The Maasvlakte 2 Cost Benefit Analysis terrain demand forecasts

An in medias res evaluation

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# Chapter 1; Introduction

## Introduction

Ports are considered crucial drivers of urban, regional and even national economic development. Their development and operations are closely monitored and evaluated by governments as well as private parties. This naturally extends to major port infrastructure projects like the construction of Maasvlakte 2. Per September 2008 the construction of Maasvlakte 2 has been steadily advancing and in May 2013 the land reclamation was officially opened. A large portion of the terrain has already been claimed by the three container terminal operators Rotterdam World Gateway, APM terminals and ECT, who will establish three new state of the art container terminals. Currently the Port of Rotterdam is in the last phase of a long process of land reclamation which, a 900 million Euro damages claim notwithstanding, seems to go seamlessly. This process, however, started almost two decades ago. Since its conception in the early 90s the Maasvlakte 2 has gone through years of planning, discussion, evaluations and eventually building. The groups that had a say in the process range from local businessmen to the national government. The ‘Planologische Kernbeslissing’, a procedure required by Dutch law for large infrastructure projects, was pivotal for securing governmental support for the project. At the base of this procedure stood the 2001 cost benefit analysis conducted by Netherlands Bureau for Economic Policy Analysis and the Netherlands Economics Institute (NEI). This document predicted a terrain shortage for the Port of Rotterdam and the costs connected to such a shortage as well as the costs and benefits of land reclamation. Even though the prognosis of the port authority’s operating results was bleak the projected societal gains were clear and significant.

About twenty years after the Maasvlakte 2 project was first conceived, it seems like a good time to look back and evaluate. Many things have changed in said 20 years; political climate shifts, changing competitive positions of ports, technological advances and an economic crisis occurred. This thesis will explore to what extent the predictions made in the Cost Benefit Analysis, 12 years ago, came true.

## Scientific relevance

In scientific literature a lot has been written on the subject of cost benefit analyses, be it *ex ante, in medias res* or *ex post* evaluations. Some examples are articles by de Rus & Inglada (1997) and de Rus & Nombela (2007) which evaluate high speed rail projects in a Cost Benefit Analysis context. Similarly Willis et al. (1998) and Forslund & Johansson (1995) discuss road construction projects.

There appears to be a distinct lack of scientific literature coverage on port infrastructure projects and their respective cost benefit analyses. This thesis will try to provide a framework by which to evaluate such a cost benefit analysis with the limited data available when the evaluation takes place before the project is finished.

## Practical relevance

With a 900 million Euro claim still at the feet of the Rotterdam Port Authority the relevance of an evaluation of a pivotal factor in the decision making process is obvious. At a total cost of 2.9 billion euros it is important that the highest standard of preparation is adhered. Any conclusions concerning the methods used to predict important variables can be applied to future cost benefit analyses for port infrastructure expansion.

The Ministry of Finance (2006) published guidelines on the evaluation of public or partially public projects. The approach for *ex post* evaluations emphasises the determination of the effectiveness and the efficiency of a project. Effectiveness being the extent to which goals are reached and efficiency the extent to which the least resources are used to the greatest effect. This thesis, while not a direct evaluation of efficiency, since there are no relevant data yet, provides preliminary information towards the efficiency evaluation. The information on how well the initial predictions, which were then acted upon, were made can later be used to assess the efficiency of the committed resources.

## Research question and methodology

The main question to be answered in this thesis is the following.

* To what extent did the Maasvlakte 2 cost benefit analysis correctly predict the terrain demand for the Port of Rotterdam and how can the observed deviations be explained?

To answer the main research question these three sub questions will first be answered.

* Which studies were at the base of the cost benefit analysis predictions and what were their results?
* What are the current values of the predicted figures and how do they compare?
* What is the likely cause of the deviations between predicted and historic values and is there room for improvement in the prediction process?

The predicted demand for terrain presented in the cost benefit analysis was compiled from various studies and forecasts. The goal of this thesis is twofold. Firstly, to sketch the extent to which the predictions have come to pass so far. Secondly, to evaluate the prediction process by means of current knowledge in those cases where there is a significant deviation from the predicted results. To achieve these goals a three step approach will be used, gradually narrowing the analysis from the entire terrain demand prediction section of the cost benefit analysis to a select few variables that can be analysed.

In chapter three the studies that were the base for the Cost Benefit Analysis (CBA) predictions and the way they contributed to the predicted terrain demand figures will be analysed, forming a foundation for the rest of the thesis.

The fourth chapter will contain a side by side comparison of the available historic variables and the predicted variables. When a discrepancy between the two is observed it will be analysed in a qualitative framework.

# Chapter 2; Literature review

In the sections below, the scientific literature relevant to this thesis will be examined. First a general introduction to Cost Benefit Analysis will be provided, followed by several models for predicting economic or industry variables. Lastly some articles on entry barriers and the importance of intra port competition are presented.

## 2.1 Cost benefit analysis

This section has a short introduction to the history, basics, users, structure and relevance of Cost Benefit Analysis. In the end a few applications of CBA for large infrastructure projects in the scientific literature are discussed.

The concept of Cost Benefit Analysis dates back to 1848, when Jules Dupuit first described it. It was later shaped into a formal theory by Alfred Marshall. It wasn’t until 1936, when the US government made it obligatory to conduct a CBA to test the viability of public waterway infrastructure projects, that it gained momentum as a tool to evaluate public policy decisions. Cost Benefit Analysis has come a long way since then and is now obligatory for, or at least involved in, the decision making process of large public infrastructure projects in many countries.

Boardman et al. (2006) summarise CBA as follows: “CBA is a policy assessment method that quantifies in monetary terms the value of all consequences of a policy to all members of society.”   
A Cost Benefit Analysis can be reduced to the following formula, NB = B – C, stating that benefits minus costs equals net benefits which is an indicator of the economic feasibility of a project. For a social Cost Benefit Analysis the formula becomes NSB = SB – SC. In a social Cost Benefit Analysis the monetary and non-monetary costs and benefits for all members of society are included. Cost Benefit Analyses can be performed in an *ex ante*, *in medias res* or *ex post* setting. Since this thesis concerns the CBA for Maasvlakte 2 any subsequent use of CBA or Cost Benefit Analysis refers to an *ex ante* Social Cost Benefit analysis unless explicitly stated otherwise.

The users of a CBA are often governments that need to decide whether a public policy or project, affecting a large number of citizens in different ways, is worth pursuing. In the Netherlands the preparation of a CBA is obligatory for any large public infrastructure project as per the ‘OEI leidraad’. The makers of a CBA are usually large national economic research institutes or consultancy firms. In case of a large project, preparing a CBA requires considerable resources and expertise.

The basic structure of a CBA can seem simple enough, estimate costs and benefits, potentially for several scenarios to expand the range, and subtract the one from the other. The complexity of CBA arises from the choices and estimations that have to be made. The people creating the CBA have to decide whose costs and benefits will be considered, which can range from the inhabitants of a single town to the global population. Next they have to decide which specific costs and benefits to include in the analysis. Then the following figures, as listed by Cellini and Kee (2010), have to be estimated and in some cases monetised.

* The costs involved, both direct and social
* The benefits involved, both direct and social
* The way the costs and benefits are spread over the timeframe of the analysis
* The proper discount rate for future costs and benefits

Once all the choices are made and the variables are estimated the maker can calculate the net benefit of a project. To create a wider perspective the net benefit can be calculated for various scenarios or subjected to sensitivity analysis.

The (normative) relevance pertains to the extent to which CBA is an appropriate technique to measure changes in welfare. When a large public project is considered there will be winners and losers and thus people that consider it unfair. Two traditional measures of fairness are Pareto efficiency, which is impractical since it does not accept even a single loser, and the Kaldor-Hicks criterion. The Kaldor-Hicks criterion poses that a project is socially justified when the societal gains exceed the societal losses in a way that the winners could compensate the losers, regardless of whether this actually happens (Persky, 2001). Adler and Posner (2000) claim that while a CBA does not satisfy either the Pareto efficiency or Kaldor-Hicks criteria this does not harm its normative relevance. Instead they pose that CBA can measure a level of *overall well-being* to derive its relevance from.

De Rus & Inglada (1997) conducted an ex-post Cost Benefit Analysis for the high speed rail track that was constructed in Spain in 1987. They concluded that the introduction of a high speed train, henceforth HST, was not economically justified at the time and advise to seriously evaluate upcoming expansions of the high speed rail network. The effects of new roads are considered by Willis et al. (1998), who provide a way to include environmental external effects in monetary terms in the CBA model the English government uses. They conclude, based on a few examples, that roads are built which are not, from a social cost benefit point of view, the best options.

Articles similar to the ones above that relate to port infrastructure projects are largely unavailable. One exception is the article by Kuipers & Jonkhoff (2011), who conducted an ex post analysis of the Maasvlakte 1 project and linked it to the Maasvlakte 2 by an examination of their respective residual values. They approached the material by first setting it in a historical perspective, examining the political and economic forces at work at the time. After this the individual sources of costs and benefits were listed an in the case of the residual value recalculated to form a benefits minus costs figure. This figure was translated to an internal rate of return to establish the efficiency of the project.

In conclusion of their article Kuipers and Jonkhoff emphasise the critical importance of timing in the case of large port investments. For Maasvlakte 1 a more phased development might have lowered costs and avoided decades of low occupation, increasing the efficiency. This result emphasises the need for accurate predictions of terrain demand in ports.

## 2.2 Economic forecasting methods

Generally speaking there are two ways of forecasting economic variables. Firstly qualitative forecasting which is based on subjective judgements made by experts and usually employed when there is insufficient data. Secondly there is quantitative forecasting, which is based on the analysis of historical data. Below a few of the techniques in either class are discussed.

The Delphi method as a forecasting tool is qualitative in nature and was developed in the 50s. Multiple experts are usually involved in a Delphi process, which is a method to elicit expert knowledge on a subject. It consists of several rounds of questionnaires alternated by feedback rounds where statistical aggregates of the answers provided by the panellists are relayed back to them. These aggregates are accompanied by anonymous arguments as to why panellists thought what the outcome should be. The anonymous and cyclical nature of the procedure assures that arguments and predictions are only judged on merit and not on the status of the respective experts or the views of the majority. (Stewart, 1987)

Rowe and Wright (1999) argue in their paper, which is a review of 27 studies into the effectiveness of the Delphi method, that while Delphi is clearly superior to an unstructured approach, in terms of accuracy of predictions, there is no evidence of clear advantages over alternative structured approaches.

Regression analysis aims to capture the relationship between a dependant variable and (multiple) independent variables. Seabrooke et al. (2003) use a multiple regression model to forecast the cargo throughput of the Port of Hong Kong. In their article they first analyse which factors are relevant to the development of cargo throughput and then create their regression based on this knowledge. Their model consists of 43 equations based on 11 independent and 27 dependant variables. Especially the regressions related to the overall movement of goods are successful resulting in significant T statistics for all the variables at a 5% significance level. The regressions dealing with only inward or outward cargo flows for specific goods are slightly less successful with the outward cargo flow regressions performing the worst.

In their article Peng & Chu (2009) evaluate and compare 6 univariate[[1]](#footnote-1) models for making short term forecasts with seasonal variations. They test the classical decomposition, trigonometric regression, regression with seasonal dummy variables, grey forecast, hybrid grey and seasonal autoregressive integrated moving-average (SARIMA) models with monthly data from three major Taiwan ports. By comparing the predicted data with historical data they conclude that the relatively simple classical decomposition model provides the most accurate short term forecasts.

## 2.3 Entry barriers and intra port competition

In their article De Langen & Pallis (2007) discuss entry barriers in ports and their significance. They distinguish between economic, regulatory or institutional and locational (geographic) entry barriers. Locational or geographic entry barriers are relevant to the Port of Rotterdam since, for a long time, there was no land available for large scale expansion of the container sector. In their conclusion they advocate an active policy, by port authorities, to diminish entry barriers.

The absence of entry barriers is important for healthy intra port competition. In another article De Langen & Pallis (2006) describe the positive effects of, the potential barriers against and the strategies to improve intra port completion. According to Baptista (2000) intra port competition fosters specialisation, innovation and diversity in a port.

# Chapter 3; Data and background

## 3.1 Research framework

This part of the thesis will analyse the studies that were used as a base for the predictions made in the cost benefit analysis. By breaking down the analysis into answering multiple sub questions a clear and comparable image will be formed. These questions will be, where possible, answered for each of the sectors.

Who conducted the study?   
I will look at the person or institute that conducted the study and his, her or its scientific credibility, related previous work and expertise in the relevant field.

What was being researched?  
This section will provide a breakdown of the goal of the study and the extent to which this goal is in line with the way it was used in the cost benefit analysis.

Which conditions was the study based on?  
Here any relevant or unusual premises that the study was based on will be presented.

Which methods were being used?  
This part will outline the methodology of the studies.

What were the results?  
In this section a summary of the results will be presented.

(How) were the results transformed to fit the CBA?  
This will be a brief examination whether the results were interpreted differently in the CBA than in the original study. When available, the reasoning behind this discrepancy will be given.

## 3.2 Three scenarios

The Netherlands Bureau for Economic Policy Analysis, henceforth CPB, is a mostly governmentally financed economic policy research institute that was founded in 1945. Its main purpose is to provide scientifically based knowledge and insights that can be used by the government to assess public or economic policy. It publishes, among many others, four yearly documents that contain economic and social estimates on various scales. Another recurring publication, which is made roughly twice per decade, provides a multiple scenario based set of predictions for social and economic indicators and variables. The 1996 long term scenarios document (Centraal Planbureau, 1996) is part of the foundation of the cost benefit analysis.

For the 1996 document three distinct socioeconomic scenarios were developed. Ranking from best to worst case scenario they were called Global Competition, European Coordination and Divided Europe. The meta characteristics per scenario are discussed briefly below.

Global Competition, henceforth GC, sketches a situation with intensive European as well as global competition. It is also marked by high international transferability of knowledge and an internal focus on knowledge and education. Because of the strong emphasis on a knowledge economy the tertiary sector grows faster than the industrial sector.

European Coordination, henceforth EC, considers an increasing European integration while the world becomes more and more divided in large economic blocks. Less emphasis on global specialisation and knowledge transference result in a lower GDP growth than in the GC scenario. The manufacturing sector is expected to grow more rapidly than in the last 20 years while the tertiary sector will not grow as fast.

In Divided Europe, henceforth DE, a failing European market as well as failing political integration damages its global competitive position. With an enduring high unemployment this scenario predicts the smallest GDP growth for The Netherlands.

Table 3.1 shows the predicted GDP growth figures per scenario as well as the historic values. Over the period 1996-2010 and 2000-2010 the average GDP growths were respectively 2.25% and 2.90%. The other variables that were estimated in the long term scenarios document can be found on the CPB website[[2]](#footnote-2).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 3.1 | GC | EC | DE | Historic\* |
| 1996 | 3.30% | 2.80% | 1.70% | 3.40% |
| 1997 | 3.30% | 2.80% | 1.70% | 4.30% |
| 1998 | 3.30% | 2.80% | 1.70% | 3.90% |
| 1999 | 3.30% | 2.80% | 1.70% | 4.70% |
| 2000 | 3.30% | 2.80% | 1.70% | 3.90% |
| 2001 | 3.30% | 2.80% | 1.70% | 1.90% |
| 2002 | 3.30% | 2.80% | 1.70% | 0.10% |
| 2003 | 3.30% | 2.80% | 1.70% | 0.30% |
| 2004 | 3.30% | 2.80% | 1.70% | 2.20% |
| 2005 | 3.30% | 2.80% | 1.70% | 2.00% |
| 2006 | 3.30% | 2.80% | 1.70% | 3.40% |
| 2007 | 3.30% | 2.80% | 1.70% | 3.90% |
| 2008 | 3.30% | 2.80% | 1.70% | 1.80% |
| 2009 | 3.30% | 2.80% | 1.70% | -3.70% |
| 2010 | 3.30% | 2.80% | 1.70% | 1.60% |
| 2011 | 3.30% | 2.50% | 1.30% | 1.00% |
| 2012 | 3.30% | 2.50% | 1.30% |  |
| 2013 | 3.30% | 2.50% | 1.30% |  |
| 2014 | 3.30% | 2.50% | 1.30% |  |
| 2015 | 3.30% | 2.50% | 1.30% |  |
| 2016 | 3.30% | 2.50% | 1.30% |  |
| 2017 | 3.30% | 2.50% | 1.30% |  |
| 2018 | 3.30% | 2.50% | 1.30% |  |
| 2019 | 3.30% | 2.50% | 1.30% |  |
| 2020 | 3.30% | 2.50% | 1.30% |  |

\* Source: Statistics Netherlands

## 3.3 Results

The final additional terrain demand figures that were estimated in the cost benefit analysis are listed in the table below per scenario for the period 2000-2020 (CPB, NEI & RIVM, 2001, p. 98). The way these values were estimated will be explored in the rest of this chapter.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 3.2 | Global Competition | European Coordination | Divided Europe |
| Container terminals | 302 | 207 | 87 |
| Roll-on/roll-off | 25 | 25 | 15 |
| Remaining general cargo | 0 | -5 | -25 |
| Distribution | 130 | 90 | 40 |
| Empty depots | 50 | 35 | 20 |
| Chemical industry | 205 | 168 | 79 |
| Oil industry | -15 | -15 | -15 |
| Throughput liquid bulk | 64 | 4 | -51 |
| Remaining industry | 103 | 115 | 43 |
| Dry mass goods | 101 | 98 | 34 |
| Other activities | 113 | 94 | 75 |
| Total | 1088 | 816 | 302 |

In hectares

## 3.4 General structure

For most sectors the terrain demand is predicted by the same method although with different sources and studies. At the base are predictions of economic figures such as GDP, the state of the world economy and growth of various relevant industrial sectors. With these figures predictions are made for the size and future path of the sector which are then, via market share analysis, translated to figures for the Port of Rotterdam. Lastly the Port of Rotterdam sector figures are translated to potential terrain demand and adjusted for the estimated increase in spatial productivity.

In some cases the three different scenarios are treated separately from the start of this procedure. For other sectors only the final figure is adjusted per scenario or three paths are followed from one of the intermediate points.

The figure below shows, per step of the process, the main study or document used, the analysis taking place and the results of that step. While not all the separate sections follow this exact path it is the backbone of the prediction process.

Figure 3.1

## 3.5 Chemical sector

The main source for the predictions in the cost benefit analysis is a study by Arthur D. Little (1999) International Inc., henceforth ADL. ADL is well suited to conduct a sector study on the chemical industry since a majority of their employees come from a chemical background and consultancy for chemical firms is a large part of their business. They have conducted similar studies before and after the 1999 one.

The goal of the sector study was to predict the potential terrain requirement of the chemical sector in the Netherlands from 2000 to 2020. For the cost benefit analysis a potential demand figure had to be made for the port of Rotterdam in particular. While this wasn’t an official goal of the 1999 study, ADL did provide a prediction of the market share for the port of Rotterdam. The figure that was used in the cost benefit analysis is based directly on a combination of the total chemical industry terrain demand for the Netherlands and the projected market share of the port of Rotterdam.

The following assumptions were made as a base for the study.

* The share of the chemical industry of the Netherlands in the West European market will stay constant while the spatial productivity will grow by 25% from 2000 to 2020.
* The predicted demand for terrain does not account for buffer zones that usually surround chemical factories and thus represents an absolute minimal figure for terrain demand.
* The predicted demand of terrain is based on a 100% mark-up over actual factory terrain demand.
* While environmental and safety regulations regarding buffer zones have been considered in the analysis, terrain demand for strategic reasons has not.

The study consists of two steps. Step one provides a selection of chemical clusters that are relevant to the Netherlands, starting out with a large list of possible clusters and narrowing it down by the process of elimination. The second step is an analysis of the potential demand for terrain generated by the aforementioned clusters. The demand for terrain in the Port of Rotterdam is derived from an estimate of its competitiveness. ADL did not use a multiple scenarios approach and as a result only provided two figures, a minimum and a maximum demand for terrain in the Netherlands, depending on the area that is required as a buffer zone surrounding a chemical facility. While not disclosing any GDP figures, the chemical production growth figures ADL used match those of the European Coordination scenario as predicted by the CPB and so the final value was connected to that scenario. The various steps are shown in table 3.3.

|  |  |
| --- | --- |
| Table 3.3 | Estimated for period 1999-2020 |
| Total Dutch plot terrain demand | 238 hectares |
| Rotterdam market share | 43% |
| Rotterdam plot terrain demand | 102 hectares |
| Site-plot factor | 1.5 |
| Rotterdam site terrain demand | 153 hectares |
| Rotterdam site terrain demand incl. int. Reserves | 175 hectares |
|  | **Adjusted for 2000-2020** |
| Rotterdam site terrain demand incl. int. Reserves | 168 hectares |
| As above adjusted for DE scenario\* | 79 |
| As above adjusted for GC scenario\* | 205 |

\*These figures were not estimated by ADL. They were derived from the ADL figure and are scaled up- and downwards relative to GDP figures for the three scenarios.

The results of the ADL study were taken over completely and the results of a 1996 study by Chem Systems were wholly discarded. ADL did not provide estimates for the Divided Europe and Global Competition scenario. Those were estimated by the people preparing the cost benefit analysis by scaling the ADL figure relative to the GDP figures from the scenarios.

## 3.6 Oil industry

Studies by ETIN (1999) and GHR (1998a), which was the Rotterdam Port Authority at the time, were mentioned in the CBA section predicting the terrain demand changes for the oil industry. ETIN was declared bankrupt in 2010 and apparently specialised in consultancy and providing financial services. There is no indication of their expertise in the relevant field. The Rotterdam Port Authority refused to disclose the GHR study for the purpose of this thesis.

The ETIN study explored the oil and refinement industry on a European scale to provide data for use in the cost benefit analysis. One of the many goals of the GHR document was to map the developments in the oil and refinement industry that are relevant to the Port of Rotterdam. The methods used in either study are not specified.

ETIN reported an overcapacity for the refinement industry in Northwest Europe of 10 to 15 per cent. Their prediction that the demand for oil products would be relatively stable for the next 35 years was also used in the cost benefit analysis.

The GHR document contains the following predictions that are relevant to the Port of Rotterdam.

* A future surplus of refinement capacity in Western Europe.
* A further penetration of gas in Germany.
* Closing of refinement capacity in Western Europe and an increase in Eastern Europe
* An increasing share of the supply from the Middle East for Western Europe

The predicted terrain demand presented in the CBA was not a result of either one of the studies. The already planned shutdown of refinement activities in the Pernis area was expected to yield 60 hectares of which 45 would go to internal reserves of the remaining factories, resulting in a prediction of a negative terrain demand of 15 hectares for the 2000 to 2020 period regardless of the scenario.

## 3.7 Storage and throughput of liquid mass goods

The analysis of liquid mass goods in the cost benefit analysis was broken down into crude oil and oil products, energy gasses (notably LNG) and chemical products. Because these three have their own distinctive properties, their terrain demand figures were based on separate studies and this analysis will look at the separate parts as well. It should be noted that this section concerns the throughput and storage of the liquid mass goods that aren’t transported in containers or by ro-ro, and not the production or refinement.

### 3.7.1 Crude oil and oil products

The prediction of terrain demand in 2020 for the crude oil and oil products sector was based on a document by a collective that was assigned to look at the then current Port of Rotterdam area. This collective, called the “Samenwerkingsverband Bestaand Rotterdams Gebied”, henceforth SBRG, was not scientific in nature but rather tasked to observe and interview and then compile the results.

The goal of the SBRG study was to compile a number of possible projects for a more efficient use of the then current terrain of the Port of Rotterdam. Since this was one of the studies started up to support the Maasvlakte 2 decision making procedure it is well aligned with the cost benefit analysis. The projects that were compiled had to serve one or more of three purposes. They had to improve the spatial quality and alleviate the pressure on the environment, to improve existing natural areas or to develop new natural areas or offer new terrain for recreation.

The study was conducted in two phases. Phase one consisted of interviews and workshops with stakeholders, such as local businesses and interested parties, to gather ideas for spatial improvement. During the second phase the ideas were compiled into six larger scaled plans by a collaboration of stakeholders and experts. It is not defined who these experts are.

The conclusion was that there was a possibility to intensify the use of terrain in the current Port of Rotterdam area and avoid the potential terrain shortage. This would however put an increasingly heavy strain on the environment and the quality of life in the adjacent residential areas.  
Since the study was not conducted specifically to predict the terrain demand figure of crude oil but rather to present an alternative to land reclamation, these results are irrelevant here.

Only two results of the SBRG study were used to justify the predicted demand figure; a potential gain of 40 hectares by a collaboration of various companies and the potential return of 20 hectares of internal reserves due to a collaboration of two terminals. It is also mentioned that 70 hectares of terrain would be returned based on the GHR (1998c) document ‘Verkenningen 2020’. It is not explained how the makers of the cost benefit analysis determined the final prediction that the crude oil and oil products sector would represent a negative demand of 51 hectares from 2000 to 2020.

### 3.7.2 Energy gasses

The predicted additional terrain demand for energy gasses for 2000 till 2020 comes solely from the projected opening of a new LNG terminal. A study by Holland Innovation Team (2000), henceforth HIT, was referenced to support this prediction. HIT is specialised in consultancy regarding LNG, biofuels and combinations of relatively new technologies. They have conducted various studies on the chemical and energy industry. The lead researcher drs. Peter van der Gaag had worked at the Rotterdam Port Authority for 8 years prior to writing the report.

HIT was tasked by the Rotterdam Port Authority to explore the possibilities for innovative and upcoming industries to settle in the Port of Rotterdam. For the makers of the cost benefit analysis this would provide a useful tool when predicting the total terrain demand. Due to the noncommittal nature of the report there are no specific conditions involved. The conclusion does paint a picture of a potential terrain demand of 350 to 500 hectares that depends on the Port of Rotterdam running a proactive acquisition and industry policy.

For the study various new or innovative industries were identified and the likelihood that they would settle in Rotterdam was assessed. Due to the large number of unknown variables influencing such settlement decisions no actual odds were estimated. A list of requirements for settlement was given per potential industry.

The part that made it to the cost benefit analysis is the strong prediction, which is not supported by numbers, that a LNG terminal will be settled in the Port of Rotterdam. HIT distinguishes between a large terminal of 70 hectares and a small terminal of 30 hectares which was ultimately used in the CBA.

### 3.7.3 Chemical products

Though the projection of terrain demand was made using the GSM7 model developed by the GHR, the variables were estimated by Frederic R. Harris B.V. This company has vast experience in research, consultancy and construction supervision for port, waterway and transport projects.

The Harris (1996) sector study was focussed on storage and throughput of dry and liquid mass goods and roll-on/roll-off transport. It was commissioned to provide estimates of the variables that were needed to calculate volumes using the GSM7 model. Harris predicted a continuously strong competitive position for the Port of Rotterdam due to the solid chemical distribution and pipeline facilities. Based on the report the GHR assumed a 0.3% yearly spatial productivity growth for the GC and EC scenarios and 0.15% per year for the DE scenario.

The GSM7 model results for the period 2000-2020 are shown in table 3.2 along with the results of the energy gasses and oil subsectors.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 3.4 | GC | EC | DE |
| Crude oil & oil products | -51 | -51 | -51 |
| Energy gasses (LNG terminal) | 30 | 30 | 0 |
| Chemical products | 85 | 25 | 0 |

In hectares

## 3.8 Container sector[[3]](#footnote-3)

The figures for container throughput are based on the CPB (1996) growth scenarios, the GHR (1998b) GSM7 model and the 1999 study by Ocean Shipping Consultants Ltd (1999), henceforth OSC. The CPB scenarios mentioned above were at the base of many of the studies that were conducted specifically for the cost benefit analysis. The Netherlands Bureau for Economic Policy Analysis has a long history of outlining scenarios and predicting economic variables. OSC is a large firm focussed on trade and shipping market analysis, they have made dozens of large publications in the relevant field.

The CPB provided growth predictions of relevant variables, namely GDP growth and physical production growth, for three potential scenarios. These figures were used as input for the GSM7 model to estimate container throughput for the Port of Rotterdam as well as predictions for a large number of other categories. The GSM7 document is based on a model for projecting container flows. The development of flows of goods is linked to the development of sectors or other relevant variables. These flows are then coupled with country or region specific projections. Lastly a scenario based competitive analysis determines the market share per flow resulting in a prediction of container throughput per scenario.

Presented below are the results of the GSM7 model per scenario.

|  |  |  |
| --- | --- | --- |
| Table 3.5 | 1995 (real) | 2020 |
| Global Competition | 4.8 | 17.6 |
| European Coordination | 4.8 | 15.1 |
| Divided Europe | 4.8 | 10.5 |

In million TEUs

After the publication of the GSM7 document it was announced that new container terminals would be built in Amsterdam and Vlissingen with relative capacities of 0.8 and 2.4 million TEUs. OSC predicted that in the case of the GC scenario about 75% of the Amsterdam capacity and 25% of the Vlissingen capacity would be taken from Rotterdam. Since the EC and DE scenarios project lower cargo flows across the board, the nominal effects of the new terminals would be less. The figures were scaled down accordingly for the GC and EC scenarios. The DE figure ended up higher because more recent growth figures that exceeded the 1996 scenario estimations were included in the calculation. The final result is shown in table 3.6.

|  |  |  |
| --- | --- | --- |
| Table 3.6 | 1995 (real) | 2020 |
| Global Competition | 4.8 | 16.4 |
| European Coordination | 4.8 | 14.1 |
| Divided Europe | 4.8 | 11.0 |

In million TEUs

To translate the TEUs to hectares of terrain demand the makers of the cost benefit analysis used the following conversions. For 2020 an average terminal occupancy of 80% is predicted and at this occupancy the terminals are estimated to have a capacity of 29000 TEU per hectare. Every TEU in excess of the projected capacity of the Port of Rotterdam without Maasvlakte 2 is translated into potential terrain demand by the aforementioned conversion. The final predicted demand figures can be found in table 3.2.

## 3.9 Roll-on/Roll-off

The Roll-on roll-off sector largely consists of transport between Great Britain and the European mainland. The GSM7 model was used to predict the transport flows.

The model used the predicted variables of various flows of goods between Great Britain and Europe combined with the percentages of ro-ro transport per product group to predict the tonnage. An adjustment was made on account of the Channel tunnel, which dampens the ro-ro throughput. The results of the GSM7 model for 2020 were a yearly 26, 22 and 17 million tonnes for the GC, EC and DE scenario respectively.

The potential demand for terrain was estimated by scaling the projected tonnage on the current throughput and adjusting for a 2.5%, 2.4% and 2.2% yearly increase in spatial productivity for the GC, EC and DE scenario respectively. The increase in productivity was estimated in by the GHR (1998c). The final numbers for additional terrain demand are presented in table 3.2.

## 3.10 Remaining general cargo

The remaining general cargo sector consists of the general cargo that does not get shipped by container or ro-ro. All the research backing up the terrain demand prediction was done by the GHR.

The GSM7 model was used to predict the potential tonnages for the three scenarios. One condition was a stable competitive position of the Port of Rotterdam in the remaining general cargo market. In the ‘Verkenningen 2020’ (GHR, 1998a) document the effect of a shrinking sector in terms of required terrain was explored.

Where the 1995 tonnage of this sector was 10.5 million tonnes, the GSM7 model projected 10.2, 9.3 and 7.7 for the GC, EC and DE scenarios respectively in the year 2020. This lower tonnage, coupled with an approximately constant spatial productivity, which is an unsupported assumption in the CBA, results in the return of terrain. According to the GHR about 50% of the terrain yielded in shrinking sectors will be available for other port activities.

The final results for the terrain demand in the period 2000-2020 are listed in table 3.2.

## 3.11 Distribution

To map the potential terrain demand for the distribution sector three separate studies were considered. The CPB (1997), GHR and Buck Consultants International (1999), henceforth BCI, studies produced three terrain demand growth figures. BCI is a research and consultancy firm that specialises in, among other things, infrastructure, logistics and transport. They have a long history of working in the relevant field for private businesses, governments and combinations of the two.

In the CPB and GHR documents the estimate of the terrain demand for distribution is one of many goals for the study. The BCI study was commissioned by the makers of the cost benefit analysis solely to explore the potential terrain demand of distribution and provide a side by side comparison of the results from the three studies. All three studies are based on the economic variables growth figures from the CPB (1996) scenarios. The BCI study provides a figure for the period 2000-2020 whereas the figures in the other two studies are for 1995-2020.

The CPB study linked the distribution to throughput of other sectors and made a projection based on the predicted growth figures for aforementioned sectors. An adjustment was made for an increase in spatial productivity similar to that of the container sector.  
The CBI study consisted of several steps. First the boundaries of the current and future distribution sector and its separate segments were defined. Secondly the developments in the logistics chains per segment were analysed. Next the data was specified for the Port of Rotterdam by means of a preferred location analysis, SWOT analysis and market share analysis. Lastly the future spatial productivity was estimated to predict the total terrain demand.

The table below shows the results per study for the two most extreme scenarios adjusted for the period 1995-2020.

|  |  |  |
| --- | --- | --- |
| Table 3.7 | Divided Europe | Global Competition |
| CPB | 81 | 165 |
| GHR | 70 | 190 |
| BCI | 110 | 205 |

In hectares (BCI, 1999)

Ultimately the GHR results were used in the cost benefit analysis. They were adjusted for new predictions for the container throughput which aren’t defined further. The final results for the period 2000-2020 can be found in table 3.2.

## 3.12 Empty depots

The predicted terrain demand for empty depots[[4]](#footnote-4) is linked to the container throughput predictions and adjusted. The study ‘Verkenningen 2020’ (GHR, 1998c) was used.

To estimate the figure with which the growth would be adjusted, GHR looked into the trends of empty container throughput for the Port of Rotterdam. These trends were then quantified to get to the results. It was concluded that the empty depot terrain demand growth would follow the container sector growth figures minus 2%, 1.8% and 1.25% for the GC, EC and DE scenarios respectively. These growth figures were translated to predicted terrain demand. The results can be found in table 3.2.

## 3.13 Dry mass goods

Dry mass goods are a collection of all throughputs that aren’t included in container throughput, ro-ro, remaining general cargo or liquid bulk throughput. Primarily it is made up of agricultural bulk, coals and iron ore throughput. Some forms of processing the aforementioned goods on site are also included.

The results for dry mass goods throughput were derived from the GSM7 model (GHR, 1998b). Other studies by Harris (1996), the CPB (1997), Tauw (1998) and PMR (2000) were used for input and adjustments. Tauw is a consultancy and engineering bureau with a focus on the environment and sustainability.

Results from the various studies were put together in the cost benefit analysis to separately construct a potential terrain demand figure for each of the three scenarios. It was broken down into the effects of coals, iron ore, agricultural bulk throughput and processing and the remaining goods. The resulting predicted terrain demand for the dry mass goods sector is listed in table 3.2.

## 3.14 Remaining industries

The remaining industries terrain demand prediction was made by combining the results of various smaller studies and three larger ones by the GHR (1998c), the CPB (1997) and, most prominently, NEI & DHV (1999). NEI, the Netherlands Economics institute, was one of the parties responsible for the production of the cost benefit analysis. It has been in the business of applied economic research for more than 82 years and produced countless studies for clients all over the world. DHV, known as Royal Haskoning DHV since a 2012 merger, also has a long history of project management and consultancy for global clients.

NEI & DHV made a sector study specifically exploring the industrial subsectors that weren’t included in the other sectors. For these sectors they analysed industrial trends and potential terrain demand. Since the study was conducted on behalf of the project team working on the cost benefit analysis the goals of the study are in line with the CBA.

They used two steps to predict the terrain demand. First, the terrain demand is linked to the predicted employment opportunity developments in the Rijnmond area for the period 2000-2020. A model called the RUBIAE-model was used to make this conversion. The resulting prediction was then adjusted on a more detailed level based on information from interviews and surveys among companies and branch organisations.

The result of the NEI/DHV study only covers the EC scenario and comes down to 115 hectares of additional predicted terrain demand for 2000-2020. To fit the cost benefit analysis a GC and DE figure had to be estimated. The total estimated terrain demand for the EC scenario consists of several subgroups that were estimated separately. For each of these subgroups the makers of the cost benefit analysis made an estimate of the conversion factor needed to calculate the GC and DE figures. The compiled figures can be found in table 3.2.

## 3.15 Other activities

The other activities sector encompasses activities such as commerce, transport and service. It contains both port related activities, e.g. tugboats and customs, and activities unrelated to the port, e.g. recreation and environmental services.

To predict the demand a CPB (1997) study was used as the main document and a GHR (1998a) one for background information. In predicting the demand it was assumed based on previous experience that many of the companies in this sector are small and fill up, for large companies, obsolete lots. This is not expected to change in the future.

The demand figure was composed in two steps. Firstly by estimating the growth of commerce and services based on the national projections and adjusting for the fact that it is expected to grow less in the Port of Rotterdam. Secondly some specific activities that represent a large terrain demand were individually added. The final results for the ‘other activities’ sector can be found in table 3.2.

# Chapter 4; Economic analysis

In this chapter of the thesis I will compare the available data with the data presented in the cost benefit analysis. The comparison will be on a sector by sector basis while, when relevant, different variables per sector will be examined. For example, the container sector can be examined by comparing the both the predicted terrain demand and the predicted throughput in TEUs with the actual figures.

If available, data from 2010 and the most recent data will be included. The 2010 data are relevant and easy to compare since it is in the middle of the 2000-2020 period that was considered in the previous chapter and the cost benefit analysis. 2012 Data are obviously the most recent and might lead to new insights relating to recent events. The predictions in the Cost Benefit Analysis are for the year 2020 and the 2010 figures are calculated under the assumption of linear growth over the period 2000-2020. Along with a side by side comparison of the data a short evaluation will be given with any noteworthy information regarding the path of the data.

Any observed discrepancies will then be analysed by answering the following questions.

* What is the most likely cause of the observed difference between the predicted and the historic figures?
* Could this have been foreseen in the cost benefit analysis?
* Is there a suitable alternative method of prediction?

The two sectors that show a significant deviation from the predictions and will be analysed further are the container sector and dry mass goods. The remaining general cargo sector will, although a discrepancy was observed, not be examined due to its negligible size.

## 4.1 Container sector

Table 4.1 shows the container throughput figures of the port of Rotterdam as observed and predicted by the CBA per scenario. The numbers represent million TEUs and the observed values are in line with the GC scenario. (HbR, 2013a)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table 4.1 | Real | Real | Real | Real | DE | EC | GC |
|  | **1999** | **2005** | **2010** | **2012** | **2010** | **2010** | **2010** |
| Maasvlakte Bound | 3.5 |  |  |  | 5.7 | 7.43 | 8.58 |
| Other deep-sea | 2.0 |  |  |  | 2.0 | 1.84 | 1.74 |
| Short-sea | 0.8 |  |  |  | 1.06 | 1.13 | 1.27 |
| Total | 6.3 | 9.3 | 11.15 | 11.87 | 8.76 | 10.39 | 11.59 |

In million TEUs

Table 4.2[[5]](#footnote-5) shows the terrain demand of the container sector and the empty depots sector combined. Empty depots are included in the container sector for two reasons.  
 - The Rotterdam Port Authority does not provide terrain usage data in which they are separate  
- The growth figures predicted in the CBA follow the same pattern as those of the container sector so the analysis of the two combined sectors makes sense.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table 4.2 | Real | Real | Real | Real | DE | EC | GC |
|  | **2000** | **2008** | **2010** | **2012** | **2020** | **2020** | **2020** |
| Container terminals | 473 |  |  | 997 | 560 | 680 | 775 |
| Empty depots | 95 |  |  | 109 | 115 | 130 | 145 |
| Total | 568 | 904 | 917 | 1106 | 675 | 810 | 920 |

In hectares

The separate 2012 figures for container terminals and empty depots are estimations. They were derived by taking the known total terrain demand figure of 2012 and comparing this with the terrain demand of the new container terminals that have been established on the Maasvlakte since 2000.

Table 4.3[[6]](#footnote-6) breaks down the real terrain demand figure from table 4.2 per terminal.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 4.3 | 2000 | 2008 | 2012 |
| Pre 2000 terminals | 473\*\* | 473 | 473 |
| Delta terminal ECT | 0 | 270 | 270 |
| Euromax terminal ECT | 0 | 0 | 84 |
| APM terminal | 0 | 0 | 60 |
| RWG terminal | 0 | 0 | 110 |
| Empty depots | 95 | 161\* | 109\* |
| Total terrain demand | 568 | 904 | 1106\*\* |

In hectares

\*The 2008 and 2012 figures of empty depots aren’t actually based on evidence but rather serve as error terms to explain the discrepancy that arises under the assumption that the only changes in the container sector terrain demand since 2000 are those related to the four terminals in table 4.3.

\*\*Excluding options

In table 4.2 it is shown that the container sector historic values diverge significantly from the path predicted in the cost benefit analysis. These figures do include terrain demand for empty depots which is, because of its insignificant share, not considered in the rest of the analysis.

### 4.1.1 What caused the difference?

The predicted terrain demand was initially derived by scaling it along the predicted throughput volumes. The fact that terminals have to be built before throughput demand arises rather than after was incorporated by considering an 80% occupation up to 2020 (CPB, NEI & RIVM, 2001).

A more or less smooth increase in container terminal terrain demand was predicted, the fact that container terminal expansion usually progresses by large increments notwithstanding. What actually happened, the construction of two large new terminals and one sizable expansion, was not accounted for. The construction of the Rotterdam World Gateway, APM and ECT terminals puts the terrain demand for container terminal terrain well above the predictions of the most optimistic scenario. On top of that all three terminals have options for potential expansion.

The difference between the predictions and the historic figures seems to be caused by the assumption of gradual expansion that is made for the cost benefit analysis. A large expansion, that would cause low occupancy for an extended period of time, was ignored as a possibility.

### 4.1.2 Could it have been foreseen?

To evaluate whether the large expansion, which is the most likely cause of the discrepancy, could have been foreseen the business climate at the time will have to be examined.

One distinct indicator would be the relation between Maersk and ECT. In the years before the creation of the cost benefit analysis Maersk expressed the desire to leave ECT, who was the main provider of container throughput at the time, and set up their own terminal as soon as their contract ended (Barnard, 1997). Eventually it was agreed that Maersk and ECT would operate a new terminal together and ECT would not lose their largest customer (Chan, 1998).

This is only one indicator that large shipping companies were eager to become less dependent on the near monopolist ECT for their business in the Port of Rotterdam. An analysis of the current players in the port of Rotterdam and their long term plans should have been included in the prediction process of the terrain demand.

### 4.1.3 Alternative method

To identify indicators of the aforementioned kind, a well-known method can be used. Due to the relatively low number of large players in the container throughput business in the Port of Rotterdam it is possible to perform individual SWOT analyses for each of the companies involved.

The following things might have come up if this method had been applied for the cost benefit analysis. For large volume container shipping companies such as Maersk the opportunity to exploit their own terminal would be listed as an opportunity. ECT on the other hand stands to lose their near monopolistic position as well as large clients in case of expansion, marking it as a threat.

Once it would have been established that current ECT customers wanted to start exploiting their own terminal the presence of entry barriers could have been observed. It seems reasonable to assume that locational entry barriers were present in the form of terrain constraints and that they were largely lifted when Maasvlakte 2 was finally built. It is then also reasonable to assume that the model that was used to estimate the potential terrain demand of the container sector did not include entry barriers. By including entry barriers in the economic modelling it is possible that the large instantaneous expansion could have been foreseen.

## 4.2 Dry mass goods

Table 4.4[[7]](#footnote-7) contains the historic and predicted values for the dry mass goods terrain demand

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4.4 | Real | | Real | | Real | | DE | | EC | | GC | |
|  | **2000** | **2010** | | **2012** | **2010** | **2020** | | **2010** | **2020** | **2020** | | **2020** |
| Total terrain demand | 342\* | 381 | | 435 | 359 | 376 | | 391 | 440 | 393 | | 443 |

In hectares \*including options

The most recent figures on the terrain demand for dry mass goods throughput suggest that the cost benefit analysis estimations were too low.

The historic values in the table below were taken from a document published by the Rotterdam Port Authority and the predicted 2010 figures adapted from the CPB (1997a) document. A discrepancy exists since the CPB document reports a real tonnage figure of 82,300 for 1995, which will also be used to calculate the predicted figure for 2010, while the Port Authority reports 89,572. It is unclear what was omitted or modified since the CPB document does not provide a breakdown of the total tonnage. (HbR, 2013b)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4.5 | Real | Real | Real | DE | | EC | | GC | |
|  | **1995** | **2010** | **2012** | **2010** | **2020** | **2010** | **2020** | **2010** | **2020** |
| Agribulk | 15,469 | 8,383 | 8,050 |  |  |  |  |  |  |
| Ore and scrap metal | 46,297 | 39,884 | 32,742 |  |  |  |  |  |  |
| Coals | 17,887 | 24,080 | 25,282 |  |  |  |  |  |  |
| Remaining dry mass | 9,919 | 12,293 | 12,029 |  |  |  |  |  |  |
| Total dry mass goods | 89,572 | 84,640 | 78,103 | 79,840 | 78,200 | 82,300 | 82,300 | 101,440 | 114,200 |

In 1000 metric tonnes

The trend observed in tonnage clearly deviates from the predicted path for any of the scenarios. It is also interesting that while the tonnage shows a declining trend over the last 17 years the terrain demand in hectares was still rising up to 2012[[8]](#footnote-8). This discrepancy is the cause for the rest of the analysis.

### 4.2.1 What caused the difference?

In predicting the volumes and terrain demand of the dry mass goods sector the four subsectors coals, scrap metal and iron ore, agricultural bulk and remaining dry mass goods were separately analysed. It was estimated that coals and remaining dry mass goods would stay stable in terms of volume and terrain use. Scrap and iron and agricultural bulk volumes on the other hand were predicted to shrink resulting in, respectively, unknown terrain demand changes and unchanged terrain demand.

Over the last twelve years only the coal throughput subsector has consistently shown volumes above its 2000 level. It is not surprising then that the only three major expansions in terms of terrain were realised to accommodate coal throughput. In 2004 EECV finished a new coal transhipment terminal on 35 hectares terrain which was further expanded in 2011 (HbR, 2011a). EMO, the first company to settle on Maasvlakte 1 and the largest dry bulk company in the Port of Rotterdam, has expanded its operations, the throughput of coals and iron ore, in 2011 on another 24 hectares of terrain (HbR, 2011b).

While agricultural bulk and remaining dry mass goods have been in slow decline for the last 12 years the iron ore and scrap metal sector has faced the hardest hits. With the crisis dampening the steel industry in Europe, for which a large portion of raw materials went through the port of Rotterdam, this sector has experienced historically low volumes in the last decade (HbR, 2012). The most likely reasons for the observed discrepancy are the expanding coal throughput and the fact that the other three dry mass goods sectors, the iron ore and scrap metal sector in particular, are suffering.

### 4.2.2 Could it have been foreseen?

In part, the way the dry mass goods volumes are developing has been foreseen in the cost benefit analysis. For the Global Competition scenario a 443 hectare terrain demand was predicted, its increase mostly ascribed to the increase in coal throughput. For this scenario it was, apparently accurately, predicted that Rotterdam would benefit from the closing of coal mines in Germany and its resulting increased coal imports. (CPB, 2001, P.91)

The most likely cause of the recent decline in overall dry mass goods volumes, the 2009 financial crisis, could not have been foreseen in the cost benefit analysis.

### 4.2.3 Alternative method

There does not appear to be a method that could have led to relevant new insights at the time the Cost Benefit Analysis was written. Predicted sector production volumes, recent and expected relevant events as well as potential new activities were all considered.

## 4.3 Roll-on/Roll-off

The roll on/roll off total shipped volumes are shown in table 3.5. (HbR, 2013b)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 3.5 | Real | Real | Real | Real | DE |  | EC |  | GC |  |
|  | **1999** | **2005** | **2010** | **2012** | **2010** | **2020** | **2010** | **2020** | **2010** | **2020** |
| Tonnage | 9,937 | 9,870 | 16,968 | 17,919 | 13,000 | 17,000 | 15,500 | 22,000 | 17,000 | 26,000 |

In 1000 metric tonnes

The roll on/roll off volumes appear to be developing almost perfectly along the line of the GC scenario predictions. Recent data on the roll on/roll off terrain demand are not available.

## 4.4 Remaining general cargo

The table below indicates that the path the volume takes deviates significantly from the predictions in the cost benefit analysis. This suggests a higher potential return of terrain than initially predicted. A possible cause is the higher than expected containerisation. (HbR, 2013b)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table 3.6 | Real | Real | Real | Real | DE | EC | GC |
|  | **2000** | **2005** | **2010** | **2012** | **2020** | **2020** | **2020** |
| Tonnage | 8,754 | 8,511 | 6,875 | 5,865 | 7,700 | 9,700 | 10,200 |

In 1000 metric tonnes

# Chapter 5; Conclusions and recommendations

To answer the question to which extent the Maasvlakte 2 Cost Benefit Analysis correctly predicted the terrain demand for the Port of Rotterdam and what caused any observed deviations a three phased approach was used. In the first phase the backing research was examined and it was found that while some studies were unavailable, most of the studies were conducted by credible companies or institutions, providing a solid backing for the Cost Benefit Analysis predictions. When, in the second phase, the resulting predictions were compared with the available historic data some discrepancies were observed. Due to the lack of published information, several important sectors could not be analysed. In the third phase the significant deviations observed in phase 2 were analysed leading to the, very limited, answer to the main research question.

Based on the available data and the fact that anno 2013 it seems the most reasonable option to assume a linear progression of the predicted variables the following conclusions can be drawn.

* For the most part there is no reason to believe the predictions of the future terrain demand made in the 2001 Cost Benefit Analysis will deviate significantly from the actual values
* The container sector is the exception. The terrain demand in 2013 already exceeds the highest predicted figure for 2020 and is expected to increase during the next phase of Maasvlakte 2
* In the prediction of future container terminal terrain demand a qualitative approach was neglected, resulting in the failure to include entry barriers in the prediction model
* Because entry barriers weren’t modelled the future demand for container terminal terrain was grossly underestimated

This result calls attention to the use of a mix of qualitative and quantitative methods to predict economic or industrial variables. Future research can be done to investigate the value of this approach for new Cost Benefit Analyses of large infrastructure projects. It can also be reviewed whether there are Cost Benefit Analyses that already employed a mix of methods and whether the results were more accurate.

Another area in which more research is required is the evaluation of port infrastructure projects in general. The importance of ports to the economy, as mentioned in the introduction of this thesis, warrants a better developed body of knowledge concerning the evaluation of large infrastructure projects in ports than is currently available.

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# A; Port of Rotterdam current terrain demand

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Source: Rotterdam Port Authority |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| **Tabel 1 Bezetting Verhuurbaar Ruimtebalans Gebied per 31 december in Ha.** | | | | | | |  |
| **Bezetting** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** |  |
| Verhuurd | 4,614 | 4,754 | 4,813 | 4,785 | 4,962 | 5.012\* |  |
| Optie | 248 | 191 | 83 | 102 | 261 | 250 |  |
| Reservering | 2 | 28 | 60 | 67 | 255 | 239 |  |
| Interne Reservering | 92 | 112 | 58 | 108 | 144 | 128 |  |
| Vrij | 213 | 179 | 184 | 149 | 270 | 293 |  |
| **Totaal** | **5,169** | **5,264** | **5,198** | **5,211** | **5,892** | **5,922** |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| **Tabel 6 Verhuurde terreinen VRG per segment per 31 december in Ha.** | | | | | | |  |
| **Hoofdsegment/ Marktsegment** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** |  |
| Non-bulk | 1,225 | 1,280 | 1,303 | 1,307 | 1,471 | 1,493 |  |
| Breakbulk | 357 | 376 | 387 | 391 | 385 | 388 |  |
| Containers | 868 | 904 | 917 | 917 | 1,086 | 1,106 |  |
| Droog Massagoed | 381 | 383 | 383 | 381 | 400 | 435 |  |
| Nat Massagoed | 2,533 | 2,602 | 2,666 | 2,638 | 2,637 | 2,638 |  |
| Chemie & bio-based industry | 540 | 565 | 564 | 563 | 563 | 567 |  |
| Gas & power | 166 | 215 | 269 | 235 | 233 | 234 |  |
| Onafhankelijke tankoverslag | 404 | 398 | 405 | 413 | 434 | 430 |  |
| Ruwe olie & raffinage | 1,424 | 1,424 | 1,428 | 1,428 | 1,407 | 1,407 |  |
| Overig | 475 | 489 | 460 | 459 | 455 | 446 |  |
| **Eindtotaal** | **4,614** | **4,754** | **4,813** | **4,785** | **4,962** | **5,012** |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Tabel 1: bezetting status van de terreinen; hier hangt nog geen segment aan | | | | | | |  |
| Tabel 6: segmenten van de verhuurde terreinen. | | | |  |  |  |  |

1. : In univariate models it is assumed that future values of a time series are based solely on historic values [↑](#footnote-ref-1)
2. http://www.cpb.nl/publicatie/omgevingsscenarios-lange-termijn-verkenning-1995-2020 [↑](#footnote-ref-2)
3. The container sector constitutes the facilitation of container throughput, storage and handling of empty containers is covered by the Empty Depots sector. [↑](#footnote-ref-3)
4. The empty depots sector covers companies that store and clean containers after they have been delivered and unloaded. [↑](#footnote-ref-4)
5. The source of the 2008, 2010 and 2012 real figures can be found in Appendix A [↑](#footnote-ref-5)
6. The information on the terminal sizes was retrieved from the terminal operator’s websites [↑](#footnote-ref-6)
7. The source of the 2010 and 2012 real figures can be found in Appendix A [↑](#footnote-ref-7)
8. This might be due to the terrain demand figures provided by the Rotterdam Port Authority including some other subsector with ‘dry mass goods’ but there is no likely candidate. [↑](#footnote-ref-8)