comforting music and a warm temperature can on the other hand relax passengers and enhance the perception of level of quality of the services on a railway station.

Bitner’s Servicescape-model is an attractive model to analyse the service environment as its basic design will be used in to design the final CP-Model. However, for this research it lacks the profundity and clarity needed for analysing specific customer preferences of design aspects. Fodness and Murray pose a more interesting and detailed model on the perception of service quality. This will be discussed separately in the next paragraph.

5.3 Service: function and diversion

Fodness & Murray (2007) redesigned the three component model of Rust and Oliver in order to measure the passengers’ expectations of airport service quality. Their model is composed of three primary dimensions: ‘servicecape’, ‘interaction with personnel’ and ‘services’. Important to consider is that the ‘services’ offered by the terminal are not transport related. They are secondary services supporting the needs of passengers, besides the transport related ones.

Fodness & Murray suggest three subdimensions in each of the three dimensions. Important to mention is that although this layered approach on service quality suggests that each part works individually, the customer collects the perceptions of the dimensions holistically and forms one concluding perception. Brady and Cronin (2001) explain their interrelations:

...customers form their service quality perceptions on the basis of an evaluation of performance at multiple levels and ultimately combine these evaluations to arrive at an overall service quality perception (p. 37).

The preliminary research model clearly shows Grönroos’ model and Bitner’s servicescapes. This model was the backbone of their extensive empirical research on nearly thousand airport users. After the analysis of their data Fodness and Murray re-arranged and renamed the model at several important parts:

- The servicescape is changed into ‘Function’.
- Service personnel is renamed to ‘Interaction’.
- Ambient conditions is changed in ‘Diversion’.

In the redesigned model of Fodness and Murray, interaction is one of the three important elements of service quality perception. This research however focuses on the ability of the built environment of rail terminal to support the quality perception of the services offered inside. This leaves the ‘Function’ and ‘Diversion’ as the resulting two element of perceived service quality of the built environment. Figure 5-6 shows a simplified version.
The two main elements of terminal quality ‘Function’ and ‘Diversion’ will be described below:

**Primary design criteria: Function:** As mentioned before, the functional element of quality the perception of a terminal consists of the effectiveness and efficiency a building can serve its customer. Effectiveness is based on the Servicescapes sub dimensions ‘Function and Spatial Layout’ and ‘Signs and symbols’ It concerns the effective movement of the passenger through the terminal. Efficiency represents passenger’s concern with the timeliness of their movement through the terminal. This is a highly personal function and depends on external factors. An example is baggage claim at an airport. The ability of the airport building to facilitate fast baggage claim installations, and thus shorten the customers waiting time can be considered as ‘efficiency’.

**Secondary design criteria: Diversion:** Diversion reflects a turning aside from focusing on the fact that the passenger is, in effect, ‘trapped’ in the airport servicescape toward activities that redirect their attention or stimulate them aesthetically (Fodness & Murray 2007). The combination of ambience-related factors along with the activity-related factors may be describing an environment perceived by the passenger as offering opportunities for aesthetic, cognitive and sensory satisfaction. According to Fodness and Murray, “such an environment is of no doubt of special importance to customers who, as a necessary condition of their consumption of a service product, are required to spend relatively large amounts of time there.” Of course rail terminal customers do not have to spend the same amount of time at a rail terminal. But, the frequency of visits is usually much higher. The function diversion can therefore still be considered as relevant at rail terminals.

Diversion consists of four elements. Maintenance is the activity spent on people’s bodies (e.g. Eating, drinking, resting) and their possessions (e.g. shoe repair) and concerns concessions. Productivity relates to work and study related activities (e.g. housework and answering business mail). The third factor, ambience is consistent with Bitner’s ‘ambience’: lighting, noise, music, and scent. As a general rule, ambient conditions affect the five senses (Bitner 1992). The fourth element of Diversion is Décor, a rather difficult element to describe. Fodness and Murray describe Décor as: The “feeling” of a particular airport setting. It concerns the architecture style and expression of elements. Bitner’s ‘Artefacts’ are related to this quality element.

We will use the two airport terminal quality elements ‘Function’ and ‘Diversion’ to design an analysis model, the Customer Perception Model (CP-Model) which will be used in chapter 6.
5.4 Towards an analysis model

A customer decision process to go to a certain place or buy a certain product can be described by a multi criteria analysis (MCA). Several criteria will be evaluated by the customer before a final decision is made. This research uses a MCA approach to describe the analysis process of the customer at a service environment.

A MCA can be divided in four hierarchical layers of elements: principles, criteria, indicators and verifiers. The definition of the four elements is given below and derived from Prabhu et al 1999 by CIFOR (1999):

**Principle:** A fundamental truth or law as the basis of reasoning or action. They provide justification for criteria, indicators and verifiers.

> The founding principle of the CP-model is as follows:
> - An attractive service environment has to be offered

**Criterion:** A principle or standard that a thing is judged by. A criterion can, therefore, be seen as a ‘second order’ principle, one that adds meaning and operationality to a principle without being a direct measure of performance. Criteria are the intermediate points to which the information provided by indicators can be integrated and where an interpretable assessment crystallises. Principles form the final point of integration.

> The two criteria of the CP-model is as follows
> - Criteria 1: Service environments have to satisfy the main functional demands.
> - Criteria 2: Service environments have to offer sufficient diversion

**Indicator:** An indicator is any variable or component used to infer the status of a particular criterion. Indicators should convey a ‘single’ meaningful message. This ‘single’ message is termed information. It represents an aggregate of one or more data elements with certain established relationships. To define the indicators, a combination of Bitners’s Servicescapes and Fodness & Murays ‘hierarchical structure for airport service quality expectations’ has been used.

> Indicators which have to be applied to meet Criteria 1:

Indicator A: *High quality in Spatial Layout*
- The ability to process customers in an efficient and effective way

Indicator B: *High quality in Information supply systems*
- The ability to inform customers real time about available activities and functions

Indicator C: *High quality in Core functional Support*
- The ability to support the core function

> Indicators which have to be applied to meet Criteria 2

Indicator D: *High quality in Ambience*
- The ability to affect the five senses.

Indicator E: *High quality in Décor*
The ability to shape an attractive visual image

Indicator F: *High quality in Personal Care*

The ability to execute activities

Next chapter will describe the elements of The terminal quality indicators by using MCA verifiers:

**Verifier:** Information that enhance the specificity or the ease of assessment of an indicator. They provide the special details that indicate or reflect a desired condition of an indicator. As the fourth level of specificity, verifiers provide specific details that reflect a desired condition of an indicator. They can be considered as sub-indicators and can answer the question if the conditions for a high quality rating for an indicator is met.

Both literature and models do not clearly give an indication of the verifiers. The verifiers will be ascertained in the last chapter of Part 2, chapter 7. However, since we now have the general building blocks, we can design the preliminary CP-model (Figure 5-7):

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**5.5 Summary**

This chapter introduced the theoretical background of customer quality perception. First the respecified conceptual framework of Mehrabian and Russell was introduced, that focuses on the environmental stimuli of a rail terminal. After analysing several models on the perception of service quality, the models of Bitner's 'Servescapes' and Fodness and Murrays 'Hierarchical structure for airport service quality expectations' where combined with the principles of MCA-
based decision systems and a Customer Perception-model (CP-model) is designed. The model enables us to conduct research on design preferences of customers concerning various service environments.

To be useful for the NS, the CP-model lacks one important aspect, the definitions of the verifiers. These verifiers are the performance indicators of the model’s ‘indicators’. Next chapter will acquire the relevant verifiers via the application of the CP-model on the extensive in-depth literature studies on two narrowly related service environments: airport terminals and shopping centres.
Airports & Shopping Centres

Henry Ford once commented that had he asked customers what they wanted, they would have said "a faster horse." As Ford knew well, market research can have many pitfalls. In defining the customer preferences of rail terminal customers this research seeks the answers on what rail terminal customers want by drawing parallels with the customers of two other sectors: the airport and retail industry. As Peek (2006) illustrates is his static value chain, they each serve an essential customer at railway stations: the passenger and the shopper. Trends discussed in chapter 3 and the development of rail terminal functionality clearly illustrate that the growth potential in value creation will be initiated by satisfying the needs of these two types of customers.

The passenger

In defining the needs of the passengers a parallel is drawn with airport terminals. The airport terminal and its passengers show similarities since its passengers also show great diversity in demographics, have a dominant transport desire, are sensitive for retail and have to cope with complicated (new) building structures (Edwards 1998).

The shopper

In defining the needs of the shopper a parallel is drawn with shopping centres. The shopping centre shows similarities since its customers have the same purpose: they have a dominant shopping motive and want to be entertained (Wakefield & Baker 1998). Furthermore, the central inner-city location attracts many different customers and like a shopping centre a rail terminal will also have to differentiate itself from the surrounding retail competition if it wants to attract customers.
Both industries have a large experience in facilitating their customer and above all, much research has been conducted over the years on both specific fields of expertise (Turley and Milliman 2000, Fodness & Murray 2007). This gives us a great opportunity to learn about rail terminal customer’s preferences when we combine the two fields of expertise.

First, an in dept literature study will be conducted on relevant airport terminal research (§ 6.1). The focus on customer perception on airport quality was leading in selecting the studies. The CP-model is used to structure the analysing process and eventually paragraph 6.2 will present the verifiers of the airport passenger’s perception of a high quality service environment (airport terminal). Second, the same approach will be used on studies on the perception shopping centre quality (§ 6.3). The analysis of the second group will present the verifiers of the shopper’s perception of a high quality service environment (§ 6.4).

6.1 Learning from airport passengers

Although airport and railway station terminals do not have entirely the same conditions, the transport function of a railway station terminal shows many resemblances with the airport terminal building in facilitating the process of transferring passengers between different modes of transport. Extensive literature research on passenger’s perception of service environment of airports resulted in six relevant studies. These will be discussed below and will form the backbone in defining the transfer verifiers. Their findings are analysed, using the CP-model as a analysis tool (Figure 5-1). Appendix 10 gives a full overview of all the data analyses.

<table>
<thead>
<tr>
<th>Criterion 1: Satisfy main functional demands</th>
<th>Verifier</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Spatial Layout</td>
<td>Verifiers</td>
<td></td>
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<tr>
<td>Customer Information supply</td>
<td>Verifiers</td>
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<td>Core functional support</td>
<td>Verifiers</td>
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<td>Ambience</td>
<td>Verifiers</td>
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<tr>
<td>Décor</td>
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<tr>
<td>Personal care</td>
<td>Verifiers</td>
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Figure 6-1 | CP-Analysis tool
6.1.1 Analysis of relevant studies

**Study 1** Seneviratne & Martel (1991) | Multiple terminal elements

Seneviratne and Martel studied the variables influencing the performance of different elements in the airport terminal. In their research, they indicate that "a typical passenger terminal building has three principal users: the airline, the airport operator and the passenger who is the principal source of revenue for the airport" (Seneviratne & Martel 1991). In their view, the general consensus is that the passenger needs should be given higher priority when considering new designs or improvements to existing facilities. These passengers have to go through a mandatory sequence of activities. These activities can be summarized into three primary activities: The processing activities, the holding activities and the circulation activities. Seneviratne & Martel are one of the first researchers who claim that the level of passenger service is not only dependent on the availability of space and walking distance. For each primary function Seneviratne and Martel indicated variables which most influenced the quality perception of the airline passenger.

Seneviratne & Martel based their 'Quality service characteristics' on the research model of Heathington & Jones (1975). Their research included 227 respondents. They conclude that their limited study clearly shows that besides the availability of space and waiting time, more aspects should be considered when evaluating the performance of airport passenger's terminals buildings in terms of passenger needs. Regarding railway terminal buildings, many aspects of perceived quality such as waiting area, internal environment and the availability are also important and these aspects should also be considered in the design process.

**Study 2** Lemer (1992) | A performance view

Andrew Lemer approaches the quality perception of passengers as the ability of the terminal to deliver the required performance. According to Lemer, "performance is the ability to carry out a task or fulfill some promise or claim, and in an airport passenger terminal that ability generally has something to do with moving travelers and their bags between aircraft and ground transportation" (Lemer, 1992). In his research he focuses on three specific groups: passengers, airlines and operators. Lemer points out that each user has its own ideas about the comfort, convenience costs and ambience that should accompany this movement, and will assess performance in terms of such factors. For each specific airport user he introduced specific performance demands. The specific factors of performance from a passengers' point of view are used for this study and are based on a 1989 study of the Building Research Board by 22 professionals.

Lemer concludes that the provided list is a general list. But since airports terminals differ is size, layout and customer mix, a more specific list can vary per airport. To be able to ascertain the level of service passengers expect on a specific airport, a precise on-situ research is needed. This could also be relevant for ascertaining the perceived quality at specific rail terminals and is an interesting point for recommendation.

**Study 3** Rhoades, Waguespack and Young (2000) | Competition elements

Rhoades et al. (2000) include many different stakeholders in their analysis on airport terminal competition values. These stakeholders included: airlines, airport tenants, airport service operators and airport consumers (the airline passengers). To focus on the passengers' perception of airport terminal quality, the non-passenger actors were asked
to answer the questions ‘passenger focused’. The main list of key factors in airport quality resulted in a detailed list of elements on which an airport terminal could differ itself from other airports.

Rhoades et al designed a list of key airport quality factors form existing literature and tested this list on 150 respondents. They conclude that the items found are essential in gaining competitive advantage among other airports. Lessons can be learned since rail terminals compete with different transport. By providing an attractive rail terminal service environment, rail terminals could compete with the automotive transport industry (e.g. cars) and gain substantial market share.

**Study 4 Barros et al. (2007) | ‘Transfers’ at airports**

Contrary to Rhoades et al., Barros et al. (2007) solely approached passengers at airport terminals. Further, airport passengers were divided in three groups, departing, transfer and arriving passengers. Barros et al. then narrowed their scope down to transfer passenger, passengers who use the airport as a hub to another destination. The reason for this focus was because according to Rhoades et al. a knowledge gap was present: “Despite the increasing importance of transfer passengers for airport operations, little research has been done to determine their needs”.

This focus has a logical reasoning: the needs of transfer passengers are quite different from those of originating and terminating passengers. Barros et al. mention for instance that, “transfers do not make use of airport access roads”.

The external design factors are thus, like in this research excluded from research. The parallels with rail terminals are also interesting. Many large railway stations in the Netherlands function as hubs in the railway station network. Like on airports, rail terminals contain many interchanging passengers, or like Barros et al. call them ‘transfers’.

The research entailed 23 respondents. Although this numbers seems small, the in dept questionnaire and the focus on transfer make this research valuable for this research. Barros et al. conclude that close attention should be paid to the quality of the flight information and orientation system. The passenger wants to be able to update himself on flight information at any moment at during its staying at the terminal. Their focus on ‘transfers’ is particularly interesting since railway passengers often serve transfer at the largest Dutch railway stations.

**Study 5 Correia et al. (2007) | An integral approach to Level of Service (LOS)**

According to Correia et al., the quality of airport terminals is a ‘hot’ topic: “The development of Level Of Service (LOS) measured for airport passenger terminals has been one of the major issues for airport operators in the last several decades”. This has motivated a number of LOS studies by air transportation agencies, including the Federal Aviation Administration (FAA), Airports Council International (ACI) and Transport Canada. Despite the effort of these agencies, the LOS standards and methods provided by them have been the subject of criticism by airport professionals (Correia et al. 2007). One of the main concerns is the lack of overall passenger input. Although passenger input has been measured in several studies, Correia et al. mention that most studies have focused on individual components of the airport terminal, neglecting overall evaluation.

Correia et al. analysed various surveys on airport level of service perception and the study by Seneviratne and Martel (1991) (discussed earlier). They suggested a list of objective and subjective variables which could influence the perception of the level of service by airport consumers (the passenger). Correia et al suggest that the list of variables should be used by airport managers to obtain a degree of importance that airport users (air passengers) assign to the
airport terminal. These weights are useful, as it will be an indication of where airport managers should spend their limited resources on. A parallel can be drawn with rail terminals. Since budgets are limited, rail terminal design should achieve maximum efficiency of quality in its design considering the available resources.

**Study 6 Fodness and Murray (2007) | Passengers' expectations of airport service quality**

In their research Fodness and Murray state that although it is possible to describe passenger preferences on issues ranging from airport signage to restroom cleanliness, there is no generally accepted theory-based model of airport service quality nor is there a comprehensive profile of the experiences, expectations and perceptual influences of passengers in this setting. In their effort to develop a model on airport service quality, Fodness and Murray (2007) conducted a thorough study based on nearly 1,000 airport users. This number of respondents makes this research one of the most relevant studies on service quality at airport terminals. They identified 65 airport service quality themes. In their questionnaire, they asked airport passengers to rate the theme with a seven point scale ranging from “Strongly Agree” (7) to Strongly Disagree”.

Fodness and Murray conclude that recent events underscore the immediacy of industry interest in the measurements and management of service quality at airports. By bringing together different literatures and research paradigms (marketing, airport design) they generated new insights in research on passenger terminal quality. Their research model is also relevant for the design of the CP-model, developed in chapter 5.

6.1.2 **Transfer verifiers**

The studies mentioned above are categorized using the CP-model. As mentioned, appendix 13 shows the data collection of the six studies. This paragraph discusses each indicators of the CP-model and gives a summary of the relevant studies related to it. By grouping design aspects per indicators, the verifiers appear.

<table>
<thead>
<tr>
<th>Criterion 1: Satisfy main functional demands</th>
<th>Indicator</th>
<th>Verifier</th>
<th>Authors</th>
</tr>
</thead>
</table>
### Core functional support

<table>
<thead>
<tr>
<th>Service</th>
<th>Indicator</th>
<th>References</th>
</tr>
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<tbody>
<tr>
<td>Baggage facilities</td>
<td></td>
<td>Rhoades et al. (2000), Fodness &amp; Murray (2007)</td>
</tr>
<tr>
<td>Security environment</td>
<td></td>
<td>Correia et al. (2007)</td>
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</table>

### Criterion 2: Offer sufficient diversion

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Verifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambience</td>
<td>Quality of light</td>
<td>Senevirante &amp; Martel (1991)</td>
</tr>
<tr>
<td></td>
<td>Rest rooms</td>
<td>Rhoades et al. (2000), Barros et al. (2007)</td>
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**Table 6-1: Results airport data analysis**

### 6.2 Learning from shopping centre customers

Regarding commercial places, this research uses theories about shopping centre design to ascertain the design criteria of commercial spaces on railway stations which generate high levels of customer appreciation. Though much research has been done about the design characteristics of shopping centres (Hackett and Foxall 1994, Kirkup & Rafiq 1994, Guy 1994, Kido 2005), "the shopping still uses 'rules of thumbs' for design, decor and image cues such as tenant placement" (Dennis et al. 2005). The scientific objectivity is though dubious. Brown (1992) points out that

"They appear to be the outcome of a long and expensive trial and error process, NOT extensive empirical research. As such, they are in danger of being elevated into unbreakable shopping axioms".

Many different research angles are possible in ascertaining the essential design criteria. The starting point of many studies on shopping mall design (Hackett and Foxall 1994 and Denis et al. 2005) is the 27-image attributes of McGoldrick (1992). According to McGoldrick (1992) image appreciation is important at shopping malls. These images are formed somewhat selectively “from a combination of factual and emotional material”. Other research on shopping
mall design elaborates about the amount of excitement a consumer experiences (Wakefield & Baker 1998), the on-site (in vivo) evaluation of situational contexts of shopping mall (Teller & Reutter 2007) or the interrelations of consumers with the shopping mall habitat (Bloch et al. 1994.). The purpose of this paragraph is to review the different theories about the design criteria which make a shopping centre an attractive service environment.

6.2.1 Analysis of relevant studies

Study 1 Van der Plas I 1988
Van der Plas studies the interaction between the shopping environment (shopping centre), consumer behaviour and the related programming of the shopping centre. With an extensive literature study van der Plas forms four main criteria a consumer expects of a successful shopping environment:

(1) The shopping environment has to offer the desired stimuli.
(2) The shopping environment has to fit shopping activities.
(3) The shopping environment has to stimulate the desired social contact and
(4) The shopping environment has to offer adequate physical environmental conditions. In his research, safety and sheltering are not considered in defining the main function of a shopping centre.

Study 2 McGoldrick I 1982

Study 3 Bell I 1999
Bell suggests that intra-urban retail area patronage decisions are influenced by the image of the whole area. In defining the elements which have an impact on retail area choice, Bell uses the MR-model of Mehrabian and Russell (1974) as the basis of his model. Five variables are considered to have an impact: (1) Quality & variety of shops & products, (2) Visual amenity, (3) Price fairness, (4) Convenience, and (5) Customer service. In other words, they are a stimulus and are responsible for a certain affect on shoppers (Arousal, dominance or pleasure). This eventually affects the willingness of a shopper to buy products.

Their study provides a framework for studying shopping area behaviour that allows consideration of consumers’ affective responses to environmental stimuli in forming behaviours. The adaptation of the Mehrabian and Russell (1974) model of environmental psychology provides a strong theoretical base to this study which demonstrates a link between the image of retail shopping areas and the consumers’ liking of the shopping area.

Their research shows some important flaws. Important aspects such as spatial layout and ambience are not considered. However, since 569 respondents are involved (response rate 47%), this research gives some valuable, but fragmented insights on shopper design criteria.
Study 4 Turley and Milliman 2000

Turley and Milliman focus on the research conducted over the years on the effects of facility-based environmental cues, or “atmospherics”, on buying behaviour. They redesigned the 1995 ‘Berman and Evans-1995’-model to categorize the relevant research projects. Berman and Evans divide the atmospheric stimuli or elements into four categories: (A) the exterior of the store, (B) the general interior, (C) the lay-out and design variables, and (D) the point of purchase and decoration variables. Although their study is mainly focused on store design, essential characteristics also concern the entire centre environment. Pure product related variables and their introduced “Human variables” are not considered in our research.

As this literature stream has evolved from these early articles, marketing researchers have come to the realization that if consumers are influenced by physical stimuli experienced at the point of purchase, then the practice of creating influential atmospheres should be an important marketing strategy for most exchange environments. As noted in a more recent article written by Bittner (1990), such atmospheric planning can make the difference between a business success or failure (Turley & Milliman 2000).

Turley and Milliman conclude that although there may be some debate about whether the atmosphere can influence time spent in an environment, enough evidence is available to clearly state that the atmosphere has an effect on consumer spending and that variations of atmospheric variables affect the amount of money people spend and the number of items they purchase.

Study 5 Ng 2003

According to Ng, although the last decade showed that social scientist have begun to pay interest in shopping as a research object, environmental psychologists have yet paid little attention to the study of shopping environments. In Ng’s research, previous research is discussed from the shopper’s perspective; the goal is to increase shoppers’ satisfaction and wellbeing. Four main aspects: (1) Sensory stimulation, (2) Safety comfort and convenience, (3) Wayfinding and (4) Social interaction are introduced which resulted in a conceptual model for understanding the shopper-environmental fit with respect to shopper’s psychological needs and physical aspects of the built environment.

All the elements have their distinct consequence on shopping mall design. In Ng’s vision shopping centres try to replace public space by offering many people a way to get rid of boredom through entertainment, by providing convenient shopping, and by being a safe, free ‘public’ social space to meet and interact with others.

Study 6 Dirks & Janssen 2003

Dirks and Janssen analyse spatial and functional ‘performance’ demands of inner city shopping centres regarding specific needs of different shopping centre users. According to Dirks and Janssen, little knowledge was available on the needs of shopping centres customers. This complicates the redevelopment process of many shopping centres since the design did not match the requirements. Dirks and Janssen claim that due to this lack of knowledge valuable resources are spent on inadequate solutions which do not satisfy users’ needs.

Study 7 Verbunt 2005
Verbunt analyses the shopping environment of shopping centres and the behaviour of its related customers. She defines four important factors which can influence a customer's decision to spend time at a shopping centre. The first factor is the need for comfort and a safe environment. A safe environment includes physical and social safety and the ability to move from A to B in a comfortable manner. The second factor is the need for the ability to use certain facilities. The ability to use rest rooms, to rest, to be informed about the activities at the shopping centre and to temporarily store baggage belong to this factor. The third factor is about the ability to attract a customer. A customer should recognise and identify itself with the style of the shopping centre and the centre should provide the correct atmosphere. The fourth and last factor shopping centres should supply is the ability to orientate oneself. Customers will have to easily find their way in the shopping centre.

### 6.2.2 Shopper verifiers

#### Criterion 1: Satisfy main functional demands

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Verifier</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Availability of space</td>
<td>McGoldrick (1992), Ng (2003), Verbunt (2005)</td>
</tr>
<tr>
<td></td>
<td>Visual Information Display Systems</td>
<td>Bell (1999), Dirks &amp; Janssen (2003), Ng (2003), Verbunt (2005),</td>
</tr>
<tr>
<td></td>
<td>PA system and background acoustics</td>
<td>Van der Plas (1988), Turley and Milliman (2000), Ng (2003), Verlunt (2005),</td>
</tr>
<tr>
<td>Core functional support</td>
<td>Store characteristics</td>
<td>McGoldrick (1992), Bell (1999), Ng (2003), Verbunt (2005),</td>
</tr>
<tr>
<td></td>
<td>Security environment</td>
<td>Supplementary studies: Wakefield an Blodgett (1994)</td>
</tr>
</tbody>
</table>

#### Criterion 2: Offer sufficient diversion

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Verifier</th>
<th>Description</th>
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<tbody>
<tr>
<td></td>
<td>Outdoor elements</td>
<td>Supplementary studies: Wakefield an Blodgett (1994)</td>
</tr>
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</table>
6.3 Summary

If a rail terminal wants to be successful in attracting customers, it will have to satisfy the demands of both the passenger and the shopper. In paragraph 7.5 we will combine the two design preference lists. This will lead to a general list of verifiers which are required to satisfy the shopper and the passenger at a terminal: The rail terminal customer verifiers of an attractive service environment.
Chapter 7

“People spend money when and where they feel good.”

Walt Disney

Rail Terminal Customer Design Preferences

A rail terminal has to satisfy the demands of both passengers and shoppers. The verifiers derived in chapter 6 are therefore combined into one general list. This list of design aspects can be regarded as the most important customer quality generators. The CP model defined six indicators which we will call ‘Design Groups’. In this chapter, each paragraph discusses one design group and describes the relevant design aspects.

7.1 Verifiers indicator ‘Spatial layout’

1. **Compactness.** In designing terminal transfer space, the ease of the passenger or shopper to move for A to B is important. Compact terminal design means reduction of travel time: the distance between relevant elements like information counter and waiting area should be minimized in a compact terminal design (De Neufville (2002); Correia (2004); Bandara and Wirasinghe (1992); Senevirante & Martel (1991); Lemer (1992); Barros et al. (2007); Correia et al. (2007); Fodness & Murray (2007); McGoldrick (1992); Ng (2003); Turley & Milliman (2000) and Verbunt (2005)).

2. **Circulation.** Passengers at rail terminals perceive terminal circulation quality by accessing the amount of obstacles, level changes and the way these level changes are facilitated (Seneviratne & Martel (1991), Lemer (1992); Correia et al. (2007)). The need to use escalators, elevators and stairs is negative related to customer quality perception. Shoppers value a short, efficient and comfortable movement free of barriers (Van der Plas...
(1988), Ng (2003), Dirks & Janssen (2003), Turley and Milliman (2000). An easy access to internal and external elements (McGoldrick 1992), Dirks & Janssen (2003), Verbunt (2005) are also highly valued. Figure 7-2

3. Availability of space. Terminal design should prevent crowding by supplying open spaces (Senevirante & Martel 1991, Lemer (1992), McGoldrick (1992), Ng (2003), Verbunt (2005) and Fodness & Murray (2007). Reducing open spaces, and thus increasing the chance of crowding, influences the perception of control and eventually reduces service experience (Hui & Bateson 1990). Figure 7-3

4. Spatial logic. Terminal design should have spatial logic (Van der Plas (1988), McGoldrick (1992), Lemer (1992); Edwards (1998) Correia et al. (2007), Correia et al. (2007), Dirks & Janssen (2003), Ng (2003), Verbunt (2005), and Fodness & Murray (2007). Spatial logic is created by clarity in physical layout. Easy orientation is possible via sightlines as Ng mentions: “shoppers should have the ability to see from one end of the mall to the other”. Functional hierarchy is expressed by light intensity and structural hierarchy. Figure 7-4

5. Adaptability. Terminal design should contain high level of adaptability (Dirks & Janssen (2003), Dennis (2005). Adaptability is created by designing a terminal structure which supports flexibility in service elements and layout. Figure 7-5

7.2 Verifiers indicator 'Customer information supply'

6. Wayfinding. Terminal design should provide effective wayfinding. It entails the ease with which airport customers can navigate through the built environment of the terminal. Wayfinding should be clear, comprehensible and legible (Van der Plas (1988), Seneviratne & Martel (1991), Lemer (1992), Bell (1999), Rhoades et al. (2000), Turley and Milliman (2000), Ng (2003), Verbunt (2005) Barros et al. (2007); Correia et al. (2007)). Several physical qualities can affect the wayfinding at terminal buildings. The length of corridors, number of decision points and the number of level changes all
affect the orientation process in some way. See figure 7-6

7. Visual information distribution systems (VIDS). Visual Information Display Systems (VIDS) are relevant for departing and transferring passengers and shoppers who want information about the activities at the rail terminal. Up to date knowledge of information is essential for reducing the passenger’s and shoppers level of stress. Many studies underline the importance of this verifier. VIDS must be readable, available and up to date (Dada (1997), Dada and Wirasinghe (1999), Bell (1999), Caves and Pickard (2001), Rhoades et al (2000), Dirks & Janssen (2003), Ng (2003), Verbunt (2005), Correia et al. (2007), Fodness and Murray (2007). Figure 7-7

8. Public Addressing system and background acoustics I The level of background noise and the ability to make one heard is an important quality aspect of transfer terminals and shopping centres. (Van der Plas (1988), Seneviratne & Martel (1991), Turley and Milliman (2000), Ng 2003, Barros et al. (2007)). Auditive information is essential in acquiring transfer information and the comprehensibility depends on speaker quality and the reverberation capacity of the terminal. High levels of background noise will stress the passenger shopper and will also limit customers in having social contacts (Lemer (1992)). See figure 7-8.

7.3 Verifiers indicator ‘Core functional support’

9. Ticketing I According to Peek (2006) railway stations create value by providing customers retail and transport services. Transport services require a clear and easy ticketing system which provides a smooth ‘check-in’ process for passengers. Waiting rows particularly frustrate passengers and also passengers who are obstructed by these lines. The ticketing facilities should have a short processing time (which reduces waiting lines) (Lemer 1992, Correia et al 2007) and should be well designed (Barros et al 2007). This indicator is only mentioned in airport terminal literature. Figure 7-9.

10. Baggage facilities. Passengers can carry a lot of luggage. The transfer passenger (airport or railway) demand proper baggage facilities in order to use the terminal in a convenient way. (Rhoades et al 2000, Fodness & Murray 2007). Terminals can thus be seen as a storage facility for passenger baggage and should provide adequate storage facilities. This verifier is only mentioned in airport terminal literature. Figure 7-10
11. Branding. This verifier mainly concerns the shopper at the rail terminal and consist of two elements. First, the availability of well-known retail formulas is valued by shopping centre customers. Well known retail formulas are for example anchor stores\(^{18}\), which attract shoppers because they know the shopping centre has one (McGoldrick (1992), Bell (1999), Verbunt (2005)). A second crucial design requirement, according to McGoldrick (1992), Bell (1999) and Verbunt (2005), is the variety of store offering. A customer wants to be surprised (Wakefield and Blodgett 1994) and according to Ng (2003) "a positive relationship exists between preference of shopping mall areas and mystery, see figure 7-11.

12. Security environment. This verifier is one of the most controversial topics of recent discussions on terminal design. After terrorist attacks in New York, London and Madrid, many actions have been taken to increase terminal security. This development also has its implications on the experienced ambience at a Terminal: a secure feeling of the terminal environment should be designed and control measurements should be clearly visible (Correia et al. 2007). Shopper approach the security aspect from a slightly different angle, here social safety is more relevant Ng (2003), Verbunt (2005). Figure 7-12.

7.4 Verifiers indicator 'Ambience'

13. Quality of light. Visual quality of the built environment is the first impression a passenger forms when entering service environment. The visual impression "sight" is an important element of the overall visual impression. Quality of sight should have comfortable lighting (Van der Plas (1988), McGoldrick (1992), Seneviratne & Martel (1998) Turley and Milliman (2000), Dirks & Janssen (2003), Verbunt (2005)), which means it has to have a tranquil effect on the stressed customer (Edwards, 1998). Figure 7-13

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\(^{18}\) Anchor Store: is one of the larger stores in a shopping mall, usually a department store or a major retail chain (source: ICSC Shopping Centre Definitions: www.icsc.org/srch/idx/SCDefinitions99.pdf Accessed of September 3rd 2008.)
14. Maintenance. Customers of a service area resent a filthy environment. Both passengers (Seneviratne & Martel (1991), Fodness & Murray (2007)) and shoppers (McGoldrick (1992), Turley and Milliman (2000), Verbunt (2005)) value a clear fresh environment. This can be realized by supplying the needed equipment (litter bins) and using easy to maintain materials. Figure 7-14.

15. Quality of Air. Transfer terminals and shopping centres can be considered as large volume buildings. This makes regulating the quality of air particularly difficult but according to Verbunt (2005), air quality "is one of the most important background elements of a shopping centre". Air temperature, humidity and cleanliness (smell and hazardous gasses) should thus be properly controlled in order to create quality for terminal customers (Van der Plas (1988), Seneviratne & Martel (1991) Lemer (1992) Turley and Milliman (2000), Dirks & Janssen (2003), Ng (2003), Verbunt (2005) and Fodness & Murray (2007)). Figure 7-15.

7.5 Verifiers indicator ‘Décor’

16. Architecture. According to Edwards (1998), terminal buildings have several primary functions. One of them is the landmark function. In order to function as a landmark, terminals usually have an expressive architecture. Lemer (1992) identifies the eye-catching architecture of a terminal as a relevant character of the of airport terminal performance. ACI (2000), underlines this by indicating that airport aesthetics and style of design of the terminal are essential LOS aspects. Fodness and Murray (2007) emphasis that the airport should represent the local culture of the city and an airport should have ‘a current décor’. Shopping mall customers also value the overall architecture of the service environment McGoldrick (1992), Turley and Milliman (2000), Dirks & Janssen (2003), Ng (2003). The shopping area should be pleasing to look at (Bell, 1999) and should have a distinct architectural style (Verbunt, 2005)). Figure 7-16.

17. Artworks. Art can be used for various functional applications (Turley and Milliman, 2000). Art can shorten the perception of waiting time, it can function as a point of reference (Ng (2003) Dirks & Janssen (2003)) for tourists to gather and airport passengers and shopping centre visitors also

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18 LOS: Level of Service
appreciate it as an object which increases the 'ambience' of the terminal and can 'entertain' tourist (Verbunt (2005), Fodness & Murray (2007)). Figure 7-17.

18. Flooring. The quality and type of floor are discussed in several studies (Van der Plas, Turley and Milliman 2000)). According to them, proper flooring is essential for customer perception of quality and safety. Shoppers view this element as a separate part of the shopping centre and thus is discussed next to shopping centre architecture. This verifier is only discussed in shopping centre literature. Figure 7-18.

19. Outdoor/green elements. The presence of water, plants and greenery is mentioned by Ng (2003) as ways to enhance a tranquil atmosphere at shopping centres. According to Wakefield and Bloydett (1994, it eases the busy shopper. Although airport literature does not mention this verifier, it is plausible that outdoor elements could also have a tranquil effect on passengers. Figure 7-19.

7.6 Verifiers indicator 'Personal care'

20. Productivity (work/study). A large proportion of passengers at airports (and railway stations as well) are business related. These passengers are particularly interesting since their spending budget is significantly higher than regular passengers (e.g. tourists) (Van Hagen 2003). Business passengers expect several functions to be available at transfer terminals. Barros et al. (2007) and Lemer (1992) suggest car rental services and Fodness and Murray (2007) suggest the availability of conference centres and business facilities. Shopping mall literature does not mention this verifier (figure 7-20).

21. Seating | Passengers will inevitably have to spend time waiting at a transfer terminal, due to delays or other activities. Seating is greatly valued during these times. Sevirante & Martel (1991), Barros et al. (2007) and Correia et al (2007) all indicate that the quality of seating facilities, the availability of seating and the quality itself are important aspects in spending time at transfer terminals. Van der Plas (1988), Ng (2003), Verbunt (2005) also view 'seating' facilities as important elements for customer appreciation. Since shopping centre visitors walk quite some distances, Verbunt mentions
that shoppers value a place to relax (figure 7-21). Seneviratne and Martel (1991) indicate that furniture is an important aspect of terminal design. In their opinion, furniture can have a large impact in the conception of terminal quality.

22. Availability concessions
Concessions are gaining importance during time spent at a service environment (Bitner, 1992). In defining the quality of concessions, available at transfer terminal, three elements are important: variety of retail facilities (McGoldrick 1992), Lemer (1992) Rhodes et al. (2000) and Correia et al. (2007), ease of access to the concessions and the number of available concessions, (Seneviratne & Martel 1991), Bell (1999), Ng (2003), Verbunt (2005). The concessions support personal activities in maintaining life. According to Csickszentmihalyi & Graef (1980) they mainly support the maintenance of the passenger’s body (e.g. food and beverage). Foodness and Murray (2007) mention that national known retail outlets and chain restaurants are important eye catchers (figure 7-22).

23. Rest rooms
The fourth verifier of Personal Care is rest rooms quality (toilets and places for personal hygiene). Sufficient availability of clean rooms (Rhoades et al. (2000)), of places for refreshments (drinking water, Barros et al. 2000) are frequently mentioned in literature. The ACI (2000) also included restrooms in their quality perception query on its associated airports. The overall standard (cleanliness), number/availability and ease of finding these restrooms are important elements of this verifier (McGoldrick (1992), Ng (2003), Verbunt (2005)) (figure 7-23).

24. Social interaction
This verifier is mainly found in shopping centre literature. Shopping centres do not only facilitate the need of people to shop. Many people, present at shopping centres want to have social contact (Karam, 2005). According to Ng (2003): “Social interaction is an important motive for going shopping”. The level of communication possibilities (van der Plas (1988), Dirks & Janssen (2003)) and visual contact (Ng 2003) are important design elements which facilitate social interaction (figure 7-24).
7.7 Final model

After having analysed all the studies concerning customer perception of the service environment from the passengers and shoppers perspective, the final CP-model for rail terminals can be designed. Figure 7-25 shows the model.

![Customer Perception Model for service environment analysis](image)

**Figure 7-25 | Final Customer Perception Model**

7.8 Summary

This chapter consolidates all the verifiers of passenger perception of the two industries into one single model. The six indicators (Spatial layout, Customer information supply, Core functional support, Ambience, Décor and Personal care) are described by a total of 24 verifiers; relevant specific elements of a successful terminal design.

The model indicates all the verifiers that are according to studies of importance for enhancing customer perception of the service environment. Although the 24 found design aspects makes it possible to narrow the focus in the design process, the sheer number (24) still makes it hard for a designer (or design group) to decide what focus will be applied. A more specified insight in the relevance of the verifiers on passenger perception can help terminal designers in making the right design choices during the complicated design process. Part three will address this challenge.
The 24 design elements derived in Part Two are essential in creating a positive customer perception. However in a design process, resources are limited and strategic choices on resources thus have to be made. This part analyses which design aspects should be preferred in the design process, in order to achieve an optimal service environment for the rail terminal customer. Chapter 8 briefly discusses the expert survey used for this research and chapter 9 elaborates about the data-analysis.
Expert Survey

The 24 design preferences of rail terminal customers, defined in chapter 7 cannot all be directly applied in the design process. 24 focus aspects are simply too many aspects to focus your design strategy on. In order to make use of the design preferences we have to know which aspects are more important than others during the design phase than others. Since rail terminals have to satisfy two types of customers, the design preferences may vary. This research uses an expert survey to generate the focus needed in the design phase. Two groups of experts will be consulted. The first group are professionals in hub development. Their knowledge and experience on successful hub development will deliver the focus from a passenger’s perspective. To acquire the shopper’s perspective, experts from the retail industry are approached. The survey will give us two interesting focuses in the design process and will help us to answer the second research question. This chapter will describe the process of developing the survey. First, the survey design will be discussed (§ 8.1) and secondly, the survey details (case description, expert panel, panel objective) are introduced in paragraph § 8.2.

8.1 Survey Design

The expert survey, conducted in this research provides results after the completion of six phases (Figure 8-1).

![Design phases](image_url)
The first step states the goals which the expert survey will need to achieve. This step results in a survey mission document. The document is used as guidance in defining the design criteria of the site (sub paragraph 2). Here several design alternatives are discussed and this phase concludes with the design specification document. The third phase is the design phase (sub paragraph 3) and results in an online Beta-version. This beta version is tested in phase 4 (sub paragraph 4). The testing phase collects valuable feedback and eventually results in the final version. Once tested a final check is conducted and the site continues into the fifth phase: Go live. The fifth phase will collect the data for the last phase: analysis. This phase will be described in a separate chapter, chapter 9.

8.1.1 Step one: State goals

The 24 design preferences defined in chapter 7 are customer based. Although they are all valued by the rail terminal customer, it is not practical in defining the focus in rail terminal design. 24 criteria is clearly too much, no focus can be possible and since resources (e.g. financial resources and space) are limited a shortlist will have to be developed.

To be able to advise the NS on what design aspects they will have to prefer in rail terminal design if they want to successfully develop an attractive rail terminal for passengers and shoppers, we will have to know what aspects are more relevant than others and we will have to know what design aspects show a large discrepancy in preference.

Survey Mission: this research uses an expert survey to utilize the expertise of professionals from the transport and retail industry to focus the design aspects and to indicate potential large discrepancies in preference.

8.1.2 Step two: Preliminary design criteria

Once the survey mission has been stated, a clear method to extract the relevant information is designed. After several interviews with NPC consultants, the following criteria were stated:

- The survey should have a minimum of 20 respondents of each expert group
- Each expert group should consist of at least five different companies
- The survey should produce a ranking in design aspects

Respondents. To be sure that the initial response rate would result in 20 (minimum for statistical analysis) or more, respondents 35 respondents per expert group were chosen. After identifying the relevant industry representation fields (e.g. airport designers), the group was formed by sending an invitation by mail. To be sure that the initial response rate would result in more than 20 respondents, experts were approach via NPC or personal connection. This formed an endorser and resulted in a response rate of 72% at the transport group and 97% at the retail group.

Ranking system. In order to acquire a priority list of design aspects this survey used a two layered ranking system. In the first step experts divided the design aspects into three groups:

- Yes, this is certainly a priority (++)
- Yes, this should be considered (+)
- This is not really a priority (0)

\(^{20}\) 1 out of 27 transport respondents and 1 out of 38 retail respondents neglected the invitation
The second step asked the experts to value the aspects in the three groups separately. Each group consisted of eight aspects and by scoring each element a second ranking was achieved. Eventually, this resulted in a ranking of the 24 design aspects per expert group.

Appendix 10 shows two screenshots of the survey steps:
Step one: divide the 24 design aspects into the three groups
Step two: rank the 8 design aspects in the group itself

8.1.3 Step three: Design basic structure & layout
The design criteria are the input for the basic design of the beta-version of the site. The site consists of a front-end and a back-end. The front-end was designed in a clear structure where six 'chapters' are introduced (chapters mentioned above) and illustrated in figure 8-2.

8.1.4 Testing
The testing phase took eight days and consisted of two parts. Part one was the analysis of the site's structure and the textual information. The second part was about the interaction design of the ranking system. The test panel consisted of five members.

Most important points of feedback:
- Reduce information significantly
- Provide better instructions
- Provide more interaction
- Use consistent terminology

8.1.5 Go live
The site went online at Monday 17th November 2008, and the participants were sent an email to respond. Since site development and testing took a considerable amount of time and the deadline for preliminary data results was Tuesday November the 25th 2008, respondents were encouraged to respond as soon as possible. The graphic below shows the data input into the site's database and appendix 11 shows several impressions of the site.
8.2 The Case

To simulate the stressed situation, suggested by Bertolini & Spit (1998), this research uses a fictive new rail terminal development project: Den Dolech Central Station.

8.2.1 Den Dolech Central Station, 2014

Den Dolech is a Dutch top five city, with 400,000 inhabitants, located in the heart of the Netherlands. In 2006, a unique redevelopment project has been initiated by the municipality of Den Dolech. The project consists of a large former industrial area in the heart of the city which will be redeveloped into a new vivid city district. Today, after 8 years, the city district has attracted thousands of new inhabitants and new companies, increasing Den Dolech's population to over 500,000 inhabitants.

In 2010, the city of Den Dolech joined the European High-speed rail network. The integration of Den Dolech Central station in the European High-speed network was a boost for Den Dolech's city tourism.

The large amount of new city inhabitants, the connection to the European High-speed rail network and the steady growth of railway users in the Netherlands forced the Dutch government, Den Dolech municipality, the Dutch railway company NS and ProRail in 2012 to think about redeveloping the old Den Dolech railway station and plans for a brand new rail terminal are proposed.

Due to its inner city position the new terminal will have to service two types of customers: (international) railway passengers and shoppers.
8.2.2 Objective participants

Two investors are attracted to develop in Den Dolech’s new rail terminal.

- Investor A wants to generate as much passenger value at the rail terminal (best travel experience).
- Investor B has the objective to generate as much shopper value at the rail terminal (best shopping experience).

Previous literature studies produced a list of 24 customer design preferences. Since resources (space and financial resources) are limited in any development project, investor A and B will have to prioritize their investments. Each investor asks advice from a consultancy firm to focus their investments.

You are a member of one of the two consultancy firms: Transfer Consulting Group (TCG) or RetRail Inc.

**TCG:** You have to advise Investor A, that wants to develop a successful transfer-function in the rail terminal. Your expertise will help Investor A to succeed in creating an attractive transfer hub. What focus in the design process (most important points of attention during the design process) should investor A prefer?

Participants who have to advise on generating as much value for the passenger work in different fields of expertise and work in governmental organizations (Prorail, Ministustry VenW), rail industry (NPC, NS Poort, NSC and EPF) and airport industry (NACO, Schiphol). They all share one common customer: the passenger. See Appendix 12 for the list of participants of the TCG group.

**RetRail Inc:** You have to advise Investor B, that wants to develop a successful shopping-function in the rail terminal. Your expertise on design principles of urban retail agglomerations will help Investor B to succeed in creating an attractive retail centre. What focus in the design process (most important points of attention during design process) should investor B consider? See Appendix 13 for the list of participants of the RetRail group.
Chapter 9

"A railway station should not be a cold shower but a warm bath"

Mark van Hagen
NS MOA

Analysis of data

The data acquired in the expert survey is used for a three step analysis. First the data will be used to determine each sectors hierarchy in prioritising the design aspects (§ 9.1). The second step of the data analysis combines the two lists, generated in paragraph one to create insight in the overall impact of the design aspect on rail terminal experience (§ 9.2). The third analysis step will indicate large discrepancies by performing several statistical tests. (§ 9.3).

9.1 Hierarchy in design aspects

In order to be able to answer our second main research question, a ranking will have to be applied in the twenty-four aspects. The expert survey delivered two lists of rankings which are derived by calculating the respondent group means. Appendix 14 shows the complete scoring lists. One list consists of prioritised design aspects which create as optimal transfer experience for the passenger and one list consists of prioritised design aspects which create optimal shopping experiences for the shopper. This research uses the theory of Maslow’s hierarchy of needs21 to visualise both lists. The lowest design aspects are the most basic design aspects which have to be considered to enable customer experience. Once this design aspect has been realised, more design aspects can be included in the design. The top design aspects can be regarded as Maslow’s points of self actualisation (Maslow 1943): the highest possible design aspect in order to pursue positive customer experiences. First the hierarchy of creating passenger experience

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21 Maslow’s Hierarchy of needs is predetermined in order of importance. It is often depicted as a pyramid consisting of five levels: the first lower level is being associated with Physiological needs, while the top levels are termed growth needs associated with psychological needs. Deficiency needs must be met first. Once these are met, seeking to satisfy growth needs drives personal growth. The higher needs in this hierarchy only come into focus when the lower needs in the pyramid are met. Once an individual has moved upwards to the next level, needs in the lower level will no longer be prioritised (Jim. Owies, Khutorchev, Vesh 2002).
is visualised (figure 9-1) and discussed. Second, the hierarchy in designing an attractive environment for shoppers is given (figure 9-2) and discussed. The design aspects are divided in three groups: > 0 – 8.0 points = low priority, > 8.0 – 16.0 points = medium priority, > 16.0 – 24 points = high priority

9.1.1 Hierarchy in creating transfer experience for passengers

<table>
<thead>
<tr>
<th>Design Group</th>
<th>Decor</th>
<th>Core functional support</th>
<th>Personal care</th>
<th>Ambiance</th>
<th>Core functional support</th>
<th>Personal care</th>
<th>Ambiance</th>
<th>Core functional support</th>
<th>Personal care</th>
<th>Ambiance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decor</td>
<td>5.20</td>
<td>6.17</td>
<td>6.30</td>
<td>7.22</td>
<td>8.05</td>
<td>10.30</td>
<td>11.13</td>
<td>11.30</td>
<td>12.30</td>
<td>14.61</td>
</tr>
<tr>
<td>Core functional support</td>
<td>5.22</td>
<td>6.17</td>
<td>6.30</td>
<td>7.22</td>
<td>8.05</td>
<td>10.30</td>
<td>11.13</td>
<td>11.30</td>
<td>12.30</td>
<td>14.61</td>
</tr>
<tr>
<td>Personal care</td>
<td>6.17</td>
<td>6.30</td>
<td>7.22</td>
<td>8.05</td>
<td>10.30</td>
<td>11.13</td>
<td>11.30</td>
<td>12.30</td>
<td>14.61</td>
<td>14.87</td>
</tr>
<tr>
<td>Ambiance</td>
<td>7.22</td>
<td>8.05</td>
<td>10.30</td>
<td>11.13</td>
<td>11.30</td>
<td>12.30</td>
<td>14.61</td>
<td>14.87</td>
<td>16.43</td>
<td>18.22</td>
</tr>
</tbody>
</table>

Figure 9-1 | Hierarchy in creating transfer experience for passengers at rail terminals

The hierarchy model shows six design aspects which can be regarded as high priority aspects for creating a positive transfer experience for passengers. These design aspects include: spatial logic (21,22), wayfinding (20,61), circulation (20,48), availability of space (18,22), state of maintenance (16,70) and compactness (16,43).
Many design aspects have a mean scoring between 8 and 16 points. They can be regarded as medium priority design aspects. Since the number of design aspects is large, the aspects are divided into two equally large groups. Group one (medium-high priority) is described by the aspects: ticketing systems (15,87), quality of light (14,87), seating (14,61), VIDS (14,26), PA system and acoustics (13,96) and branding (13,65). The second group entails availability of concessions (11,30), flooring (11,13), restrooms (10,43), architecture (10,30), quality of air (8,65). Low priority is rendered to design aspects: artworks (5,00), security environment (5,22), baggage facilities (8,17), outdoor/green elements (6,30), social interaction (6,39) and productivity (7,52).

### 9.1.2 Hierarchy in creating shopping experience for shoppers

| Design Group | Decor | Custom, Inform, supply | Core functional support | Personal care | Ambiance | Core functional support | Spatial layout | Personal care | Ambiance | Core functional support | Spatial layout | Personal care | Ambiance | Core functional support | Spatial layout | Personal care | Ambiance | Core functional support | Spatial layout | Personal care | Ambiance | Core functional support | Spatial layout | Personal care | Ambiance | Core functional support | Spatial layout | Personal care | Ambiance | Core functional support | Spatial layout |
|-------------|-------|------------------------|-------------------------|---------------|----------|-------------------------|---------------|---------------|----------|-------------------------|---------------|---------------|----------|-------------------------|---------------|---------------|----------|-------------------------|---------------|---------------|----------|-------------------------|---------------|---------------|----------|-------------------------|---------------|---------------|----------|-------------------------|---------------|---------------|----------|-------------------------|---------------|
| Design Aspect | | PA systems and acoustics | Outdoor green elements | Social interaction | Seating | Architecture | Quality of air | Productivity | VIDS | Restrooms | Ticketing systems | Compactness | Availability of Concessions | Conciliation | Quality of light | State of maintenance | Branding | Wayfinding | Spatial Logic |

**Figure 9-2** Hierarchy in creating shopper experience for passengers at rail terminals
The hierarchy of design aspects to create an attractive shopper environment clearly show different scorings. The high priority group of design aspects consists of four elements: spatial logic (19, 39), wayfinding (17, 61), branding (16, 65) and state of maintenance (16, 39). These design aspects are the first design aspect which will have to be integrated in the design process in order to create environment which attract shoppers.

The medium priority group is also divided into two groups. Group one, the medium-high priority group are design aspect that have means close to 16 points or are well above the mean of the medium priority group (12). The design aspects are: availability of space (15, 74), quality of light (15, 39), circulation (15, 13), availability of concessions, security environment (14, 57), compactness (14, 26), adaptability (13, 83) and ticketing systems (13, 35). The second group, the medium-low group contests of mainly personal care and decor design aspects: restrooms (11, 13), VIDS (11, 09), productivity (11, 04), quality of air (10, 83), flooring (10, 04), seating (9, 87), social interaction (9, 17) and baggage facilities (8, 39).

Low priority is rendered to only three design aspects. These aspects can be regarded as the final elements in achieving an optimal customer environment for shoppers: outdoor/green elements (7, 96), PA systems and acoustics (7, 17) and artworks.

Although both groups seem to have many similarities in scoring, several design aspects (e.g. circulation) seems to be valued different by the two expert panels. In order to give a clear overview of the discrepancies in scoring between the two expert groups, paragraph two introduces the Priority Matrix.

9.2 Priority matrix

The two priority list discussed in paragraph one can be compared by introducing a 3 x 3 matrix. Each expert panel will use one axis. The horizontal axis indicates the means scoring of the transport industry. Design aspects which should receive the highest priority are plotted on the far right of the matrix. On the vertical axis, the scoring means of the shopper experts are presented. Elements which can be found at the basis of the priority hierarchy discussed in paragraph one (the highest means) can be found at the top of the matrix. When we use the same 0-8-16-24 scale as in paragraph

Figure 9-3 | The 3x3 priority matrix
one, the following matrix can be drawn as shown in Figure 9-3. In this matrix six different types of design aspects can be defined.

**Field 1 Essential Design Aspect:** If a design aspect has a mean ranking of sixteen points or higher by both expert groups, it is considered to be a design aspect which is certainly a mutual priority in the design process. This design aspect will be referred to as an 'essential design aspect'.

**Field 2 Strategic Design Aspect:** If a design aspect has a mean ranking of sixteen points or higher by one expert group and a ranking of eight to sixteen from the other respondent group, both groups confirm its priority, though one respondent group does not consider it a high priority. This is a 'strategic design aspect' since this aspect can fulfill one group's specific needs while the other group is also appreciates the effort.

**Field 3 Common Design Aspect:** If a design aspect has a mean ranking between eight and sixteen points by both respondent groups, it is considered to be a design aspect which shares mutual medium priority in the design process. This design aspect will be referred to as a 'common design aspect'. Both confirm the consideration but do not rank it as a top priority.

**Field 4 Dominant Design Aspect:** If a design aspect has a mean ranking of sixteen points or higher by one of the groups and a ranking of one to eight from the other respondent group, one group values it as a high priority, though the other respondent group does not consider it a priority at all. This design aspect is referred to as a 'dominant design aspect'. This design aspect can cause discussions during the design process since respondent groups ranking show a great discrepancy.

**Field 5 Tactic Design Aspect:** This aspect is valued as a medium priority by only one group. After the negotiations about the most important design aspects, these tactic design aspects can enhance the service experience of one of the two customers at a rail terminal and are therefore useful further down the negotiation process.

**Field 6 Perfection Design Aspect:** If a design aspect is not considered as a high or medium priority by both respondent groups, the design aspect will be discussed at the end of the design process. It is clearly disregarded as a prescriptive design aspect for customer satisfaction. The design aspect will however enhance customer perception of the rail terminal when the other priorities are met.

Figure 9-4 shows the resulting 3x3 matrix with all the twenty-four design aspects. The experts who participated in the transfer group serve the passenger and their fictive case-company was named TCG. The shopping experts served shoppers and worked during the expert survey for ReRail inc. Table 9-1 shows an overview of the specific design aspects per matrix group and Figure 9-5 shows the priority matrix and the number of design aspects each field it represents.
Figure 9.4: The 3x3 priority matrix with twenty-four design aspects

<table>
<thead>
<tr>
<th>Field 1</th>
<th>Essential Design Aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Aspect 4</td>
<td>Spatial Logic</td>
</tr>
<tr>
<td>Design Aspect 6</td>
<td>Wayfinding</td>
</tr>
<tr>
<td>Design Aspect 14</td>
<td>State of maintenance</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field 2</th>
<th>Strategic Design Aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Aspect 11</td>
<td>Branding</td>
</tr>
<tr>
<td>Design Aspect 1</td>
<td>Compactness</td>
</tr>
<tr>
<td>Design Aspect 3</td>
<td>Availability of space</td>
</tr>
<tr>
<td>Design Aspect 2</td>
<td>Circulation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field 3</th>
<th>Common Design Aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Aspect 13</td>
<td>Quality of light</td>
</tr>
<tr>
<td>Design Aspect 9</td>
<td>Ticketing</td>
</tr>
<tr>
<td>Design Aspect 22</td>
<td>Availability Concessions</td>
</tr>
<tr>
<td>Design Aspect 5</td>
<td>Adaptability</td>
</tr>
<tr>
<td>Field 4</td>
<td>Dominant Design Aspects</td>
</tr>
<tr>
<td>---------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Design Aspect 7</td>
<td>VIDS</td>
</tr>
<tr>
<td>Design Aspect 21</td>
<td>Seating</td>
</tr>
<tr>
<td>Design Aspect 23</td>
<td>Restroom quality</td>
</tr>
<tr>
<td>Design Aspect 18</td>
<td>Flooring</td>
</tr>
<tr>
<td>Design Aspect 16</td>
<td>Architecture</td>
</tr>
<tr>
<td>Design Aspect 15</td>
<td>Air Quality</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field 5</th>
<th>Tactic Design Aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Aspect 8 (Relevant for group A)</td>
<td>PA system and acoustics</td>
</tr>
<tr>
<td>Design Aspect 12 (Relevant for group B)</td>
<td>Security Environment</td>
</tr>
<tr>
<td>Design Aspect 20 (Relevant for group B)</td>
<td>Productivity</td>
</tr>
<tr>
<td>Design Aspect 24 (Relevant for group B)</td>
<td>Social interaction</td>
</tr>
<tr>
<td>Design Aspect 10 (Relevant for group B)</td>
<td>Baggage facilities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field 6</th>
<th>Perfection Design Aspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Aspect 19</td>
<td>Outdoor/green elements</td>
</tr>
<tr>
<td>Design Aspect 17</td>
<td>Artworks</td>
</tr>
</tbody>
</table>

Table 9-1 | Design aspects per matrix group

**Priority Matrix**

![Priority Matrix](image)

Figure 9-5 | The 3x3 priority matrix, field representation
9.3 Statistical analysis of Conflicting design aspects

As mentioned in a NS 2005 study, one of the main reasons for a sub optimal rail terminal design are conflicting stakeholder interest. Large discrepancies in scoring can represent these conflicting interests and could indicate a serious threat to the design process and overall rail terminal quality. In order to advise the NS to achieve optimal rail terminal design quality, these potential conflicts should be detected.

A first comparison between the means of the design aspect scorings per respondent group indicates five large discrepancies. Here the means of aspect 2, 8, 12, 20, 21 and 22 differ more than 3.5 points between the two respondent groups. Table 9-2 shows the scorings of the six design aspects with the largest discrepancies in scoring and appendix 15 shows the discrepancies in scoring for each design aspect.

<table>
<thead>
<tr>
<th>Design Aspect</th>
<th>Mean A</th>
<th>Mean B</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Circulation</td>
<td>20.48</td>
<td>15.13</td>
<td>5.35</td>
</tr>
<tr>
<td>8 PA system and acoustics</td>
<td>13.96</td>
<td>7.17</td>
<td>6.79</td>
</tr>
<tr>
<td>12 Security environment</td>
<td>5.22</td>
<td>14.57</td>
<td>-9.35</td>
</tr>
<tr>
<td>20 Productivity</td>
<td>7.52</td>
<td>11.04</td>
<td>-3.52</td>
</tr>
<tr>
<td>21 Seating</td>
<td>14.61</td>
<td>9.87</td>
<td>4.74</td>
</tr>
<tr>
<td>22 Availability concessions</td>
<td>11.3</td>
<td>14.83</td>
<td>-3.53</td>
</tr>
</tbody>
</table>

Table 9-2 Scorings of the six design aspects with the largest discrepancies in scoring

To ascertain the significance of the discrepancies, we will perform t-tests as statistical analysis method. By performing these tests, this research can indicate with a better accuracy the real potential conflicting design aspects. The purpose of this series of tests is to ascertain if there is a significant difference in the equality of means. Appendix 16 shows the SPSS output of the t-tests. Below, table 9-3 shows the design aspects where difference in equality of means is not assumed.

<table>
<thead>
<tr>
<th>Design Aspect</th>
<th>Significance</th>
<th>95% confidence interval of the difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>2 Circulation</td>
<td>0.029</td>
<td>1.925</td>
</tr>
<tr>
<td>6 Wayfinding</td>
<td>0.002</td>
<td>0.313</td>
</tr>
<tr>
<td>8 PA system and acoustics</td>
<td>0.517</td>
<td>3.440</td>
</tr>
<tr>
<td>12 Security environment</td>
<td>0.000</td>
<td>-12.757</td>
</tr>
<tr>
<td>21 Seating</td>
<td>0.280</td>
<td>1.677</td>
</tr>
</tbody>
</table>

Table 9-3 Design aspects which show no proof of equality of means

The conflicting design aspects which are confirmed are: circulation, PA system and acoustics, security environment and seating. Design aspect Wayfinding also shows a difference a significant difference in equality of means. However since wayfinding is regarded as a essential design aspect, both groups value it as important, this design aspect will most probably will not cause potential conflicts in terminal design.
After having revealed the results of the data analysis, the answer to our research questions and practical recommendations can be given. First general conclusions are introduced and second practical implications regarding NPC's experience based Circle of Five<sup>®</sup> location scan will be discussed. The second chapter of this part concerns a discussion on this research findings and a personal evaluation.
Conclusions

10.1 General conclusions

10.1.1 List of design aspects

This research provides two detailed lists of design aspects which are essential in order to satisfy the demands of the two customers of future rail terminals: the passenger and the shopper. The two lists show a large number of similar design aspects (e.g. circulation and quality of light). However, they also provide a few important relevant design aspects required to fulfill a more specific need (e.g. branding). The lists can be combined to form the overall list and therefore the first research question can be answered. Below the list of twenty-four relevant design aspects:

<table>
<thead>
<tr>
<th>Compactness</th>
<th>Quality of Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circulation</td>
<td>State of Maintenance</td>
</tr>
<tr>
<td>Availability of space</td>
<td>Quality of Air</td>
</tr>
<tr>
<td>Spatial logic</td>
<td>Architecture</td>
</tr>
<tr>
<td>Adaptability</td>
<td>Artworks</td>
</tr>
<tr>
<td>Wayfinding</td>
<td>Flooring</td>
</tr>
<tr>
<td>Visual information distribution</td>
<td>Outdoor/green elements</td>
</tr>
<tr>
<td>PA system and background acoustics</td>
<td>Productivity</td>
</tr>
<tr>
<td>Ticketing systems</td>
<td>Seating</td>
</tr>
<tr>
<td>Baggage facilities</td>
<td>Availability concessions</td>
</tr>
<tr>
<td>Branding</td>
<td>Rest rooms</td>
</tr>
<tr>
<td>Security environment</td>
<td>Social interaction</td>
</tr>
</tbody>
</table>

Table 10-1 | The twenty-four design aspects

"Feel welcome and at ease, that is the core of a high quality railway station experience."

Evelien de Munck Mortier

NS Poort
10.1.2 Focus on design

To introduce a priority in the twenty-four design aspects, the list acquired by research question one was prioritised by two industry expert groups. This resulted in two prioritised lists of design aspects. These lists were transformed into two hierarchic lists based on Maslow’s theory: the bottom design aspects are the most essential in generating customer experience. Since rail terminals will have to serve both types of customers (passengers and shoppers) both list can be used to define a focus in the design process.

This research provides a Priority Matrix (paragraph 9.2) to define a list of most important design aspects which should be preferred during the design process. From this Priority Matrix, a step by step focus path can be derived. This will provide us with the focus needed to answer the second research question.

> Step one: Focus on Essential Design Aspects...

The Priority Matrix generated three essential design aspects: spatial logic, wayfinding and state of maintenance. These aspects can be considered as most important in creating customer experience at rail terminal and should be the leading design elements during the first hours of the design process. Spatial logic requires a simple layout, so customers can easily form a mental map. It requires sightlines and functional hierarchic elements in terminal design. Wayfinding should ensure the terminal customers that they arrive at the right place without too much effort. Clear, comprehensive and legible signing is crucial. The last design aspect is the state of maintenance. Terminal design should clearly show ownership. Durable high quality design elements and a low maintenance and an easy to maintain design should be the starting point of successful rail terminal design.

> Step two: Focus on Strategic Design Aspects...

To enhance passenger experience on a rail terminal three strategic design aspects (compactness, availability of space and circulation) should be chosen. Passengers value short walking lines since they usually perform under stressing situations. A compact rail terminal design therefore should provide direct access to the passengers main transfer elements. During the time spent at rail terminals, passengers also greatly value the availability of space. A crowded transfer space stresses passengers and reduces overview. Open spaces and wide transfer paths should thus be included in a successful terminal design. The last element to enhance the passenger experience at the rail terminal is by providing sufficient circulation. This means that level changes should be avoided as much as possible and in case of level changes, sufficient facilities should be available to ensure a smooth journey.

To enhance shopper experience on a rail terminal, one strategic design aspect is of importance: store branding. Shoppers are attracted to well known retail formulas and therefore, brands are vital to create an attractive environment for shoppers. Without a divers attractive retail offer with several anchor stores rail terminals will lose the interests of shoppers since nearby competing inner-city shopping centres are always available.

One striking conclusion is that no dominant design aspects were measured. Since NS research (2005) suggested that conflicting interests resulted in scattered contemporary rail terminal designs, we certainly expected to find several
dominant design aspects. However, this could be regarded as a positive point in the design process since large discrepancies between expert rankings could indicate a potential cause for conflict.

> Step three: Focus on Common Design Aspects...

Ten design aspects are valued as relatively important by both expert groups. They concern the following design aspects:

- The ambiance of the rail terminal (*quality of light, quality of air*),
- The ability of customers to spend time on activities related to personal care (*availability of concessions, seating facilities, restrooms quality*),
- The decor of the rail terminal (*flooring and architecture*)
- The ability of the terminal to adapt to customer desires (*adaptability*)
- The ability of deliver up to date visual information (*visual information display systems*)
- The ability to support core functions of the rail terminal by serving adequate ticketing systems (*ticketing systems*).

> Step four: Focus on Tactic Design Aspects

More passenger experience is further created by offering a well designed Public Addressing system and by adequate background acoustics (this is achieved by reducing reverberation). This design aspect enables the passenger to understand messages about rail operations and also enhances the possibilities to communicate.

More shopping experience is further created by introducing the design aspects *security environment, productivity, social interaction and baggage facilities*. Shopping centres provide a social function (hence the priority for a design which supports social interaction). An important condition (especially for elder people) is the presence of a safe environment. Baggage facilities should enable greater mobility to the shopper. Last productivity design aspects should also be considered (e.g. car rental services).

> Step five: Focus on Perfection Design Aspects...

*Green elements* (fountains, trees and indoor parks) and *artworks* are the last two design elements which are introduced to the terminal design to create customer value. The low priority of these design aspects does not mean that terminal customer not value them, they just form the top of the hierarchies of both expert groups in achieving optimal customer experience.

> But stay alert, discrepancies in scorings

Relatively large discrepancies where measured at six design aspects: *circulation, PA system and acoustics, security environment, seating facilities, productivity and availability of concessions*. Statistical analysis (Appendix 15) however could only confirm significant relevant discrepancies in the scoring of the first four aspects. These design aspects should be closely monitored since they can create discussions about design preference.
Further, many design aspects are centred near the diagonal axis and 10 of the 24 design aspects are located in the common design aspect field. This could indicate that the research method used to ascertain the priorities of industry experts (by calculating the mean value) has its practical limitations.

10.2 Practical implications

The results from this research can be used by the NS to enhance the quality of rail terminal designs. This study uses NPC's Circle of Five, an experienced based model and tool, as a starting point to discover how the results of this research can lead to practical gains.

10.2.1 The Circle of Five®

The Circle of Five® is an experience based model that represents NPC's vision on location development. The model is founded on the notion that location development issues should be approached integrally by combining various disciplines. In analogy with the model used in the food industry, five main constructs have been determined that should be included in the development process to come to a 'healthy' location. These five main aspects are Asset Management, Mobility and Logistics, Safety & Security, Design, and Exploitation. They are combined in the Circle of Five® that instantly shows their interdependence (Figure 10-1) (van 't Hof 2008).

From this model, an instrument was constructed to analyse healthy locations (e.g. rail terminals) or to improve existing locations. This 'Location Scan' is used to judge a location on the five constructs by weighing and scoring the location on 15 predictors for each construct, resulting in weighed scores on 75 predictors in total (See Appendix 17: 75 NPC Circle of Five predictors). The weighted scores are generated as follows:

- Interviews with the client generate a weighting of a predictor. The higher the score, the more important the predictor (See ‘relevance’ figure 10-2) and the darker the colour of the predictor (figure 10-3)
- Independent scoring for the elements by NPC certified consultants. This results in the size of the predictor in the performance projection. The maximum score is 5 which means a well designed predictor in the design. (See ‘Score’ figure 10-2). A high score is visualised in figure 10-3 by the length of the predictor.
The Circle of Five® has proven itself to be a useful instrument in location development, and various Location Scans have already been carried out successfully. This suggests that the instrument contains the important elements and useful predictors to judge a location’s condition. However, the predictors are experience based and need a scientific underpinning with which they can be validated. Results from this study can help NPC’s Circle of Five® in two ways:

1. Verification of predictors (which were ascertained from an experience based approach) and make recommendations for new relevant predictors.

2. Make recommendations about the importance of the predictors for the two specific client wishes:
   - If a client wants to check the terminal design of commercial functionality (and attractiveness), this research can indicate specific predictors which should be considered as very important design aspects (dark colour).
   - If a client wants to check the terminal design on transfer functionality (and attractiveness), this research can indicate specific predictors which should be considered as very important design aspects (dark colour).

10.2.2 Verification of predictors which are ascertained from an experience based approach.

The comparison between the 24 customer design aspects, acquired in chapter 7 and the 75 predictors have resulted in the verification of 27 predictors. This number is greater than 24, since several design aspects can be described by more than one predictor. Regarding the construct ‘Design’ almost all predictors are verified. This means that the extensive literature research on successful service environments found similar aspects. The only construct which has not been verified is ‘Spatial embedding’. This is not a surprise since it concerns itself about the spatial embedding of the terminal in its surroundings. This was not considered in this research since chapter 2 clearly defines the scope of the rail terminal. Appendix 18 shows the validation 27 of the 75 predictors,

Seven predictors of the construct ‘Exploitation’ are verified. Important to mention is that this research produced five design aspects which could fall under predictor ‘Facilities level’. This is lacks profundity and this research advises on considering a more in-detail approach to this predictor since all of the related design aspects are important to the
terminals customer and many of the related design aspects are ranked as a preferred design aspect in the design process by both respondent groups. This research also verifies two predictors of construct Safety and four of Mobility & Logistics. None of the Asset management elements were verified at all. One of the main causes could be found in the fact that many of the three constructs above concern other stakeholders of the service environment than customers.

Four design aspects are not considered in NPC's circle of five. Two of them should according to this research be preferred in creating positive customer experiences: visual information display systems and flooring. Both design aspects can have a great impact on the perception of the customer at a service environment. A marble floor for instance gives a different perception of the quality of the terminal than an anonymous square 30 by 30 cm. tiled floor which shows little evidence of ownership. Visual information display systems provide the customer of relevant and up to date information about the activities at and near the service environment. Service environments provide a service, and its ability to communicate with customers about these services is essential. It can for instance reduce customer stress. This research thus opts for an integration of these two elements in the Circle of Five©.

The design aspects 'Artworks' and 'Green elements' are also not considered in NPC's circle of Five©. Although this research indicates them as important creators of a positive customer experience, professionals of both shopping and transport industry do not view them as high priorities in creating customer experience. This can be argued since green elements (plants, parks and fountains) are memorisable aspects which can play a large role in the perception of the customer of a service environment. Art is a highly effective point of reference. Every station, airport or shopping mall uses art, often as a point of reference. This value of these functions should not be neglected and these two design aspects should be included in one of the 75 predictors.

10.2.3 Relevance of the predictors

In the NPC's circle of Five©, three degrees of relevance can be chosen to indicate the relevance of the predictor (0, 1 or 2 points). This scale can be compared with the ranking scale used in the first step of the expert survey (0, +, ++). By linking the verified predictors with the scorings of the two respondent groups, we can generate a function specific weighted list of the predictors. Appendix 18 shows this list. Since each service environment has its specific accents (more commerce, more transfer), the ranking can be used to differentiate and thus specify the ranking of relevance of NPC's Circle of Five©.
Discussion & Personal reflection

The current study shines a light on the design aspects which will have to be prioritised in the design process of a rail terminal and partly fill up the gap of knowledge in this field. The multidimensional approach through inclusion of both passenger and shopper preferences of a service environment extends the insights complex design challenge faced by stakeholders in the rail terminal design process. Moreover, this study suggests several practical implications for the NS and verified many predictors of NPC’s Circle of Five location scan. The results of this study can be used in several relevant discussions that are currently taking place in the Dutch railway sector. We will address these discussions first (§ 11.1). Secondly, this chapter provides a short personal reflection which describes my personal development during my time as an intern at NPC.

11.1 Discussion

Three topics will briefly be discussed: The concession in 2015, the introduction of OVCP and the development of the NS Wereldstations.

In 2015 the Ministry of V&W wants to tender the main rail network in one large concession. Currently, NS has the right till 2015. The 2015 concession is not certain yet but if the Ministry of V&W proceeds, the NS can expect tough competition from several large international railway companies such as the German Deutsche Bahn and the French SNCF. These competitors operate on a much larger scale and a head on competition with these European giants will likely end in a loss of the concession by the NS. Yet, while the concession may be lost, the NS could continue its
operations as a leading railway station developer and owner. Like the BAA and Schiphol (which operate several airports), the NS could become a hub developing organization. Focus on the acquisition of knowledge on hub development, and especially rail terminal development will therefore become essential. This research has generated a small amount of knowledge on the design aspects of successful rail terminals and is hopefully a starting point for more research.

Another major rail sector shake-up is the introduction of the OVCP system (the digital ticketing systems in Dutch public transport). Although this systems as it's clear advances (possible positive impact on design aspects ticketing systems and security environment), some practical disadvantages can be noticed. These disadvantages mainly concern spatial logic, circulation and availability of concessions. Spatial logic can be reduced since OVCP systems have its limitations in application. For instance, they require a considerable amount of space a can therefore be deployed at a less logic location. The OVCP systems require a gated rail terminal. This means that gates will be posted at all exits and entrances of rail terminals. Especially during rush hours this could lead to a limitation in processing capacity and thus in de decrease of circulation. This can cause considerable amounts of stress and discomfort at passengers. Finally, OVCP systems could cause a decrease in retail turnover. Since rail terminals will have strict closed OVCP systems, a rail terminal customer will be limited in its movements. Once a passenger has checked-in for a journey, it is not clear if passengers can return to the terminal to purchase a service. This research suggests that before the system is applied, research on the impact of the introduction of OVCP on the three design aspects is conducted. This research supports the ambitions of the NS to develop more airport like rail terminals which provide numerous new retail offerings for rail terminal customers. As the research problem definition already suggested, the final vision has already been defined. The steps to get there show a more vague perspective. The trial and error case of Leiden Centraal will generate valuable insight but in order to design rail terminals of the future, the NS should learn from other industries where valuable experience has already been collected. This research used the expertise of the retail and airport industry. However, the entertainment industry (e.g. Walt Disney) could provide valuable insights in reducing the perception of waiting time and the hotel industry can be consulted for its experience on providing customer comfort.

11.2 Personal reflection

The kick-off document of this research, the research proposal, presented three specific competences I wanted to develop while writing my thesis. I will discuss the way I tried to develop these competences and the final result of these efforts. In my research proposal I also mentioned two specific risks which I viewed as a potential causes for problems during in the research process. I can now conclude that these risks were fairly justified, and I will make some comments on the way I have tried to cope with these risks.

11.2.1 Personal competences

During my final thesis period I wanted to develop three distinct competences. This would benefit my qualities to perform as a young professional. The three competences suggested in my research proposal were:
- Develop more knowledge about semi-public spaces in general, and complex infrastructural locations in special
- Develop the ability to perform individual academic research
- Develop the capability to present my personal argumentation in a more structured and effective way

As a full subsidiary of the NS, NPC's expertise concerns consultancy on semi-public spaces. The opportunity to write my final thesis and the head office of NPC, gave me an opportunity to absorb a vast amount of knowledge on rail terminal development. I got the change to get an inside scoop of many interesting projects such as a tender in Stockholm, a large consultancy and implementation project in South Africa, a location scan of an hospital and I got to see details of NS Wereldstation Breda.

The second competence I wanted to develop was the ability to conduct individual academic research. Striking now is the term 'individual'. After finishing this thesis I can now say that my research really took off after consulting other students and sharing my thought with many people. This research is the result of efforts of many people and I think that my initial individual attitude did not benefit the research process.

At the start of this research process I wanted to increase my capacities to present my argumentation in a more structured way. I think that the main aspect of this problem was my lack of direction in research approach. The first month I was quite intimidated by NPC professionals, since every consultant had an opinion on my research and tried to suggest a different course. I must say I encountered quite some difficulties in structuring my own research approach but with the continuous support of my NPC mentors a final course has eventually been set.

11.2.2 Risks

Knowledge of your personal weaknesses is important in order to develop capabilities to overcome them. At the start of my research project I indicated two specific distinct risks: 'lack of focus' and 'lack in communication'. Both had a significant impact on my research.

I think creativity is one of my most positive and most valuable competences. I love to combine elements and create new approached to a solution. Lucky to have this, there is however a catch. Creativity often requires chaos: a non structured approach to conducting business. Chaos is not a good feature when one has to focus. When I started at NPC, this quickly resulted in an overload of non structured, hardly related information. The world I entered was too interesting. On macro level national studies about governmental policy, on meso level NS studies on rail terminals, IATA reports on airport terminals and on micro level data on customer perception and processing of environmental stimuli: everything was interesting. After a few months however, I forced myself to set a course, regardless of the topic (everything was interesting enough). During the past nine months I often thought about other interesting studies which could be conducted at NPC. "If I could... ", often crossed my mind.

My suggestion in the research proposal that I could have a problem in communicating with peers and superiors was quite justified. In the beginning of the research period I didn't set a clear course. Since I had no particular piece of relevant generated information and thus I was very scarce in sharing information with my mentors and fellow students. This changed after I got into contact with Koen van 't Hof. He also wrote a final thesis and gradually we started sharing information and started to discuss different topics of our research. We even did some on-site research
at two HiSpeed Business lounges. Discussing about my research helped me in setting a research course and from that point I decided to be more open to my mentors and fellow CME students. If I had an appointment with my mentors I didn’t have to give a presentation about the progress (which is one-way communication), I had to discuss my steps and present my pressing thoughts.

I can certainly say that I have learnt a lot during the 11 months at NPC. The road was long, and sometimes very hard. But it gave me a chance to get to know one of the largest of the Netherlands and I got in contact with some remarkable colleagues. I am confident that NS will pursue its goal to develop better rail terminals and that rail terminals will become a better place for passengers and shoppers. It’s just a matter of time.
Sources of information
Sources of information

Literature


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Interviews

Interviews with professionals for inspiration, advice and relevant in dept knowledge

Interviews for orientation

Marcel van Galen (NPC)
Tijp Sietasma (NPC)
Alex de Ruijter (NSPoort)
Wout Ritzema (NPC)
Wout van der Heijden (NPC)
Bert van Eekelen (PRC)
Hans Kleine (TU/e)

Commerce
Suzanne Steenbergen (NSPoort)
Earde Yepma (NSPoort)
Arjan Hagendoorn (NPC)

Transfer
Jorien Maltha (ProRail)

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