A decision enhancement studio for area planning in the Port of Rotterdam

Port Research Centre, Rotterdam-Delft
A decision enhancement studio for area planning in the Port of Rotterdam,
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Preface and acknowledgements

This report describes the activities of a very challenging 8 month project in which several employees of the Port of Rotterdam (PoR), and several researchers and students of TU Delft worked together in an intensive project to research and enhance spatial planning activities for the Port of Rotterdam.

As usual, many persons contributed to the success of this study. Teun Tuijtel of PoR agreed on carrying out the project, signed for it during a PoR – TU Delft meeting, and heavily supported the project during its execution. The support of the various PoR departments involved in spatial planning activities in the port has been excellent. Everyone was very willing to share information and insights, and made their time available to support the project and critically comment on its progress and direction. The OTA department deserves separate thanks as they always quickly provided both the geographic information and the information on current lot use of the port whenever we needed it.

From TU Delft, Henk Sol and Peter Keen came with the original ideas on Decision Enhancement Studios (DES). We built heavily on their ideas and turned them into first prototypes. Wenlong Zhao participated in the early architectural stages of the project, and Mariëlle den Hengst was very instrumental in preparing the test of the DES, which will take place in Spring 2005.

Hopefully we can continue the project in 2005 with a team that has the same spirit, pace, and drive for success.

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Delft/Rotterdam, February 2005
Executive summary

This report describes the activities of a very intensive 8 month project in which several employees of the Port of Rotterdam (PoR), and several researchers and students of TU Delft worked together to research and enhance spatial planning activities for the Port of Rotterdam.

The PoR is responsible for developing and exploiting 10000 acres of the Rotterdam port and industrial zone. The zone can be developed in many different ways, from renting it to private companies to facilitating infrastructure. Well considered and conscious development of the zone is in the best interest of the PoR. Interdisciplinary teams work together in projects that can take up to 10 months to handle the amount of information and complexity involved. In these projects, called ‘spatial planning projects’, a systematic preparation of activities for the development of parts of the zone is made. Despite spatial planning efforts there are many variables that make control over the development uncertain.

Spatial planning projects involve many different disciplines and a lot of data per discipline. Therefore, it has been suggested to support this complex process with computerized tools and possibly a more streamlined process. Since mid-2003 a combined PoR and TU-Delft team (DES-team) is responsible for developing a Decision Enhancement Studio (DES) for the area-planning process at the PoR. The project to develop the DES is embedded in the Memorandum of Understanding (MoU) between the PoR and Delft University of Technology (TU-Delft).

In the current area planning process several phases can be distinguished: a start-up phase, an investigation of the area, for each lot the opportunities and constraints on all aspects are determined, the determination of the area-plan in a workshop, and a finalization phase where the results are reported and presented. The aspects which are considered for matching lots and (land) uses can be categorized in terms of availability, reachability, livability, sustainability and commercial attractiveness. Each of these aspects can be regarded in terms of desirabilities and possibilities. A so-called “matrix” was developed in which the characteristics of uses for the most recognizable aspects are documented.

In the proposed way of working, the ambition is set to enhance the area planning process by means of a studio for spatial planning which is characterized by a focus on: both process and content; multiple users; static and dynamic properties of area-planning; past, present and future; and a strong integration with data sources available within the organization. Support is provided through a suite of software tools. A software architecture has been developed for the support environment. The tools identified to support the process of area-planning include a digital and fully customizable demand/use matrix which can be linked to a digital map. Furthermore tools to support version management, documentation, communication and user authentication were identified. The software architecture is implemented in a prototype using web-based software technologies.

To evaluate the design and measure the success a test is planned. The test is centered around a fictive area-planning process. The primary objective is to get feedback on the expected usefulness, usability and usage of the tool suite. Furthermore a description of how to embed the tool suite in the PoR was made.
The architecture, design, and prototype implementation have been evaluated with different parts of the PoR organisation at several occasions. The reactions were positive in all the meetings that were organized. It was clear that these new area planning instruments can enhance the quality of the matching processes in the port. The tools are valuable for all planning processes in the port, in the entire range from granting lots to customers in the commercial processes, to making the strategic 25-year plan for the entire port. The recommendation from this first phase of the project is therefore to continue with the enhancement of the tools and implementation of the project in the Port of Rotterdam.
Management samenvatting

In dit rapport worden de activiteiten van een zeer intensieve samenwerking tussen een aantal medewerkers van het Havenbedrijf en onderzoekers en studenten van de TU Delft beschreven. Het betreft een onderzoek ter verbetering van de ruimtelijke planvormingsactiviteiten van het Havenbedrijf.

Het havenbedrijf heeft de verantwoordelijkheid voor de ontwikkeling en exploitatie van de 10.000 hectaren die het havengebied en de industriële zone beslaan. Deze zone kan op meerdere manieren ontwikkeld worden, variërend van het verhuren aan private ondernemingen tot het faciliteren van infrastructuur. Een weloverwogen ontwikkeling van het gebied is dientengevolge van groot belang voor het Havenbedrijf. Interdisciplinaire projectteams werken samen in projecten met een doorlooptijd tot tien maanden waarin een grote hoeveelheid complexe informatie en gegevens verwerkt worden. In deze projecten, gebiedsplanningsprojecten genaamd, wordt een systematische voorbereiding van de activiteiten voor het ontwikkelen van delen van het havengebied gemaakt. Door de complexiteit en de omvang van de te verwerken gegevens is het ondanks de inzet van betrokkenen bij gebiedsplanning lastig om de onzekerheden omtrent gebiedsplanning lastig om de onzekerheden omtrent gebiedsplanningsprojecten onder controle te houden.


In het huidige gebiedsplanningsproces kunnen verschillende stadia geïdentificeerd worden. Ten eerste is er een initialisatiefase waarin het gebiedsplanningsteam gevormd wordt. Daarna vind er een onderzoek van het gebied plaats waarin de relevante aspecten en dominante karakteristieken van het gebied worden vastgelegd. Vervolgens worden de kansen en beperkingen van het gebied in kaart gebracht waarna de geschiktheid van combinaties van kavels en invullingsvormen geanalyseerd kunnen worden. Uiteindelijk resulteert dit in het opstellen van het gebiedsplan. Dit gebeurt in de vorm van een workshop waarin de teamleden al brainstormend en discussiërend tot overeenstemming proberen te komen over de beste invulling van het gebied. Ten slotte wordt het gebiedsplan gedocumenteerd en gepresenteerd in de CZ-I&B vergadering.

De aspecten waarnaar gekeken wordt bij het analyseren van een gebied of kavel zijn te categoriseren in: geografische beschikbaarheid en geschiktheid; bereikbaarheid, leefbaarheid, duurzaamheid en commerciële aantrekkelijkheid. Ieder van deze categorieën heeft een wenselijkheidscomponent en een mogelijkheidscomponent. De wenselijkheids-component geeft, gezien vanuit het Havenbedrijf, aan in hoeverre een aspect wenselijk is, terwijl bij de mogelijkheidscomponent de focus ligt op de beperkende factoren. Om gebiedsplanners te ondersteunen bij het maken van initiële afwegingen over de geschiktheid van een invullingsvorm voor een bepaalde kavel wordt gebruik gemaakt van een tabel, de
z.g.n. Matrix. Hierin is per invullingsvorm / bedrijfstype voor een aantal key-aspecten aangegeven wat voor typische waarden men kan verwachten of waaraan voldaan moet worden. Verder wordt er veelvuldig gebruik gemaakt van kaartmateriaal.

De ambitie van het onderzoeksproject ligt zoals hierboven aangegeven in het ondersteunen en verbeteren van het gebiedsplanningsproces door middel van een Decision Enhancement Studio. Deze DES wordt gekenmerkt door: aandacht voor zowel het proces als de inhoud, het ondersteunen van meerdere gebruikers, zowel statische als dynamische gegevens, aandacht voor verleden, heden en toekomst alsmede de transitie tussen deze fases en tenslotte een sterke integratie met gegevensbronnen van de organisatie.

Er is een architectuur ontworpen voor de software suite die bedoeld is om het proces te ondersteunen. Er kan een onderscheid gemaakt worden tussen tools die specifiek gericht zijn op het ondersteunen van gebiedsplaanning en meer generieke tools. Voor het specifiek ondersteunen van gebiedsplaanning zijn twee tools geïdentificeerd: een digitale vraag/aanbod – matrix en een digitale kaart. Beiden representeren een digitale versie van hun papieren tegenhangers. De digitale vraag/aanbod matrix is volledig aan te passen aan de issues die spelen in het gebied. Er zijn verschillende doorsnijdingen te maken in de gegevens die opgeslagen zijn in de matrix waardoor het mogelijk is om vanuit verschillende gezichtspunten naar een gebiedsplan in wording te kijken. Het is bijvoorbeeld mogelijk om een invullingsvorm voor een kavel te vinden, maar ook om juist voor een specifieke kavel een geschikte invullingsvorm te vinden. De digitale kaart maakt het mogelijk om vanuit het vertrouwde geografische perspectief het gebied te beschouwen. Verschillende vormen van informatie kunnen gecombinéerd worden om de relaties tussen verschillende aspecten zichtbaar te maken.

Tevens zijn er meer generieke functionaliteiten geïdentificeerd die van belang zijn in het gebiedsplanningsproces. Dit is bijvoorbeeld de mogelijkheid om vergaderstukken, memo’s, rapporten etc. bij te houden op een centraal punt en deze te koppelen aan verschillende representaties van het gebiedsplan. Tevens is het bijhouden van versies van documenten en modellen van belang omdat er vaak meerdere parallelle deelprocesen plaatsvinden waarvan de resultaten in een later stadium gecombineerd moeten worden. Tenslotte zijn er functionaliteiten voor user management en user authentication nodig.

Er is een prototype implementatie van de software suite gemaakt. Deze implementatie is volledig web gebaseerd en gericht op de hierboven beschreven tools en functionaliteiten. Tevens is er een testplan opgesteld om het ontwerp van de software suite te kunnen testen alsmede het proces waarin deze gebruikt zal worden. De test gaat uit van een fictieve casus om eventuele bevooroordeeling van de deelnemers zoveel mogelijk te voorkomen. Het doel van de test is het verkrijgen van feedback over het nut, de bruikbaarheid en het gebruik van de software suite. Tevens is er een beschrijving gemaakt over hoe de uiteindelijke software suite ingebed kan worden in het Havenbedrijf.

In diverse bijeenkomsten bij het Havenbedrijf zijn de architectuur en de ontwikkelde gereedschappen besproken en geëvalueerd. De reacties waren zeer positief in alle bijeenkomsten die zijn georganiseerd. Het was de deelnemers duidelijk dat de planningsprocessen in de haven veel baat kunnen hebben bij gebruik van een volgende versie van de software suite. De gebiedsplanning zelf kan sneller en professioneler plaatsvinden. Daarnaast kunnen zowel commerciële processen als strategische processen hun voordeel doen met electronisch beschikbare en makkelijk toegankelijke gebiedsplannen. Het advies na de eerste fase van dit project is dan ook om het project voort te zetten en een stapsgewijze implementatie in het Havenbedrijf voor te bereiden.
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1 Introduction

The Port of Rotterdam (PoR) as port authority is responsible for developing and exploiting 10000 acres of the Rotterdam port and industrial zone. The zone can be developed in many different ways, from renting it to private companies to facilitating infrastructure. Well considered and conscious development of the zone is in the best interest of the PoR. In the past, the PoR managed to control the development with plans based on experience and intuition. Nowadays that control is achieved through interdisciplinary teams that work together in projects that can take up to 10 months to handle the amount of information and complexity involved. In these projects, called ‘spatial planning projects’, a systematic preparation of activities for the development of parts of the zone is made. Despite spatial planning efforts there are many variables that make control over the development uncertain.

Spatial planning projects involve many different disciplines and a lot of data per discipline. Therefore, it has been suggested to support this complex process with computerized tools and possibly a more streamlined process. Since mid-2003 a combined PoR and TU-Delft team (DES-team) is responsible for developing a Decision Enhancement Studio (DES) [Keen and Sol, 2005] for spatial planning. The project (DES-project) aims to enhance decision making in spatial planning. The project to develop the DES is embedded in the Memorandum of Understanding (MoU) between the PoR and Delft University of Technology (TU-Delft).

In section 1.1 we define spatial planning, as it is the central subject in this research. In section 1.2 we describe the actors and the concept of a DES in the DES-project. The limited resources available and the complexity of spatial planning forces us to focus on a specific part of the DES project. In section 1.3 we explain the focus on a specific type of spatial planning. In chapter 2 we specifically describe the outline of this research within the DES-project, and introduce the rest of the report.

1.1 Introduction to spatial planning

A spatial plan is a vision on the spatial development that optimises the availability, accessibility, liveability, sustainability and commercial attractiveness of an area in the port, in a flexible way and in harmony with its external environment [van der Blaak et al., 2004]. The result of spatial planning is a systematic preparation of activities to deploy the area in the Rotterdam port industrial zone. A plan consists of feasible and the most promising area-use combinations and a set of adjustments or actions to develop the area. All intellectual efforts in spatial planning can be placed under determining the possibilities, merits or adjustments [Voogd, 1995]. Area is a part of space (land and/or water) in the Rotterdam port industrial zone, and use is a way to develop and exploit an area. When a spatial planning team chooses to exploit an area commercially, a general market segment or potential customer is chosen. Alternative, non-commercial ways for developing an area are, among others, port facilities, public area or nature compensation. An area plan is an instrument for the PoR to guard their interests by controlling the spatial development of areas.

Making long-term plans for a complex and dynamic area like the Rotterdam port and industrial zone is far from trivial. The number of aspects and dependencies make the acquisition and interpretation of the information a complex exercise. Furthermore, many different actors are involved, which look at the issues from different perspectives. The

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1 J.W. Weststrate and J. Smits of the PoR
meaning of long-term plans is that interests of the future must be reflected in area plans of today. The interests of the future adds another axis in the complexity, dynamics in time.

A scenario without conscious and well-considered planning is not in the best interests of the PoR. When for instance the PoR would agree to every request from a potential or existing customer the use might become fragmented. A threat of fragmented development is that it obstructs bundling of services such as roads, electricity, quays, or cables and pipelines [Chin et al., 2004]. In the end this may lead to higher costs and reduce the competitiveness of the port.

Different uses in vicinity of each other may lead to: conflicts or advantages. The task of spatial planning is to avoid the conflicts and exploit the concentration of uses that lead to advantages for the actors involved.

### 1.2 A Decision Enhancement Studio for spatial planning

In this section the Decision Enhancement Studio (DES) project is described. In the preliminary plan of the DES-project it has been assumed that some sort of DES will enhance decision making in spatial planning. First we describe on the stakeholders setting of the DES-project in section 1.2.1. The underlying concepts of the DES are introduced in section 1.2.2.

#### 1.2.1 Actor setting

The Port of Rotterdam (PoR) and Delft University of Technology (TUD) have a memorandum of understanding (MoU) for joint research which resulted in a notion to develop a `Decision Enhancement Studio’ (DES) [Keen and Sol, 2005] for area planning. Since mid-2003 the DES has been in development. One of the decision process to support, is matching of supply and demand of lots in the Rotterdam port industrial zone.

In the introduction we mentioned the MoU between the PoR and TUD and notion to develop a DES. The stakeholders of this research are the same as for the DES project. This research is done for the division ‘Port Infrastructure’ (I&B) and ‘Commercial division’ (CZ) of the PoR and Systems Engineering group (SE-group) of the TUD as a part of the DES project.

**Port of Rotterdam**

The PoR is the port authority for the Rotterdam port and industrial zone. “The division Port Infrastructure is responsible for optimising the development, construction, design and management of the port area. This division’s main concerns are focused on client-specific infrastructure such as quay walls and jetties, and public infrastructure such as port basins, roads, railroads and pipeline strips. Limiting conditions involve environmental and use legislation and agreements made with neighbouring actors.”

For the division Port Infrastructure it is important that spatial development is well considered to prevent additional and unnecessary costs and infrastructural and logistical deficiencies. The approach introduced in this research will aim to enhance the decision process of matching.

“The Commercial Division focuses on attracting new businesses and cargo flows and on strengthening existing cargo flows in the port of Rotterdam. Together with its clients, the Commercial Division develops new logistic and industrial concepts and makes sure these

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2 www.portofrotterdam.com visited at the 15th of September 2004
concepts are implemented. The division maintains commercial contacts with existing lessors and shipping companies. Furthermore, the Commercial Division is responsible for all rental and leasehold contracts and for offering information on and the collection of harbour dues."³ The Commercial division guard the interests and needs of their customers and potential customers. An area plan enables the Commercial division to quickly scan available lots to match it with a potential customer.

**Systems Engineering Group**

The Systems Engineering Group (SE-group) of the Faculty of Technology, Policy and Management of Delft University of Technology is mandated with the development of the DES. The Faculty is active on the interface between technology and management. The research of the SE-group focuses on both system analysis and decision support. The DES project creates a possibility to develop, apply and test the knowledge and skills of the group in a scientific way.

**1.2.2 Concept of a Decision Enhancement Studio**

In this section we go through the concept of a decision enhancement studio described in [Keen and Sol, 2005]. A studio is a virtual environment where people, process and technology come together. Together they create an environment where successful decision-making is more likely. An effective Decision Enhancement Studio combines the usefulness, usability and usage to the organizational, social and political context. The usefulness of tools and methods is the value that they add to decision processes, their usability is the mash between people, process and technology and their usage is their flexibility, adaptively, and suitability [Keen and Sol, 2005]. The components in a decision enhancement studio are:

**Landscaping**

The assessment of the organization’s business vision, time horizon, partnership strategies and imperatives – “must do’s” on the immediate business agenda. It is key because this defines what will be the decisions that matter for the organization. Landscaping answers such questions as how far out are we looking – what is our time horizon? How broadly are we looking – just at our enterprise needs and plans or across our supply chain, customer and partnership

**Orientation and initiation**

Ensure a team with the skills, credibility and domain expertise to attract, motivate, coordinate and help the studio participants move to a decision commitment.

**Recipes**

Recipes are proven, repeatable, adaptive and codified procedures that can be transferred across organizations. Recipes are methods build on practice and experience.

**Suites**

Integrated sets of tools focused on enhancing the process and the people contributing to decision-making. Suites are effective if and only if stakeholders in a decision situation actually use them.

³ [www.portofrotterdam.com](http://www.portofrotterdam.com) visited at the 15th of September 2004
Processes
Well structured processes influence the likelihood of their making effective decisions. The processes describe the steps that the participants have to make together in order to support them reaching a decision.

1.2.3 Studio for spatial planning at the Port of Rotterdam
The DES-project departs from the assumption that a ‘studio’ or ‘tool suite’ can enhance the decision process in spatial planning at the Port of Rotterdam [Chin et al., 2004]. In the DES-project the DES-concept is applied on the decision processes in spatial planning at the PoR. In this section we explain some of the ambitions and vision on use cases of the DES-project, which is worked out in more detail in chapter 4.

1. Support both process and content
The DES-project aims to support both process (the work that the PoR employees carry out to make the spatial plan) and content related issues (helping to structure the information that is the basis for the plan) in a spatial planning process.

2. Support multiple users with different backgrounds
Multiple users who look at the problems from their own perspective go through the spatial planning process. The reference-framework of each user may result in a need for tailored elements in the process and suite design.

3. Support through a suite of software tools
In the Decision Enhancement Studio a suites of software tools is available to support decision makers. As we have several disciplines contributing to the spatial plan, different tools may be needed for support.

4. Attention for static and dynamic properties relevant for spatial planning
The studio should be able to cope with both static aspects (e.g. the properties of an area), and dynamic aspects (e.g. the effect of choices on the road use over the day).

5. Attention for past, present and future
Decisions of today may block opportunities in the future. Consideration of the past, present and future are relevant for developing an area, and should be supported by the studio.

6. Strong integration with data and sources present at the PoR
At this moment the PoR own a tremendous amount of data and sources of data. Many of them can be useful for spatial planning. The studio should use the relevant data and sources present at the PoR.

1.3 Focus of this project
In this section we will describe the focus of the activities within the DES-project. The focus is determined in close contact with the stakeholders of the DES project. The function of this focus is twofold:

1. produce specific applicable output instead of some general findings,
2. effectively use the available resources for this project.

Many different types of spatial plans are used at the PoR. Each of these plans refer to a collection of various spatial planning efforts. We narrow the scope of this research to a specific type of spatial planning called ‘area-planning’. In section 1.3.1 the type of area planning is explained based on some leading axioms. There are many different decision processes that take place in an area planning study. This project has an important focus on
supporting the *matching process* within these studies. In chapter 3 we describe matching in more detail.

### 1.3.1 Matching within a specific type of spatial planning

**Leading axioms to distinguish spatial planning characteristics**

The PoR does not have univocal definitions and vocabulary for the different types of spatial planning. Iterating through a collection of spatial plans show differences between them in terms of size, detail and time range. Although the names for the types of spatial planning at the PoR are not univocal it may, to some extent, provide insight into the three axioms. The types of spatial planning distinguished are: port plan, spots plan, area plan and development plan. The three axioms to indicate the differences between spatial plans:

1. **Scale**
   The size of the area and the lots considered in an area plan are unique for each spatial planning activity. The size in spatial planning is a continuum from the port plan that considers the whole Rotterdam port an industrial zone with its 10,000 acres, to a development plan that considers an individual lot of for instance 2 ha. Based on the considered area size, the general order of spatial planning activities in between is: spots plan and area plan.

   **Example of different types of spatial planning**

   For an area near the Markweg, the area plan is quite specific. Because of small lot size and limited facilities, the bandwidth of optional lot-use combination is limited. The level of detail made it possible to specify the nature-value and plan to integrate, compensate and mitigate it in detail. For the Europoort-Oost the area planning is done on a larger scale and therefore the role of nature-value in the process was very limited [van der Blaak et al., 2004].

2. **Scope**
   The level of detail of a spatial plan refers to how specific the plan prescribes the activities for the development. The level of detail is a continuum from general market segments, such as containers, chemical or dry-bulk, to specific customers or non commercial uses. Another element is how specific the relevance area of the planned use is. In a spatial plan the relevance area can be indicated specifically on lot level or general on a map without considering current lot boundaries (spot). In general a port plan prescribes general market segments in larger zones of the port. On the other end of the continuum a development-plan describes a specific customer in a lot or non-commercial use of a lot, and the specific design of necessary adjustments.

3. **Time range**
   Every spatial plan is created for a time range. Some of the adjustments are impossible to realise within a certain time. The current occupation of areas cannot be instantaneously moved to another location instantly. The time range of spatial planning at the PoR is a continuum from 20 years in a port plan to 1 year in a development plan.

   **Four types of area planning**

   At the PoR Four levels of area planning may be distinguished: port plan, spots plan, area plan level and a development plan. The scale of a port plan is a vision on the desired
A decision enhancement studio for area planning

economical and spatial development of the Rotterdam port and industrial zone\(^4\). The scope is dependent on the area and leading uses and it considers a time range of 20 years. The concept of a spot plan is used in many different scales in general it covers multiple developed and undeveloped lots. The scope of the plan is not very detailed and in general the time range is 10 years. The scale of an area plan is dependent on the area considered. The scope is dependent on the presence of potential customers and leading problems. The time range is for the coming 5 years. A development plan is a plan to develop a specific lot with a specific use. The scope is one lot and, in case of commercial issue, one specific customer. The time range considered is depending on the issues at hand. Building a quay-wall may take several years but in other cases it may take less then a year. In this project we focus on area planning. The levels of area planning are illustrated in Figure 1-1.

![Related levels of spatial planning](image)

**Figure 1-1. Related levels of spatial planning**

The different levels of area planning are related to each other. Many aspects are involved in the operational level of area planning. Some of the aspects on operational level of area planning must be taken in account on tactic and strategic level. The other way around is true as well. The chosen strategy formulated in a higher level of area planning is inherited in lower levels of area planning.

\(^4\) [www.portofrotterdam.com](http://www.portofrotterdam.com) visited at the 15\(^{th}\) of September 2004
2 Project outline

2.1 Project goal

Although area planning is an instrument to get a grip on successful arrangement of the port and in industrial zone over time, several weaknesses and opportunities in current matching can be identified. This research departs from the notion that a matching process supported by computer enables services may enhance decision making. We define the challenge for this research as follows:

“Develop a decision enhancement studio for the area-planning process at the PoR.”

For developing a process and service a development cycle is explained in section 2.2. The support of matching is viewed from a process and content perspective. The challenge from the content perspective is to handle the complexity and the extent of all the aspects involved in matching.

Matching in area planning is like a puzzle of lots and uses. In Figure 2-1 the puzzle of matching in the Rotterdam port industrial zone is illustrated. The demand side defines the possible use of lots for potential customers, general market segments or another type of development. The supply side represents the available lots in the Rotterdam port industrial zone. The uses are pieces of a puzzle, they all have specific shapes and other characteristics which have to fit the characteristics of a lot and its neighboring lots. A piece that fits the puzzle is both feasible and desirable and is a potential match. Matching many uses and lots in the Rotterdam port industrial zone on a manifold of objectives is far more complex than a regular puzzle as it involves many dimensions and boundaries that are not as fixed as regular puzzle pieces.

![Image](image_url)

*Figure 2-1. Puzzle matching lots and market in the Rotterdam port industrial zone*

2.2 Approach

The DES project is based on the spiral approach introduced by Boehm [Boehm, 1988]. In Figure 2-2, the phases of this research are derived from the spiral approach. The figure also illustrates the outline of this report coupled to the phases of this research. Applying the cycles results in incremental development of a system. This research goes through the first cycle of the spiral approach to develop a matching support approach. The phases of this research are requirements analysis, design, build, and test and evaluation. The phases are briefly introduced below.
Major characteristics of the spiral model:
- Emphasis on iterative development
- Risk control: each cycle deals with the most risky part/aspect remaining
- Definite end (opposed to development through a continuing flow of upgrades)

Figure 2-2. The spiral model

Requirements analysis

First it is needed to make an inventory of the requirements for an approach to support matching. The requirements are extracted by participating in the area planning process, previous area planning activities and user analysis. Participating in the Noord-Westhoek case and frequent meetings with the area planning team provided a clear view on the current process. In section 7.2 the Noord-Westhoek case is introduced in more detail. Some of the experiences with previous area planning projects, such as the Europoort-Oost and Hydro-Agri case have been studied. Besides the mentioned meetings and participation in the Noord-Westhoek case, additional interviews and discussions with specialists from CZ, IM and Strategy were needed to research the aspects involved with area planning. To create a reference framework, the current area planning at the PoR will be briefly described in chapter 3. Based on the current area planning process, requirements for matching support are determined and described in chapter 4.

Design

Abstracted from the current matching in the area planning process an approach to support matching is designed. The requirements for matching support are translated into an approach for matching support and the integration in the area planning process. The result of this phase is a description of an approach to support matching.

The experiences with the actual process provided a picture of usefulness to some extent. An approach to support matching is made in close contact with employees of the PoR with experience in, or knowledge of area planning projects. The designed approach is described in chapter 5.
Build

Before putting effort in implementation the approach will be validated using a prototype. The usability of the services will be limited due to the lack of computational capabilities and functions. Therefore, the prototype is a way to communicate part of the approach rather than be a fully functional support tool. Chapter 6 describes the prototype.

Test and evaluate

Although the approach is designed in close contact with the PoR, success remains uncertain. The approach for matching support cannot be tested in whole because of the magnitude of such an operation. Therefore, elements of the approach are tested on just the usability to minimise the uncertainties. The paper version of the services will be a way to communicate part of the approach to the participants in the tests. The elements of the approach will be tested to the DES project team and team responsible for making an area plan for the NW-hoek. The designed processes that embrace the support tool are to be validated by the same people that test the paper version of the support tool.

The primary objective for testing is get feedback on expected usefulness of such an approach, what is the value it adds to the decision processes. The secondary objective of the testing is create a foundation for the application of the approach to create acceptability and usability for implementation in the DES. Chapter 7 describes the proposed test approach.
3 Current way of working in area planning

In this chapter we elaborate on current area planning processes at the PoR. Knowledge of current area planning creates a reference framework in which to develop an approach to support matching. In section 3.1 the phases in the area planning process are described in chronological order. During the current area planning process a set of criteria and characteristics is used for matching. In section 3.2 the aspects related to matching of supply and demand of areas in the Rotterdam port are presented. We reflect on the current area planning process and set of aspects in section 3.3.

3.1 Process

Area planning in the PoR is a relatively new process. The first area plan was made for the Hydro-Agri area [Pons et al., 2003]. After the Hydro-Agri area planning process finished in July 2003, the procedure and status of area planning have evolved. In this chapter we describe a generalisation of the way of working during area planning until August 2004. The chronological order of phases in an area planning process is shown in Figure 3-1.

First the project is started and an area planning team investigates the area. The area has opportunities and constraints for spatial development. Based on knowledge of the area and the opportunities and constraints, the area plan is determined. At the end the area plan is communicated to the relevant actors at the PoR in the ‘finalise phase’. In general, the phases are ordered as mentioned but in reality it is an iterative process. New information entering the process in the ‘determine area plan phase’ could cause a rollback to the ‘investigate area phase’. The phases mentioned are described in paragraph 3.1.1 to 3.1.5.

3.1.1 Start up

The start up phase is illustrated in Figure 3-2. The initiative of starting an area planning process comes from repeating meetings between the Port Infrastructure division (I&B) and the Commercial division (CZ). There is a need for an area plan when a reasonable amount of area can be issued by the PoR. Areas that can be issued are: non-issued PoR-owned areas and/or some undeveloped strategic option area. For undeveloped strategic option area the PoR checks the plans of the customer. If the area can be recovered by the PoR it is taken into account.
Example of arising need for an area plan

The former producer of fertiliser Kemira has closed its facility in the Europoort-Oost area [Van der Blaak et al., 2004]. The retrieval of the Kemira terrain by the PoR and the presence of undeveloped area nearby were reasons to make an area plan.

Start up

CZ – I&B meeting
Identify need for area plan

Start up phase in current area planning process

The I&B and CZ meeting (Information & Management division together with Commercial Affairs division) determines who will be the chairman of the Area Planning Team (APT). The chairman determines the rest of the area planning team. The main actors involved are I&B and CZ and specific aspects specialists are attracted. The general team compilation is illustrated in Figure 3-3.
The compilation of the APT meetings depend on the items on the agenda. The APT in whole has monthly meetings to inform all members and decide key issues. In between, the chairman has meetings with some members (2-3) to discuss specific issues.

3.1.2 Investigate area

The ‘investigate area phase’ is illustrated in Figure 3-4. The first part of the ‘investigate area phase’ is to make an area planning proposal. The proposal consists of the motif, the goal, the focus area and the approach.

The CZ-I&B meeting reviews the proposal and decides if they are willing to start the project. If the proposal is approved, the OTA draws a map of the focus area with a general layout of the infrastructure and lots.

Figure 3-4 Investigate area phase in the current area planning process

The gaps in and research of area information is communicated in the meetings of the APT. Dominant aspects in this phase are related to area availability, liveability and accessibility as described in paragraph 3.2. Missing information is collected and investigated by the responsible team member. The issues arisen from the new acquired information are items on the agenda for the next APT meeting. When all relevant information about an area is collected, the opportunities and constraints phase is started.

3.1.3 Opportunities and constraints

For each lot the opportunities and constraints on all the aspects involved are determined. In this phase the opportunities are identified and the constraints are, when possible, solved. During the meeting the team elaborates on the subjects and if additional information is needed the responsible team members will start an analysis. The opportunities and constraints phase is illustrated in Figure 3-5.
Opportunities and constraints

APT
Communicate opportunities and constraints

Yes

The relevant opportunities and constraints are considered?

No

APT-members
Investigate discipline specific opportunities and constraints

Yes

APT
Determine feasible spatial development

The selection of options for each lot are feasible?

No

Figure 3-5 Opportunities and constraints phase in the current area planning process

Example of an opportunity
At the former Kemira lot in the Europoort-Oost area two large ammonia tanks are present. The tanks are very expensive to procure which makes it interesting to attract ammonia related industry.

Example of a constraint being solved
For the Noord-Westhoek some undeveloped lots have no rail connection. In the ‘opportunities and constraints phase’ the team determined that making a rail connection is relative easy because a rail connection was already planned for a nearby customer.

After all the opportunities and constraints are identified, the team will determine possible market segments for the development of a lot. For matching the PoR uses the ‘Matrix’, a model of characteristics of general market segments. The ‘Matrix’ is a table in which the rows are market segments and the columns are the aspects involved in fitting in the market segment. Most of the aspects involved are determined by the ‘Matrix’. In section 3.2, the ‘Matrix’ used for area planning is briefly introduced. By comparing the aspects in the ‘Matrix’ with the area characteristics, a selection of possible market segments in a lot is determined.

Example, matching of a container terminal and a lot
Possibilities to host container related activities in the Hydro-Agri area are limited [Pons et al., 2003]. First, the available lots are 8.6 and 12.5 ha and a container terminal needs about 60 to 120 ha. Second, a container terminal produces 67-69 dB(A) which does not fit within the noise budget of 60 dB(A). Third, the fairway and port basin of the Hydro-Agri area cannot provide access for ships with a depth of 15-19 meters. The arguments mentioned make the area relative unsuitable to host a container terminal.

3.1.4 Determine area plan
In the ‘determine area plan phase’ a workshop is held. The area planning team prepares the workshop by making a presentation of the lots. In this presentation, the optional uses and opportunities and constraints of a lot are elaborated on. During the workshop a multidisciplinary team will brainstorm, discuss and decide about the most desirable use per lot. The team consists of industry and logistics employees of the divisions CZ, I&B and Strategy. The results and ideas generated in the workshop are examined in detail by the
area planning team. The result of this phase is a vision on the spatial development that optimises the availability, accessibility, liveability, sustainability and commercial attractiveness of an area, flexible and in harmony with its environment. The determine area plan phase is illustrated in Figure 3-6.

![Determine area plan phase](image)

**Figure 3-6 Determine area plan phase in the current area planning process**

### 3.1.5 Finalise

The finalise phase consists of making a report on the results of the previous phases. The output is a description of an area plan. The area plan is presented to the CZ-I&B meeting which determines a plan of action. The finalise phase is illustrated in Figure 3-7.

![Finalise phase](image)

**Figure 3-7 Finalise phase in the current area planning process**

### 3.1.6 Overview of the overall process

In Figure 3-8, an overview of the overall current process is given, where all the activities as discussed in sections 3.1.1 to 3.1.5 are integrated into one diagram.
A decision enhancement studio for area planning

Figure 3-8 Actor Activity Diagram of the current area planning process
3. Current way of working in area planning

3.2 The “Matrix”: aspects to weigh alternatives

In this chapter, a set of aspects relevant in the Hydro-Agri, Europoort-Oost en Noord-Westhoek case are described. The aspects involved are described based on a categorisation. The categories have a proportion of two perspectives, aspects with a possibility and desirability share. The possibility of a match is determined by scanning area and market constraints. The desirability per possible market is evaluated by comparing the market aspects with the PoR interests.

In Figure 3-9 the categories and perspectives are illustrated. In the figure the ‘match’ has a desirable and possible side. The bars between the desirability and possibility side represents the categories. A bar has a white side indicating the desirability and a grey side indicating possibility fit of a use in a lot. Availability, accessibility and liveability are dominated by possibility aspects. In the category sustainability the two perspectives have a relatively equal share of input. The commercial attractiveness is dominated by desirability aspects. In sections 3.2.1 to 3.2.5 the desirability and possibility aspects within the categories are explained.

![Figure 3-9 Angles of approach, possible versus desirable use](image)

3.2.1 Availability

An area planning process may involve multiple lots with specific characteristics. The aspects related to the area availability are: shape, size, surface type, present structures, activities nearby and destination in the municipalities’ development plan.

The shape and surface needed by a customer must fit within a lot. The shape and surface could limit the use of a lot. A lot shape in the matrix can be a square, rectangle, trapezium, L-shape, T-shape or triangle. The size of an area is indicated with hectare (ha). Planning an industry that needs a rectangular lot in a triangular one may cause inefficient use which is undesirable.

**Example, lot shape and surface criteria for a container terminal**

To host a container terminal for deep-sea ships the lot must be rectangular, 45 to 120 ha and a lot-depth of 400 to 600 metres to host the high reach crane and container storage.

The surface type (space, size) and presence of structures (e.g. roads) could be used by a future customer for a lot. In the investigate area phase an inventory is made of the surface type and the presence of structures.
The Rotterdam municipalities make a development plan for use. The use indicated in the development plan could conflict with the desired use from the PoR perspective. In some cases an adept procedure must be started to change the development plan. This may cause delays or limit possible market segments for an area.

### 3.2.2 Accessibility

In this section we describe the lot accessibility. The description of the accessibility is divided in the water side and land side accessibility.

*Water side*

For the water side accessibility various aspects are taken into account. The manoeuvrability in the port basin and fairways may be limited because of other occupation, traffic or strong current. The depth of fairways and port basins depends on the dredge policy. The dredge policy is determined by the contracted depth of the former customer or a nearby customer. The type of quay may determine the maximum dredge depth and may limit possible customers. Fixed bridges in the fairway to the lot sets a height limit on passing ships.

The mooring facilities in an area consists of quays, mooring posts or buoys. A quay or a mooring post is built to withstand a specific side/surface pressure and dredge depth. Possible use depending on water accessibility may depend on the type of quay or mooring post. For lots without direct water access, water accessibility may be provided by the multi-user concept. The multi-user concept makes it possible for multiple customers to share water side accessibility facilities like quay or mooring posts.

In some waterways there are side-to-side transhipment facilities. Side-to-side transhipment is done using a buoy or mooring posts in a L/T setting. For a lot with possible water side accessibility nautical aspects present and possible mooring facilities have to be investigated. The result is a selection of the nautical modalities, inland navigation, Deep-sea, Short-sea, Feeder and RoRo that can reach or depart from a lot.

*Land side*

Available transport modalities like road, internal road, rail, high voltage power lines, underground cables and pipelines provide the land side accessibility of a lot. Public road access is in most cases a necessity and a spatial reservation is made for it. Access to rail or specific underground pipelines depend on the need of a customer and the costs to realise the infrastructure.

Capacity of the infrastructure has not been a big issue yet. Recently some potential capacity problems at the Waalhavenweg and near the gate of Maersk at the Maasvlakte-1 were identified. Some trajectories in the pipe strip have limited space left to put in new pipelines.

**Example, possible road capacity issue**

For a dedicated container terminal and empty depot for inland navigation the area development team identified a potential bottleneck in the crossing of the Missouriweg and the N-15. After investigation there was no doubt that the road capacity would be insufficient.

Some customers need an internal road to speed up customs handling and transport to other facilities. Because an internal road is a dedicated private road there is no need for registered
vehicles or official chauffeurs. Some lots can be reached by public transport, which could be of importance for labour intensive activities like value added logistics. Public utilities provided from the land side are: natural gas, drinking water, low voltage power, sewer, telephone lines and extinguish water.

### 3.2.3 Liveability

Liveability refers to the work conditions of the employees in the Rotterdam port industrial zone, and the live conditions of the residents nearby. Liveability aspects involve among others noise, (fine) dust, stench, external safety, soil pollution, outside view and protection of endangered species in the flora and fauna of an area and its environment.

For noise levels the customers within an area have to stay within a budget. The budget is fixed and indicated by a Maximum Tolerated Noise Level (MTG) expressed in dB(A). The PoR has a model to shift the noise budget within an area [Ketel, 2004].

The Soqumas database [Ketel, 2004] at the PoR keeps track of soil pollution in the Rotterdam port and industrial area. Soil pollution such as styrene, cumin and methylbenzene have to be taken into account to prevent delays. For some developments the soil must be purified from pollution in order to get a building permit. Before an area is developed, a so called ‘zero measurement’ is executed in order to be able to account the customer for the pollution.

The external safety could affect the optional uses. Key indicators are the group risk curve and the risk contours. The group risk curve in an area indicates the probability of a number of fatalities a year. For this curve a norm value of the maximum acceptable risk is given. The risk contour is a geographical indication of the risk of fatalities. Within the risk contour of $10^{-6}$ it is not allowed to develop activities with high people intensities such as offices. For residential areas the norm is even stricter. The PoR retrieves the information about the external safety from the Dutch national institute of public health and the environment (RIVM). For the note on risks and severe injury (BRZO ‘99) some businesses are obligated to do a safety research, the results are available through the RIVM.

Dust production could lead to complains of for instance inhabitants or greenhouse exploiters. When close to vulnerable, areas dust production could lead to problems.

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**Example, relevance of controlling dust production**

The current dry bulk terminal at the Maasvlakte-1 must take measurements against dust production. The predominant south-west winds transport dust, which is inconvenient for the nearby residential area. Area planning for the Noord-Westhoek takes in account this aspect and non-dust-producing companies are preferable.

The nature value of an area undeveloped for some time could be significant. The European Union conservation of nature laws have habitat directives for protected species. For possible presence of protected animal or plant species, a test must be done to prevent loss of nature value. When present, an exception request must be processed to be able to develop the

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5 According to Cees Pons July 2004

6 According to Peter Ketel July 2004
area for port and industrial purposes. On yearly basis a port scan is made to make an inventory of potential live areas for protected species.

The outside view of the Rotterdam port industrial zone is of importance to create a pleasant area to work and live in. The PoR has committed itself to create a good outside view and designed some objectives to create or protect the outside view. Synergies between outside view and nature values are possible. Furthermore, a line of trees or dunes could create a buffer for noise and external safety.

The difficulty faced by the client is in endeavouring to establish the thin balance between giving just sufficient undertakings to satisfy the environmental authority, and keeping as much freedom as possible. Environmental aspects of port development are here to stay, and the time and costs involved should never be underestimated [Elsdon, 1999].

**Example, relevance of environmental aspects**
On an ongoing project in the UK, although not one undertaken on a design and construct basis, the Port of Felixstowe had to enter into 18 months of delicate negotiations before all environmental issues were agreed to the satisfaction of the various environmental authorities. Mitigation measures on that project have included the creation of inter-tidal mud flats as a habit for wading birds, and the deliberate spilling of fine material during routine dredging to wash upstream. This will probably involve a cost premium, since it will reduce dredging efficiency [Elsdon, 1999].

### 3.2.4 Sustainability

A sustainable exploitation of the Rotterdam port industrial zone uses fossil fuels in an efficient and effective way. Therefore the transport in the Rotterdam port industrial zone must be optimised and the focus is on environment friendly transport modalities. Future activities should be clustered as much as possible and developed in harmony with the existing functions nearby. Exploiting synergy and cluster advantages within industrial and port logistics is one of the aspects involved in area planning. Companies may have cluster advantages can when a product or by-product of a company can be used as raw material for another company.

**Example of cluster advantage**
One of the by-product of a chemical plant is heat. Crude-oil transhipment activities near the chemical plant may use the heat for heating crude-oil. The heated crude-oil is for faster transhipment.

The combined use of facilities or recourses can be a cluster advantage. Combined use of roads, security and sewer on a distribution park lead to efficiencies. Essential in the clustering of companies is the presence of an anchor company. An anchor company is a relatively big company which attracts small companies who work together in the production of related products. Investment by the PoR is interesting when sustainable development may be attracted. It is more likely that the investments will pay of in the long run [Van der Blaak et al., 2004].
3. Current way of working in area planning

3.2.5 Commercial attractiveness

The commercial attractiveness of an area for the PoR is the right company on the right spot based on an optimal combination of area availability, accessibility, liveability and sustainability [Groen et al., 2004]. Aspects in the commercial attractiveness derived from the interest of the PoR are:

- employment in the Rotterdam port industrial zone;
- economies of scale on investments;
- economies of scope in the Rotterdam port industrial zone;
- increased competition in the Rotterdam port industrial zone;
- revenues from harbour dues, transhipment and lot rent;
- investment in, among others infrastructure;
- efficient exploitation of scarce area in the Rotterdam port industrial zone.

Some of the commercial attractiveness aspects mentioned are elaborated on in the current matrix. For instance the expected investment needed to be able to host a use is indicated by a categorical scale: high, middle and low.

3.3 Weaknesses and opportunities

Area planning is a relatively new process, the first area plan was made in July 2003 and has evolved ever since. To guide the development of area planning into the next phase the weaknesses and opportunities should be addressed. The weaknesses and opportunities of the current way of area planning are identified and described in this section. First we elaborate on the general issues for reflection in section 3.3.1, second on the matching specific issues in section 3.3.2.

3.3.1 General issues for reflection

Difficulties to cope with dynamics during area planning

Area-planning projects may take up to 10 months [Chin et al., 2004]. In a dynamic area such as the Rotterdam port and industrial zone the starting conditions could be quite different compared to the end conditions. The time between relevant dynamics and the moment the area planning team copes with the dynamics should be minimised. Delays in the identification of dynamics could make an area plan obsolete before it is published. A customer that becomes interested in a lot within the focus area of an area planning project could face significant delays. The Rotterdam port industrial zone may be less interesting for potential and current customers who need to act quickly. Some customers don’t have 10 months.

Example of delayed establishment of a customer caused by long area planning

A customer wants to develop a container terminal in the Yangtzehaven to anticipate on the expected growth. The area planning process may take a lot of time because of the complexity and uncertainty generated by the MV-2 project. A long area planning procedure may result in a missed opportunity for the customer to attract additional market. For the PoR a long area planning process can result in a missed opportunity to collect additional land rent, quay dues, and harbour dues.
Example of losing control over spatial development due to dynamics
An area planning procedure for the Europahaven area is started in January. In June a well-known company that produces raw material for the chemical industry has acquired a lot near the Europahaven. Realising a cluster of chemical related companies in the Europahaven area could be an interesting option. The area planning process cannot adjust quickly enough on the establishment of a chemical factory and an empty depot for containers is planned instead.

Even if the process successfully coped with the dynamics during the process the area plan is vulnerable for changes. The area plans are not maintained and because of changing underlying assumptions, the area plans can be outdated and be ‘just another report on the shelf’ [Pons et al., 2004]. Control over spatial developments devaluates over time if the area plans are not kept up to date.

Insufficient control over spatial development
The status of an area plan within the PoR is not unequivocal7. On one hand the status can be very strict. The area can only be developed in the way determined by the area plan. If the status of an area plan is too stringent it may result in a lost opportunity to acquire an attractive customer. On the other hand very flexible demand based issuing of area may result in spatial development that is not in the best interest of the PoR. The success of area planning in controlling the spatial development of an area depends on the status it has within the PoR. Losing control over spatial development because of an unclear status may damage the interests of the PoR. Less control may lead to an incoherent set of industries, which negatively influences possibilities for clustering and bundled services.

Use of creativity of the area planning team to solve issues
A tremendous amount of information scattered over different parties in the PoR has to be processed when an area plan is made. The information is essential to determine possible and desirable spatial development of an area in terms of market segments or potential customers. Bringing together and processing all the information takes time and drains valuable resources of the PoR. The amount of effort to collect, generate and process the information leaves limited room to exploit the creativity of the area planning team to solve issues8.

Inefficient use of resources
The main communication between area planning team members is done during meetings. Meetings are used for informing, attuning and decision making. Besides general team members some specialists are involved for input of subject-specific information. Only a selection of team members have to be informed on some subjects causing other team members to be distracted. Specialists and team member capacity are claimed although their attendance is not a requisite. Furthermore the project manager cannot convert the information directly into a decision item, which delays the process.

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7 According to Harry Smit July 2004
8 According to Joop Smits December 2004
Not enough learning from previous decision making

The area planning process is not formally standardised, there is no list of checks and issues to be taken into account. Besides team members experience and recorded considerations in the area plan report, no detailed memory of the decision process structure and content is part of area planning. Valuable experience of mistakes and successes will get lost in the organisation on the long term.

3.3.2 Matching

The set of aspects in the ‘Matrix’ is not complete

The set of aspects in the ‘Matrix’ can never be complete, because several of the problem that the area planning teams encounter are so specific for a certain area, that it can not be found in the matrix. Actually this is a good thing, as a matrix with many, usually irrelevant, aspects would be harder to use than a matrix that contains the most important aspects. The addition and deletion of aspects is hard when using a paper matrix; different versions might be confusing for the teams.

Example, additional aspect used for matching in the Europoort-Oost case

In the ‘determine area plan’ phase of the Europoort-Oost case the presence of two ammonia tanks makes the area interesting for an ammonia cluster. The structures present in a lot is not an aspect standard in the ‘Matrix’.

The aspects in the Matrix related to the commercial attractiveness are briefly elaborated on [Groen et al., 2004]. In paragraph 3.2.5 the definition of commercial attractiveness is much wider than just the height of the investment indicated as high, middle and low. In the matrix ‘added value to the PoR’ and ‘market need’ are mentioned but the columns are not yet filled in. The success of matching is partly depending on the contribution of the commercial attractiveness in matching. This is one of the areas where the matrix could – and probable should – be extended.

The types and format of aspects in the ‘Matrix’ does not grasp the complexity of reality

Some of the aspects are evaluated in a different way than in the format and type present in the ‘Matrix’. Reality is often so complex, that it can not be reduced to an easy to evaluate number in the ‘Matrix’. Spatial information, human judgements, commercial attractiveness, and many other aspects are hard to put on a numeric scale. Therefore, the area planning teams often use textual information to express the judgement on a cell in the ‘Matrix’. This makes (automated) comparisons harder, but is a much better way of dealing with the complexity of reality. By the way, the solution chosen in the prototype as sketched in section 6.4.4, specifically deals with this aspect.

Example, dynamics of clustering in the Noord-Westhoek case

The Euromax container terminal will develop over time and the need for empty containers storage nearby will increase. A lot in the area could be developed as an empty depot but the size needed is direct related to the development of Euromax. The workshop participants decide to make a flexible reservation for empty depot to cope with the dynamics.
The set of possible uses in the ‘Matrix’ is not complete

Matching is done in two phases of the area planning process. During the ‘opportunities and constraints’ phase and the ‘determine area plan’ phase. The ‘Matrix’ is used by the APT to determine the possible uses of a lot. In some cases the workshop participants in the ‘determine area plan’ phase have other ideas about the selection provided by the area planning team. The weights that the workshop participants attribute to the aspects when they have the overall view in later stages of the process is different from the original analysis where the lots were judged one-by-one. In the workshop, different types of uses might be suggested such as public area, general port service or nature. The matrix might also be extended in the way that more non-commercial types of use are added.

Example, wider range of optional uses in the Noord-Westhoek
In the workshop for the Noord-Westhoek the participants generated ideas to develop lots in the area. Some of the suggestions are added to the list of optional uses generated by the area planning team. Some of the suggestions where: hotel, business collection park and temporary storage.

Some of the comparing takes too much valuable time

The possibility or desirability is determined by comparing possible use and lot characteristics, which takes time. If part of the comparing could be done by other means it will save valuable resources of the PoR.

Overview of all the decisions taken and to be taken

Many decisions have to be taken for matching. Those decisions determine the possibility and desirability by comparing optional uses with several lots based on a set of relevant aspects. It takes a lot of effort of the area planning team to get an overview of the decisions. The decisions taken and to be taken should be structured and presented in a way that an overview is provided.

3.4 Reflection

With this analysis described in this chapter we can make the next step for developing an approach to support the area planning process within the PoR using a Decision Enhancement Studio.
4 Proposed way of working for area planning

4.1 Studio for spatial planning at the Port of Rotterdam

The DES-project departs from the assumption that a ‘studio’ or ‘tool suite’ can enhance the decision process in spatial planning at the Port of Rotterdam [Chin et al., 2004]. In the DES-project the DES-concept is applied on the decision processes in spatial planning at the PoR. In this section we explain some of the ambitions and vision on use cases of the DES-project.

Ambition of a Decision Enhancement Studio for spatial planning

1. Support both process and content
   The DES-project aims to support both process and content related cases in a spatial planning process. The support of process focuses on the way to “manage” the actor network and the interaction between participants during the design process. From the content perspective the support aims to give decision makers insight into the variables and relations in (parts) of a system. The DES-team recognised the complexity and extent of developing the Rotterdam port and industrial zone. The participants in a spatial planning project address many interdependent multi-dimensional problems [Chin et al., 2004].

2. Support multiple users with different backgrounds
   Multiple users who look at the problems from their own perspective go through the spatial planning process. The reference-framework of each user may result in a need for tailored elements in the process and suite design.

3. Support through a suite of software tools
   The concept of a Decision Enhancement Studio prescribes suites of software tools to support decision makers. The DES-team presumes that software tools may help to accomplish the objectives to support the process and content.

4. Attention for static and dynamic properties relevant for spatial planning
   In the context of area planning in the Rotterdam port industrial zone there are relative static and dynamic properties. Dynamic properties have the tendency to change more rapidly compared to static properties. The studio should be able to cope with both property types.

5. Attention for past, present and future
   Decisions of today may block opportunities in the future. Consideration of the past, present and future are relevant for developing an area. Secondly the decision making in the past may guide decision making in the future. The history of decision making consideration could proof to be a useful resource of best/worse practices.

6. Strong integration with data and sources present at the PoR
   At this moment the PoR owns a tremendous amount of data and sources of data. Some of them can be useful for spatial planning. The studio should use the relevant data and sources present at the PoR.

The vision on use cases for a Decision Enhancement Studio

In this section we explain the vision of the DES at the PoR. We use three cases to explain the vision.
1. Support preparing of meeting

A member of the area planning team working with a suite of tools to prepare a meeting is illustrated in Figure 4-1. In this preparation session he is creating new information, adding this to the data available for the other participants, and expressing his preference for certain options based on that information. In the studio the individual preparations and collaborative activities need to be well-balanced.

2. Supported spatial planning meetings

In Figure 4-2, a meeting supported by a suite of software tools is illustrated. During the meeting a domain specialist advises other members on decision items using geographical information projected to the wall. The decision makers agree that they don’t have enough certainty to decide and prepare research activities for the coming week. The decisions and choices made in this session are carefully recorded in the suite. In the case as depicted here,
not every participant has a computer. A note keeper records the off line debate which is held. The second laptop is operated by an analyst who is supporting decision makers by showing relevant spatial information. In a later stage, it could be that more participants work on a computer during the meeting, but one has to be careful that this does not distract them from paying attention to the overall planning process.

3. **Support customer acquisition**

![Figure 4-3. The suite might support customer acquisition](image)

A Business Development Manager (BDM) is working with a potential customer in Asia. The BDM prepared the meeting in his hotel-room and made a quick scan on potential lots and presented to most preferable to the potential customer. In Figure 4-3, the setting described is illustrated.

### 4.2 Introduction to matching

To come to an area plan the team or members of the team execute certain sets of activities to reach an objective. Many possible types of objectives exist, and not all objectives are “try to sell and fill this lot as fast as possible”. There might be objectives like “create enough nature use in this area to compensate for industrial use”, “create a buffer zone between two industrial segments”, “attract industry types that do not request any road use”, etc. After a few years of experience with area planning, a pattern in the set and order of activities has been recognised. Several sub-processes come back in every area planning project. One of these processes is the matching process, where supply and demand of lots and use are geared to each other.

A match in the Cambridge Advanced Learner’s Dictionary[^9] is something, which is similar to, or combines well with something else. The phrase ‘matching’ within the context of area planning at the Port of Rotterdam (PoR) is the process of: evaluating lot and use combinations, from multiple perspectives, for a moment in time, based on multiple criteria, tasks and objectives.

[^9]: [www.dictionary.cambridge.org](http://www.dictionary.cambridge.org) visited at the 12th of October 2004
In the definition of matching five dimensions are recognised. In Figure 4-4 the five dimensional evaluation of matching is illustrated. The dimensions are:

1. lots,
2. uses,
3. objectives,
4. perspectives,
5. time.

A lot is a specified part of space (land and water) in the Rotterdam port industrial zone. The lots in matching are PoR owned, issued or non issued, and developed or undeveloped.

A use is a way to develop and exploit a lot. If the area planning team chooses to exploit a lot commercially a general market segment or potential customer is chosen. Alternative non-commercial ways to developing a lot are for instance port facilities, public area or nature compensation area.

Evaluation of lot-use combinations is based on different types of objectives. Many possible objectives are possible, and they can be formulated in different ways, for instance as a goal, target, task or criterion [Voogd, 1995; Voogd, 1977]. In this approach we distinguish between different types of objectives, and base these on the vocabulary regularly used in area planning.

In Figure 4-4, the eyes with different colors illustrate that issues are looked at from many different perspectives. Each participant in an area planning project is biased by individual experience, knowledge and interests. Some members in an area planning team are responsible for putting in their knowledge and experience needed for an area plan. Others have interests in the way an area should be developed. Participants with decision power can represent or come forward with a criterion, task or objective relevant for his evaluation on the
feasibility, desirability or both. Reviewing is done to determine how well a lot and use combination scores on criteria. The result of matching in area planning is a selection of feasible competitive uses for a lot. Competitive in the sense that they are the most desired and it’s not obvious that one is preferred above another by all parties involved.

The lots, uses, objectives and perspectives in matching in the same focus area change over time.

The lot, uses and objectives axioms together form a ‘match-cube’. A match-cube in the figure illustrates a match process in a moment in time, the difference in shape illustrate the dynamic over time. Cause of dynamics the outcome of a matching is valid for a certain period.
5 Design of a tool suite

5.1 Architecture of the Decision Support Studio

In an increasingly competitive and rapidly changing environment, making decisions that matter, decisions that are urgent, consequential and irreversible becomes ever more important but also more difficult. Decision Enhancement Services [Keen and Sol, 2005] aim to support and enhance the process of decision making by providing the right content at the right time, in a format and process that makes sense. It will increase the likelihood of project success by supporting an open exchange of information and ideas, and creating a shared understanding and early identification of risks.

DES make use of generic component based software services that can be combined in many different ways to create customized solutions for a wide variety of issues. To enhance decisions that matter multiple aspects of the situation under consideration must be highlighted. Different models of different aspects can be combined to provide solutions that provide insight in complex situations. To obtain maximum flexibility, loosely coupled models can be plugged into a generic backbone that takes care of data exchange and controls the process. See Figure 5-1 for an overview.

Different stakeholders need to be supported, having different knowledge, experience and backgrounds. Their different perspectives require DES to provide them with information at their own level. Hierarchical modeling services transfer and combine the raw data into information that makes sense to a wide variety of stakeholders. In fact hierarchical modeling services allow zooming in and out, enabling stakeholders to get a quick high level overview, or to dive into the operational details of a certain part of the organization.

![Figure 5-1. Generic services for DES](image-url)
Visual thinking is crucial: if you cannot see it you cannot get it. The outcome of DES must be presented in an understandable and customized way that makes sense. Stakeholders must be able to compare, communicate and discuss ideas based on graphical and visually rich information. They must be able to report information and provide insight into key performance indicators. They must be able to interact in an easy and intuitive way with the services that are made available to them. In order to do so, effective Decision Support combines three “U”s – usefulness, usability, and use [Keen and Sol, 2005].

When designing business processes or doing strategic exploration, different options need to be considered under a variety of possible scenarios. The future is being rehearsed in a simulated environment. It is crucial that stakeholders can keep track of the different decisions that were made, when these were made and by whom. They also need to stay up to date about model changes. Scenario management services aim to keep track of various scenarios and options that were considered. These services must clearly show cause and effect information. Furthermore implementing certain options can require a considerable amount of time causing a period of transition in the organization. Transition management services aim to keep track of the impact of certain options over time.

The architecture embeds suites of modeling, information and communication tools within an effective support process, via studios that help frame the decision-making situation, provide facilitative services and apply proven and adaptive “recipes” of successful Decision Enhancement Services in specified contexts. Effective decision-making rests on effective processes. The three “U”s of Decision Support demand carefully designed studios that build comfort, confidence, convenience and collaboration to guarantee usefulness, usability and use.

The capabilities for providing the Port of Rotterdam with support for area planning, will be built within a Business Architecture, for which the generic structure is sketched in Figure 5-1. Most models and traditional decision support systems have been built bottom-up and case-by-case, with little attention to the dynamic context in which they must come alive if they are to be more than technical artifacts. The business architecture for the Area Planning DES has to link the decision process methods and tools. Therefore, much attention will be paid to the work processes of the Port Community Rotterdam employees who have to use the tools that will be developed in the course of this project. The interviews with several HbR employees in April 2004 provided the first insight into work processes for area planning.

### 5.2 Multi-Aspect modelling services

One of the key points in providing a good architecture for the Decision Enhancement Services for port area planning is that the questions and points of attention will not be constant. Obviously, some of the aspects to take into account when developing an area plan are infrastructure use, logistical aspects, safety and noise. With more and more emphasis on security and safety, the fire safety and evacuation strategies might be evaluated. When the land use around the port changes, e.g. the parts of the port that are close to the city (stadshavens), the demands on certain parts of the port changes as well. Suddenly, environmental issues like noise and stench become important in areas for which the environment was not an issue before. In other words, the questions that will be answered with the DES-suite will change over time. Furthermore, multiple users will work with the suite, and might each address their own questions from their own viewpoints, and with the level of detail that they prefer, and that closely matches their day-to-day processes.
Therefore, the architecture of the decision enhancement suite should support a flexible set of models, that can be linked to the infrastructure models and to the latest available dynamic data. The models should support analyses where the aggregation levels of the models differ. The suite should also support different aspect models, where the type of models can be very different. The user interface should enable the users to select the right models at the right levels, and prepare an analysis of the current or expected status of the areas.

The decision enhancement suite will provide a backbone architecture to which different models and different services can be connected (see Figure 5-2). The backbone guarantees access to a number of services that will always be present:

*Scenario manager*
Selecting which exact situation is analyzed, e.g. a situation with a high or a situation with a low economic growth scenario. Scenarios and policies can influence the outcome of multiple models.

*Aspect model chooser*
Providing the user with access to the library of models, e.g. models that can be ‘overlayed’ on the geographic models for noise, logistic activities, etc.

*Version management*
Multiple users can work with the system through a Web interface at the same time or at different times. Multiple versions of models and model output need to be stored and accessed, and provided with ‘tags’ to identify the data sets and models for later use.

*Infrastructure management*
Selecting and changing the area infrastructure on the basis of geographic information; which types of companies are present? What are their characteristics?

*Data management*
Services to help to connect to base data.

The visualization and reporting that the user can observe, will be very loosely coupled to the models. It is even possible that a user starts a simulation or reporting ‘job’ for which he/she requests the results at a later point in time.

The aspect models (top right in Figure 5-2) and their adapter have to be designed in such a way that new model types can be easily added to the tool suite. Currently, no technical architecture exists that provides this functionality, so this is part of the research that will be carried out for this project by TU Delft. It is expected, though, that by using the structures that are already provided in the D-SOL modelling architecture, it is possible to provide the needed flexibility.

Within a service-based design we can recognize two possibilities for the relation between services in a system (Lee and Tepfenhart, 2002):

1. autonomous peer-to-peer (P2P) relation that are services with a horizontal relation to each other,
2. layered hierarchical relation that are services spanned by multiple sub-services (or sub-systems). This is a vertical, hierarchical relation.

The autonomous peer-to-peer relation is the most important one used in the proposed architecture, as multi-aspect models need to be used, which have to be ‘plugged’ and ‘unplugged’ without crashing the entire architecture.

![Diagram of the decision enhancement studio for area planning](image)

### 5.3 Version management

The complexity of items demand activities of shaping, scanning and choosing. Handling of multiple items leads to numerous parallel activities which eventually have to converge into a single and consistent choice for matching. Each of these activities lead to a wide variety of property information, evaluation models and evaluation matrices with comments, effect, advices and choices multiple types and formats of information. To make that information accessible for future there is a need to manage this variety. The management of information can be supported using a version management service [Chin et al., 2004].

Chin and van Houten [Chin et al., 2004] introduce a version management architecture able to manage this variety of objects in complex spatial issues. In that architecture all the information stored is considered as object according to the Object-Oriented formalism. At some stage users need to make changes to an object although the existing attribute setting needs to be saved due dependency in other area plans. The user needs a service that manages the existence of multiple versions of an object. In the studio an object that somehow could be used in multiple activities needs to be version-able. A new version of an object is created by instantiated a new object using the object factory class of the object involved. The object factory is capable of reconstruct the attributes with persistent data that correspond with the model-object.
Without a way to distinguish versions of an object it would be extremely hard to recall the right version. Versions of objects should have unique identifiers to be able to distinguish the versions from each other. According to the authors a useful identifier of an object consists of:

1. type of object,
2. reference to the subject it refers to,
3. version.

The version consist of three hierarchical numbers to identify the version. The hierarchy has three levels due to application in the process. Creating a sub-minor version is typically an individual effort. A domain specialist that puts in research results or try outs. A minor-version is a final result of a scanning effort which is discussed in meetings. In a meeting the decision makers decide on accepting a set of object-versions in a new mayor version.

**Example of an object identifier according to the architecture**

In 2004 the first version of the risk-contours of the MOT are saved in the studio for area planning. In 2010 some crude-oil tanks are dismantled devaluating the risk-contour version in the studio. The risk-specialist puts in the new risk-contours and saves it for acceptance in meeting to come. The version identifier is: RiskContour.MOT.1.1.0.

For making a new version of an object it might be necessary to contact the author of the model-object to recall the considerations. For that purpose a versionable object should contain an attribute with the author name and date it was created or adjusted.
6 Prototype implementation of a tool suite

6.1 The area plan matrix

During the area planning process combinations of area and use are evaluated under a variety of aspects. The set of all possible combinations can be captured in a three-dimensional matrix. Every cell of this matrix represents a unique combination of area, use and aspect. In the next section it is described that evaluating a combination can in many cases be done automatically. However, an automatic result is not always the preferred result, because area planning is a process in which human judgment plays an important role. Therefore we can distinguish between automatically generated results and human results that overrule an automatic result. The result we try to capture is the possibility or impossibility of an area-use combination for a certain aspect. Of all possible combinations a ranking in terms of desirability can be made.

The basic structure of the matrix is given in Figure 6-1. Note that the matrix itself is called AreaPlan, because the collection of all cells is in fact a representation of a version of an area plan. In the following sections we extend this basic design with further functionalities in order to meet the identified requirements.

![Figure 6-1 The basic structure of the matrix](image)

6.2 Per aspect properties

Area planners consider combinations of area, use and aspect that we want to evaluate. From the evaluation they want to conclude whether the combination is possible or impossible. If the combination is possible we want to determine whether the combination is desirable and how desirable it is in relation to other possibilities.

Area planning is a very human process in which subjective opinions and insights play an important role. The (im)possibility of a combination of an area and use for a certain aspect is in many cases not determined by the laws of nature but by human judgment. For example,
when a company is known to produce more noise than is allowed for a certain area one could conclude that this combination is impossible. However, simply building a noise wall may solve the problem. It is highly unlikely that a computer program will automatically come up with such creative solutions, therefore human judgment is of crucial importance in area planning.

On the other hand the amount of area-use-aspect combinations to evaluate is often by far too large to fully comprehend. Making a quick shift between promising and unpromising combinations of area and use is of crucial importance to prevent area planners from ending up in a swamp of possibilities. To support area planners in making such a quick shift we introduce the concept of “per aspect properties”.

To explain this concept, consider a noise aspect. When regarding noise for a certain area-use combination, area planners determine if the noise producer will not exceed the maximum allowed noise level. It is common practice to set certain noise budgets for the available areas. Assume the area A1 has a noise budget of 70dB, which means that it is not allowed to produce more than 70dB in area A1. Furthermore assume that we consider a company that wants to rent area A1. This company is expected to produce a noise level somewhere between 65 and 67dB. This means that there is no problem for this area-use combination. Purely based on the numbers it is possible to make a first shift between possible and impossible area-use combinations. Only when the company was expected to produce between 65 and 75 dB this would be a direct reason for further research to determine if certain precautions can take away the problem.

The example shows that it is possible to make a quick shift between possible and impossible area-use combinations based in available numeric values. This does not mean that the result is fixed, but it does provide area planners with a first selection of promising area-use combinations, which reduces the perceived complexity of the problem.

Now that the usefulness of per aspect properties is explained the question arises on how to design these in such a way that an automatic evaluation is possible. Not all aspects can be captured with a range or an interval such as noise. For example the availability of road access may be captured in a form such as “available, possible, or not available”, where possible means that road access is not available but can be constructed if required. Furthermore the producer of a certain aspect is not always the use, such as in the noise-example. In some cases it is the area that produces a certain service that is required by a certain use e.g. road access. Therefore we can define a per aspect property to consist of:

1. a type: the type of information to be used to make the evaluation
2. a producer – consumer relation: an indication of what produces the aspect and what consumes it; in both cases this is either an area or a use.

The class diagram is given in Figure 6-2. Both areas and uses are evaluated for different aspects and therefore must have the capability of holding per aspect properties for a wide variety of aspects. The class diagram might confuse the reader because it suggests that Property decomposes in Aspect, Area and Use. However, a property decomposes in either Aspect & Area, or Aspect & Use. To prevent a property to have both Area and Use aggregates at the same time two constructors are defined, of which one requires an area and the other requires a use. Property is an abstract class because a wide variety of aspects
need to be represented. To incorporate this richness, specific property types such as RangeProperty and LevelProperty can be developed.

A method called “compare” is used to compare two properties. This method assumes that it receives two properties of the same type and that one of the properties represents the producer and the other one represents the consumer. The result of comparing the properties results in a number between 0 and 1, where zero means impossible and one means possible. If the result would be for example 0.7 then the area-use combination is more likely to be possible, but it is not entirely sure that it is possible.

As was described per aspect properties are used for an automatic evaluation of area-use combinations for a certain aspect. If necessary this automatic evaluation can be overruled by a human judgment. Also, if an automatic evaluation is not possible for some reason, there is always the human judgment.

### 6.3 Ranking area or use options
Suppose enough cells in the matrix are evaluated to come up with a first distinction between possible and impossible area or use options, then the question remains how to store this distinction in the model? First of all there are two ways of looking at the problem of area planning: one can find a proper use for an area, or one can find an area for a certain use. Both views can be represented as a specific way of slicing through a three-dimensional matrix:

1. When selecting an area an overview of uses versus aspects can be observed
2. When selecting a use an overview of areas versus aspects can be observed

Based on the issue at hand are planners will select one of these views. For example, when a specific company needs to be located and several areas might be suitable the second view is selected.
Within a view a selection of possible and impossible options can be made based on the evaluation of individual cells. We do not prescribe here how this selection should be made, but most likely this will be a multi-disciplinary team effort where experts communicate their preferences.

Because there are two views available it is possible to make two opposing results when using both views. For example when selecting an area, a certain use might be decided to be impossible, while nothing ensures that this area-use combination is also said to be impossible when selecting a use-view! However it is possible to track down these inconsistencies by selecting the third possible way of slicing through the matrix:

3. When selecting an aspect on overview of areas versus uses can be observed

To store the way in which areas or uses are ranked we designed a table. This table stores area-use combinations and their status and rank. The status stores whether the combination is possible, impossible or not evaluated yet. The rank stores how the combination relates to other area-use combinations for sorting purposes. Because one can look from either an area or a use perspective we must store a status and rank for both ways of viewing. In Figure 6-3 a class diagram of the RankingTable is provided. Both area and use have a RankingObject as attribute which is redundant because the same ranking object is stored in the RankingTable. However, depending on the selected viewpoint the user will always work with only one area - or use – RankingObject for every combination of area and use. Also, because respectively an area or use are fixed in an area view or a use view, it turns out to be much more practical to copy a subset of the entire RankingTable to the areas and uses that are being considered. That is why both an area and a use implement RankedObjectInterface.
6. Prototype implementation of a tool suite

6.4 Prototype concepts

The prototype has been built and implemented in the Java programming language. It is a Web-based application that has the potential to be used from different workplaces within the PoR. The prototype runs on an Apache Tomcat webserver, using Java Server Pages (JSP) as a front end to the user. The data is processed in a thin business layer using an implementation of the so-called Model-View-Controller architecture and is stored in a mySQL database. The screenshots in this section give a walkthrough of the functionality that has been conceptualised in the previous sections of chapter 6.

As the prototype is not yet complete, and the implementation might change considerably during the next phase of the project, no detailed technical documentation on the implementation is provided here yet. Description of the technical choices will be part of the documentation of the 2005 follow-up project. Most likely the services provided in the
A decision enhancement studio for area planning prototype can be re-implemented, or modified to conform with the Java Portlet Specification. This will make it possible to link to existing content management and communication services in a stable environment.

6.4.1 Overall area plan with areas, use, and aspects

The entire application is set up in such a way that it can run in or from a Web browser. No information is stored locally on the user’s computer, as that would severely hinder the applicability of the DES in the joint sessions – the whole idea behind the studio is that the information as provided by the participants can be made available during any meeting at any point in time.

After logging on to the system, the history of projects is made available to the user by presenting the area plans and their versions in a tree-like structure (Figure 6-4). Based on the user credentials, it is possible to carry out certain tasks with the project plans. Creating a new major version of the plan is, for instance, a task that only an area plan manager can carry out. When one of the projects has been selected, information about the current versions of lots, lot use, and relevant aspects are presented. There is always the possibility to create additional comments. The idea is that the successive comments of different users of the system present a trace of the line of thought of the project planning team members, that can be successfully used during the current spatial planning process, but especially during follow-up projects in successive years when the area plan is changed. Being able to read the line of thought of earlier planning teams can provide valuable information, especially if it is information that would otherwise be hard to get, e.g. because the particular person is unavailable or has already left the organisation.
6. Prototype implementation of a tool suite

6.4.2 Geographic area information

The DES has to build heavily on geographic information that will be made available through the OTA department (Ontwerp en Tekenen Afdeling or Design and Drawing Department) of PoR. From the start of the project, it has been made clear that the project should not create new geographic information, but rather build on top of the existing geographic infrastructure of the PoR. This has also been illustrated in the architectural design in Figure 5-2.

As geographic information is so important for the DES, and as most discussions are related to the map of the area under consideration, interacting with the DES through geographic interfaces is very natural. All information and all decisions relate in some way to the areas on the map. Therefore, the map interface is an important basis for interaction (Figure 6-5).

A lot of information can be presented on the maps from different background disciplines (e.g., noise contours and noise budget, dust, economic attractiveness, current activities, safety, transport related attractiveness). Therefore, it is important to be able to switch layers on and off, enabling the possibility to show the information in its geographic context and in relation to other aspects. Furthermore, information can be related to the areas on the maps. When a map is selected, detailed information about that area can be presented. The exact interaction that users will make with the map information and detailed area information has yet to be determined. An integration with GIS maps using layered information that can be switched on/off on demand in a meeting is not yet possible in the prototype.
The current prototype includes a 3D GIS viewer application that links to the areaplan-database. It reads out the current status of the area plan, or in other words which area-use combinations are selected and it updates the map accordingly using color coding and small 3D-bilboards (Figure 6-6).

Figure 6-6. 3D-map viewer - application
6.4.3 Industry type information

One side of the demand/use matrix is formed by the properties of the industry types. The tree on the left hand side of Figure 6-7 contains the versions of the industry type definitions. The idea for the next version is that a similar tree can show that the industry types themselves are ordered in a hierarchical manner. This means that industry types can be further detailed into subtypes whenever necessary, and that the matching process can take place on several hierarchical levels. Chemical industry can for instance be detailed into subtypes, where some of the aspects describe the overall characteristics and limitations of the chemical industry and are stored on the highest level: “Chemical industry”. More detailed aspects per specific industry type can then be added on the lower hierarchical levels. The main idea is to make the process of determining which area is suited for which type of industry as easy as possible for the spatial planning team. By making a first selection on the highest level, a lot of insight can already be gathered. For those industry types that remain, a more detailed analysis can be made for subtypes of that industry type. This process is, by the way, under full control of the area planning team.

At the bottom part of the screen it can be seen that the norms or guidelines per aspect can be entered. As it is the case in all screens, comments can be given to indicate choices that have to be communicated for future use.
6.4.4 Matching process

The matching process is under full control of the area planning team. It is **not** the tool that determines the best match on the basis of a multi-criteria analysis, but it is the **team** that takes decisions on good and bad matches. The tool can help in this selection and weighing process by clearly indicating the matches, mismatches, and missing information in the matrix. Manual overruling of every cell of the matrix is possible, and can be documented per cell. Manual overruling of the order in which the alternatives are presented is also possible, and that can also be documented.

Figure 6-8 shows a first idea what a matrix screen could look like. In this case a matrix is presented to judge the possible use of one area, called ‘A1’. Several other options for the graphical user interface will have to be developed and compared in the follow-up project. At the left hand side of Figure 6-8, a number of the possible uses of the area A1 are presented. There are placed in three categories: selected, possible, and rejected. The choice to place an alternative in one of these categories is done by the team, not by the computer.

The buttons on the right hand side can be used to move an alternative to another category. The cells in Figure 6-8 are grey or coloured. When they are grey, no mathematical match could be established based on the available information in the industry types and/or area. By clicking on the cell, manual information and a manual choice can be entered instead. Red cells mean that a norm or threshold has been violated. The team can, however, choose to give the cell a different colour based on additional information. By clicking on the cell, this additional information can be added. A small “M” in a cell indicates a manual evaluation result, while a small “f” indicates an automatic evaluation using a property function. In the end, a well documented set of aspects for matching the areas and industry types is available to the team, on which a final decision can be based.
6.4.5 Documenting the meetings

A final screen of which a first prototype is presented here (Figure 6-9), is the documentation of the meetings of the area planning project team or subsets of the project team. One of the main ideas behind the studio is to document the meetings as precisely as possible, because it helps the current project planning team to follow a clear process, e.g. by presenting the decisions, open agenda items, and activities to all the participants in an open way. The fact that they can access the Web-based tool from their own workplace enhances the potential, especially if meeting information is made available immediately during the meetings, so the participants will be able to access it right after the meeting.

This documentation will probably also prove to be valuable at a much later stage, when the project plan will be revisited for changes. The leader of the next spatial planning team for that area can quickly go through the meeting minutes to see what decisions the previous team has taken, and why. Other users can benefit from this information as well. One example is the port planning team that works on long-term plans for the port. By accessing the decisions...
of the area planning teams, they get a quick overview of the decisions taken and of the boundary conditions for plans for the port as a whole.

The proposed meeting screen allows for the inclusion of documents, pictures and other electronically available information. This information will be copied into the area plan database, to guarantee its availability over time. Furthermore, by storing the information that has really been used during the meeting, no confusion can arise over the potential version that has actually been used during the meeting.

In the vision for the use that has been sketched in Figure 4-2, at least one specific person present at the meeting is responsible to enter minutes, decisions, tasks, and background documents into the DES during the meeting. By having a special person at the meeting who can do this, a better guarantee can be given for the quality and timeliness of the information that becomes available during a meeting.

### 6.5 Status of the prototype

The prototype has been built, and the screen shots shown in section 6.4 are actual screen shots of the implemented system (unless labelled as “artist impression”). Based on first demonstrations and on reactions of the PoR, changes have to be made to the user interface to make it easy to understand and easy to use for the actual spatial planning experts.

One important step in reaching that goal is an actual test of the concepts and the prototype to help determining which aspects need to be changed or refined further. The next chapter describes an initial set-up of a test that can be carried out to test the tool suite and to assess needed changes and additions for the concepts used.
7 Test proposal for the tool suite

7.1 Test-objective
The first deliverable for the Decision Support Studio project is a tool suite to make a static design. Although the tool is designed in close contact with the PoR, success remains uncertain. To evaluate the design and measure the success, a test is planned. The goal of the test is to check whether the tool suite provides the support to enhance decision making. The test is centered around a fictive area planning process, but with real participants from the PoR involved, and focuses on the matching for this area planning process by the participants. The primary objective for testing is to get feedback on expected usefulness, usability and usage of the tool. The secondary objective is to acquaint potential users in using this tool in a structured process. And, the third objective is to create support for this project throughout the PoR.

7.2 Case Noordwest-hoek 2015

7.2.1 Events that changed the Noordwest-hoek
The test-case is realistic but fictitious to make sure that the participants aren’t biased by the area planning already done for the Noord-Westhoek. It is the year 2015 and a team of the PoR is responsible for revising the area plan made for the Noord-Westhoek in 2004. Many things changed in the Noord-Westhoek from 2004 to 2015 and some of the changes are illustrated in Figure 7-1.

![Figure 7-1 Case area](image)

Maasvlakte 2
The Maasvlakte-2 is built as planned and the newly created area seemed to be quite popular. Quickly some companies established and a lot of activities are going on. TransCon is a deep-sea container terminal and Chemtech a chemical plant. For the Maasvlakte a infra-bundle is realized with a 2x2 lane road, 2 lane rail and a 10 meter wide pipe-strip.

Papegaaienbek
After the contaminated mud-depot was cleaned, the Papegaaienbek is reduced in size to ease the nautical access to the Maasvlakte-2. The Papegaaienbek is used to store and
shape basalt-blocks for the creation of a sea-wall for the Maasvlakte-2. For that purpose a quay wall has been build to be able to deliver the basalt-blocks. Currently, the Papegaaienbek is undeveloped and ready for new use. In this case the Papagaaienbek is lot C.

**MOT**

The need for crude oil storage is declining. Some crude oil tanks of the Maasvlakte Oil Terminal are demolished and the area that became available is retrieved by the PoR. Lot B is delivered clean and undeveloped and ready for new use. The mooring post of the MOT is restructured to ease the nautical access of the Maasvlakte-2 and to create room for nautical access on the Papegaaienbek. The former two mooring post for the MOT are replaced by one on the south-shore.

**Euromax**

Euromax is operational and jumpstarted its operation. It has been successful in attracting additional flows of containers to Rotterdam. They clamed the option on the south-east side of the MOT to facilitate a barge terminal. The option on the west side is to be able to extend their activities. Because of the heavy competition and stalling growth on container transshipment Euromax is willing to release the option on lot A². Various container related companies are established around Euromax. An empty depot nearby has been successful in business with Euromax.

**Business-park**

The business-park has been successful in attracting a variety of companies. Business-collection-buildings, maintenance companies and even a small restaurant are located in this park.

**Distribution**

A small distribution park is developed in the area and it has attracted distribution centers. At first the park failed to attract additional customers but due to the proximity to Euromax and the Rail Feeder Point the available area was build-over soon. All the lessees in the distribution park are customers of Euromax.

**Rail Feeder Point**

The PoR has started a Rail Feeder Pont (RFP) next to the distribution park to provide indirect rail access to the companies nearby. Especially the distribution centre nearby utilizes this services. The RFP isn’t running on full capacity yet, so additional freight can be handled.

**Seabrex**

In 2007 Seabrex opened its food terminal and storage facilities south of the MOT.

**Barge mooring facility**

South of lot A1 and A2 mooring posts are created for barge vessels. The posts are able to facilitate up to 40 vessels. In case of development of lot A1 and A2 in need of nautical access, the mooring posts need to be removed.
7. Test proposal of the tool suite

7.2.2 Area property values in 2015

Risk contours

The reduction of MOT tanks changed the risk-contours but the oil-regime is still valid in the 8e petroliumhaven. In Figure 7-2 the combined risk contours of existing companies that are obligated by the BRZO to report their risk are illustrated. In this case the next items have to be taken in account:
1. no offices within the $10^{-6}$ risk contour of the MOT in lot B,
2. no high-risk producing activities in lot B and C because of proximity to MOT,
3. no container related activities in lot C.

![Figure 7-2 Combined risk contours of existing BRZO companies](image)

Road capacity

The road capacity for the whole area depends on the capacity of the A-15 and feeding roads. The A-15 is a 2x2 lane road on the outer contour of the Maasvlakte-2. At this moment the capacity on this road is sufficient. Some delays occur in the access-roads to and from the A-15 during peak hours. The road to MOT and Seabrex may be trouble because of a queue in front of the Euromax drive. In this case additional traffic of lot B and C will increase the delays during peak hours and cause more complaints of the existing companies. Lot A and B are less interesting for customers that generate a lot of traffic and/or are sensitive to traffic delays.

Dust production

Because of prevailing south-west winds it is advisable to keep in mind the current complaints from Hoek van Holland, related to dust and stench.

The fine-dust concentrations in Hoek van Holland fluctuate around de 40 milligram per m3. Because of the limited value for 2010 the PoR was obligated to initiate an offensive against fine-dust production. Various agreements with current established companies are made concerning exhaust filters on trucks, trains and ships to meet the regulations.

In case of activities that will cause additional stench, coarse or fine-dust, measurements should be taken to keep it in acceptable proportions.
Clustering advantages

Cluster advantages for the PoR are possible for the RFP. It hasn’t reached its maximum capacity yet so additional traffic may use its facilities. For the capacity of the rail modality in general additional rail transport is possible. The A-15 generates a lot of road capacity, at this moment the road isn’t used on its full capacity so activities that produce additional traffic will make the A-15 more useful.

Within the Noord-Westhoek container related activities have proven to generate mutual advantages. Euromax benefits from the empty depot nearby. It saves transport costs because it can be reached with internal transport. The empty depot is more or less secured of business. The business and distribution park benefit from the services of Euromax and RFP.

The presence of MOT could only generate cluster advantages in case of extra usage of the crude oil pipelines and storage.

Nature

The fringe of the Noord-Westhoek could be claimed to be developed as nature. The PoR have made a target for the year 2020 in the form of footsteps for nature. Especially lot C is quite interesting because of the connection to the green-strip throughout the port. At this moment the visual effect from the north side of the industrial occupation of the Noord-Westhoek is separated by a dune. If lot C is industrial developed the dune should be extended to make the area visual acceptable from the north side.

Lot specific

The lot specific data will be specified in the five aspects of the matrix, and detailed as far as needed for the test. When the other side of the matrix (industry specific) is filled as well, it becomes possible to carry out and test the matching capabilities.

<table>
<thead>
<tr>
<th>Lot</th>
<th>Physical fit</th>
<th>Liveability</th>
<th>Accessability</th>
<th>Sustainability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface [ha]</td>
<td>Noise budget [dB(a)/m2]</td>
<td>Mooring facility</td>
<td>Length [m]</td>
</tr>
<tr>
<td>A¹</td>
<td>34</td>
<td>70</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>A²</td>
<td>30</td>
<td>69</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>40</td>
<td>68</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C</td>
<td>30</td>
<td>67</td>
<td>Quay wall</td>
<td>250</td>
</tr>
</tbody>
</table>

7.3 Compilation area planning team

The tool will be tested by a possible team that could be responsible for making a real area plan. For the test we need participants that have experience with area planning or are familiar with the issues confronted in area planning projects. For this test we invite the team responsible for the area planning of the Noord-Westhoek in 2004. They are familiar with this project and have good feeling for the success-factors of a tool and the possible changes in the process as a result of applying the DES.
7.3.1 Facilitating participants

Process-manager/architect (Cees Pons I&B/OI)

His role is to create conditions in which it is more likely that decisions are made successfully. Analogies with the role of a facilitator in collaboration engineering explain the function more explicit. Some of the tasks of a architect are: selecting participants, designing the decision process, putting up the rules of the game, organising and chairing meetings, stimulating the participants to collaborate and communicating to the environment.

Part of his task description is the selection of a team. The team should be balanced in interests, knowledge and managerial capabilities. And, it is preferable that all the interests of the PoR are represented. A process-architect should check the representation of interests in the team.

The parties involved need to be convinced that the architect does not act according to his individual preferences but guards the interests of the PoR in whole. Although an external process-architect enjoys the unbiased image that makes his position much easier, he may lack knowledge of the organisational setting. For this research we preferred a process-architect from within the PoR: Cees Pons. Cees Pons will be informed and instructed with the support tool and process. The instruction will be done by someone from the TU-Delft.

Designer (Etienne Budde I&B/OTA)

A designer has the skills and ability to illustrate geographical parts or infrastructural adjustments to an area plan. Currently, a designer from OTA is a member of the area planning team.

Minute keeper (Saskia Klopstra I&B)

One of the weaknesses identified in current area planning is the memory in the organisation. A minute-keeper records decisions and the decision process. The records provide useful sources of knowledge for future area planning in the area, recollection purposes for the decision makers and learning about area planning. The minute-keeper is responsible for recording tasks, decisions and agreements, among others.

Analyst (Roy Chin or student of TU Delft)

An analyst may inform or advise decision makers on additional information. An analyst is someone that has the ability to come up with additional information and is not necessary a domain-expert.

7.3.2 Domain specialists with decision power

The role of a domain-expert is to put in knowledge, expertise and sources of information to the matching process. The domain-expert could be asked to advice in certain content related matters in matching. The members in the team rely on domain-experts to get informed or advised on specific items.

A decision-maker is a party that holds part of the decision power in the process. Only decision makers are mandated with making choices and decisions. In the enumeration below, we show the different parties with decision power involved in the area planning process.
1. Infrastructure development (Cees Pons I&B/OI)
2. Commercial affairs (CZ/PM)
3. Commercial affairs (Peter Vorenkamp CZ/BDM logistiek)
4. Nature and environment (Peter Ketel I&B/MIL)
5. Maintenance (Henk Voogt I&B/BDI)
6. Nautical (Rob Sibbes RPA)
7. Projectgroep MV-2 (Jolien Paulides)

The role of decision maker and domain expert can be combined into one person. Based on the cooperative character in the current area planning process it is assumed that the advice of the domain expert is unbiased and not influenced by his role as decision maker. If, in the future, the double role as domain specialist and decision maker threatens the unbiased cooperation, the area planning process should be reconsidered.

### 7.4 Test session

The previous sections described the characteristics of the area that should be planned and the stakeholders that participate in the area planning process with their roles. This section presents the area planning process the participants will go through during the test session. This includes more than just the area planning process. The participants need to be introduced to the new tool and way of working and feedback of the participants is needed for evaluation purposes. More in-depth information on the evaluation of the area planning process is presented in the next section.

The participants will go through several steps of the area planning process. Because of restrictions in time, we focus on the most important steps, the steps that are mostly influenced by the DES. During a session of half a day, the participants are invited to go through the process described below.

#### Introduction

In the introduction several items of the test session will be explained. The approach will be explained to the participants by a predefined process with a clear planning in time. The tool and the use of the tool within the process will be illustrated. And, the case and matrix ‘new style’ will be introduced briefly without giving away essential information.

#### Feasibility

The goal of the first phase, the feasibility phase, is to end with a set of options that are feasible given the characteristics of the area. The feasibility phase consists of several activities that are carried out either individual or collaborative.

The DES contains information on the area plan. For some questions that rise in the feasibility phase, property information or decision logic is already available in the DES and for other questions information still needs to be collected. The team can get insight in the information by queries through the DES.

The first activity is to validate knock-outs automatically generated for each lot by the DES. Some knock-outs may be avoided by taking measures in lot or area facilities. Only measures that are economically, technically or politically feasible should pass the test.
Once the knock-outs are known, the next activity is to validate the options. An option is removed from the selection when there is at least one knock-out that cannot be avoided. A removal of an option should be motivated by the area planning team.

After the first selection, a second round is done to slim the selection for each lot even more. The area planning team identifies potential knock-outs for each option. Something is a potential knock-out when the DES could not give the final answer and more information is needed. Potential knock-outs for which the information can be provided by one of the team members can directly be verified. Potential knock-outs for which the information is unavailable, not present or incomplete have to be considered further in an acquisition plan. An acquisition plan indicates who will investigate what knock-out and why. In the case that one option has several potential knock-outs, the area planning team should select one potential knock-out to further investigate. This selection should be based on the sense of likelihood that it will be a knock-out.

Once all potential knock-out questions are answered that could be answered the meeting will be ended and the individual participant will acquire and distribute property information needed for the next round. The members can prepare themselves for the next meeting by going through the new information. The new information is inserted in the DES for further use.

After the property information acquisition, the area planning team should validate the new automatic knock-outs generated by the DES. The same process as before takes place: some knock-outs can be avoided by taking feasible measures. Those knock-outs that cannot be avoided result in the removal of the option. The remaining options are taken into the next phase.

**Competitiveness**

The goal of the competitiveness phase is to go from the selection of possible options to a ranked selection of competitive options. In this phase, different participants from the PoR are involved. Participants are selected based on the fact that in this phase the options are ranked according to the competitiveness from a PoR perspective.

For the sake of time a template of criteria and weights against which options are evaluated are prepared for the test session in cooperation with the PoR. In a normal situation this template would be the result of a participative process. This template is presented to the participants and, in case of serious problems, may be reconsidered and adjusted to be accepted by the participants.

In the first activity, key criteria are used to reduce the amount of options to thoroughly evaluate. The DES generated a score for the options on the key criteria. Options that score bad on the key criteria and have a low probability to be competitive are deleted from the list. The resulting list of options is thoroughly evaluated on a more extended list of criteria, selected by the participants. The DES generates a rating of the options based on the criteria and their weights. This rating needs to be validated by the participants and could be adjusted manually by the participants. For those criteria for which information in the DES is lacking, an individual information acquisition process is started, similar to the one in the feasibility phase.

After the rating the participants may consider opportunities to improve the competitiveness of an option. Based on the relative (improved) competitiveness of the options the selection may
be narrowed down to further focus the matching process. Only options that are relative competitive are to be chosen. The cycle of evaluating options against a set of criteria can be repeated until all criteria are evaluated. The final result is a selection of competitive options ranked on their relative competitiveness.

**Evaluation**

The final phase of the test session is not related to the area planning process, but is very valuable for evaluation purposes. The experience of the participants with the area planning process and the DES is evaluated in an individual and collaborative format. More about the evaluation method is presented in the next section.

### 7.5 Thorough evaluation

The system designed for area planning contains a process design and a tool, the DES. The requirements for the system are described in the previous chapters and will be used here for evaluation purposes: to what degree are the requirements met by the system designed and implemented so far. We must always keep in mind that the test session concerns a prototype and the results of the evaluation are used to guide further design and development efforts.

The requirements can be categorized to three categories, mentioned before in this report: usefulness, usability, and usage. For each of these categories we address the evaluation method. The evaluation method is based on the observations done during the project. We categorized the observations in usefulness, usability and usage.

#### 7.5.1 Usefulness

The usefulness of a system has been described as the value the system adds to the process it supports. The added value of the system can be distracted from the observations mentioned in chapter.

**Situation awareness**

A first observation concerns the amount of information that is relevant for the area planning process. The area planning team has to deal with an incredible amount of information. Dealing with this information costs a lot of resources that might be better used for creativity in the area planning process to solve issues. The DES is a tool that can handle the information and by this release the cognitive load for the participants to work with the information. This would in the end result in more insight and knowledge about the area planning.

We turn to the concept of the situation being portrayed by the tool as a way to evaluate the usefulness of the tool on this aspect. The situation in this case is the specifics about the area being planned. The system design (DES) wants to result in an increased situation awareness of the area being planned which influences the decision making process. In literature we can find various approaches to measuring situation awareness (Endsley 1995, Gaba et al. 1995). Situation awareness (SA) is defined as a state of knowledge and that state can be divided into three levels: perception of elements in the situation, comprehension of the current situation, and projection of future status. Situation awareness is affected by the actual state of the environment, as well as task/system factors and individual factors. Task/system factors include system capability, interface design, stress, workload, complexity and automation.
Individual factors include goals and objectives, preconceptions, long-term memory stores, information processing mechanisms, experience and training. This is depicted in Figure 7-3.

Measurement of situation awareness can be done with several measurement techniques. In this research we use the Situation Awareness Rating Technique (SART) as measurement technique. Other measurement techniques include situation awareness global assessment technique (SAGAT), SABAR and measuring the workload. SAGAT is a query technique administered either after or during the activity and asks for facts to measure the level of perception, comprehension and projection. With Sabar an expert observer rates participants on a number of items. And the workload is sometimes used because situation awareness increases when the workload decreases. SART involved the scoring of thirteen different scales by the subjects themselves, each of which is potentially a factor in situation awareness. The scales can be grouped in three categories: demand, supply and understanding. Situation Awareness can now be calculated by \( SA = Understanding - (Demand - Supply) \). The scales are presented below, with a fourteenth scale added to measure overall perceived situation awareness. These scales have to be valued by the participants after having gone through an area planning process.

- **Demand:** demand on cognitive resources, instability of situation, complexity of situations, variability of situations.
- **Supply:** supply of cognitive resources, readiness, concentration of attention, division of attention, spare mental capacity
- **Understanding:** understanding of the situation, information quantity, information quality, familiarity with environment
- **SA:** Situation awareness.

Situation awareness is important for the usefulness, but this only scores effect when the tool is going to be used in practice. The Technology Acceptance Model (TAM) is an example of a causal model that has probably been the most widely cited approach with robust empirical support for predicting the future usage of a system. Its purpose is to predict usage patterns among users after an initial one-hour exposure to the technology. TAM assumes that the decision to use a particular information technology is based on one’s cognitive responses.
perceived usefulness and perceived ease of use. Perceived ease of use will be addressed under usability. Here, we focus on perceived usefulness. Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance. Beliefs about usefulness can be measured with Davis original instrument containing the following items: job difficult without, control over work, job performance, addresses my needs, saves me time, work more quickly, critical to my job, accomplish more work, cut unproductive time, effectiveness, quality of work, increases productivity, makes job easier, useful.

7.5.2 Usability

Usability has been defined as the match between people, process, and technology. Several observations addressed in chapter 3 can be seen as a usability aspect:

- The set of aspects in the 'Matrix' does not match with the relevant aspects involved.
- The types and format of aspects in the 'Matrix' does not match with the reality.
- The set of possible uses in the 'Matrix' is not complete.

In this evaluation we look at a broader scope of usability than just the three observations mentioned above. Usability is the extent to which a system can be used by specified users to achieve specified goals. Or, when we put it in the words of Davis in TAM: perceived ease of use refers to the degree to which a person believes that using a particular system would be free of effort. Davis developed a questionnaire into the perceived ease of use which contains the following elements: confusing, error prone, frustrating, dependence on manual, mental effort, error recovery, rigid & inflexible, controllable, unexpected behavior, cumbersome, understandable, ease of remembering, provides guidance, ease of use. This list can be enlarged with the three observations specific to this situation.

Using an individual questionnaire for evaluation purposes is a frequently used instrument, but so is a collaborative usability evaluation. Evaluating usability in a group setting might reduce bias and, therefore, is favorable next to an individual evaluation. Collaborative usability testing has been successfully supported with Group Support Systems by Fruhling and De Vreede. The E-CUP process they developed will be applied here as well. This process is flexible in the way that the aspects which are tested is open. In that way it can be applied in many different settings. The process contains a preparation phase and an execution phase.

- **Preparation – Aspect.** During the preparation phase it has to be decided which usability aspects to include in the process. This decision is informed by the literature on usability and the characteristics of the system under investigation. Possible aspects include ease of use, user control and freedom, consistency, help & documentation, and so on. The project team has to make a final decision on what aspects to include.

- **Preparation – Scenario, Session, Participants.** The preparation phase also includes the development of one or more scenarios that the participants will execute during the usability testing. Their execution of these scenarios will trigger the participants’ usability feedback. The scenario has been described in great detail in the previous sections of this chapter.

- **Execution.** The execution process itself consists of a series of thinkLets that lead the group of participants through a structured evaluation of the system’s usability. The diagram of Figure 7-4 gives an overview of the processes.
7.5.3 Usage

Usage is defined earlier as the flexibility and suitability. For suitability we focus on the observation of inefficient use of resources. The main communication between area planning team members is done during meetings, even though not every activity needs to be collaborative. In the new situation a balance is sought for collaborative activities and individual activities. The nature of the activity should be suitable for the goal to be achieved: do things collaboratively when necessary, but go individually when possible.

To measure whether the new situation makes more efficient use of the resources we take two measurements into account. The first is observation. The researchers observe the behavior in the test session. The activities are observed and the researchers pay special attention to whether the activities are collaborative when necessary, but individual when possible.

The second measurement is satisfaction. Through a validated meeting satisfaction questionnaire the participants’ perceived satisfaction is measured. The participants have to indicate their satisfaction with the outcome and with the process. Especially their satisfaction with the process is important in this respect.
7.5.4 Summary

We have introduced several instruments to evaluate the design. The instruments are summarized below. The number of instruments is quite large, but each instrument sheds a different light on the evaluation. When necessary because of time or cognitive resources, we might have to make a further selection in these instruments.

- Questionnaire afterwards:
  - Situation Awareness
  - Satisfaction
  - Perceived usefulness
  - Perceived ease of use (with extra questions for the specific situation)

- Observation:
  - Activities and their collaborative nature (what activities are carried out and who is involved)

- Collaborative usability testing
8 Embedding of the tool suite in the Port of Rotterdam

8.1 Introduction
The process of embedding the tool suite encompasses the development, the implementation and the internalization process of the tool (see Figure 8.1). These three processes are interrelated. Managing this interrelatedness is critical for the success of embedding the tool suite in the Port of Rotterdam (PoR). This chapter describes the embedding process that took place from the start of the project (April 2004) until now (December 2004). In addition this chapter also presents a general overview of activities in the year to come.

8.2 The process of embedding the tool suite
In the past year the focus has been primarily on development and implementation. Whereas the development process was focused on conceptualization and the development of a prototype, the implementation process was mainly focused on the achievement of ‘acceptance’ among stakeholders regarding the idea of having a tool suite which supports the area planning process. Latter mentioned has consumed a great deal of time at the PoR. During the implementation process an important aspect is to inform the diverse stakeholders gradually as development progresses. As Figure 8.1 shows, the development process goes on ahead the implementation process. This ‘gap’ creates the momentum which is needed for the advance of the embedding process.

In order to maintain this momentum it is important to consider the sequence of phases in each process and their interrelatedness. If the ‘gap’ becomes too large it will produce organizational resistance as the organization is not ready for the new way of working. On the other hand if it becomes too small, expectations are raised which can not be fulfilled. Table 8.1 gives an overview of the activities and deliverables.
Figure 8-1. Process of embedding the tool suite
8. Embedding of the tool suite in the Port of Rotterdam

<table>
<thead>
<tr>
<th>Development process</th>
<th>Implementation process</th>
<th>Internalisation process</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. <strong>Conceptualisation static tool DES:</strong> conducting a requirements analysis on the basis of individual interviews and input from participants from the project team.</td>
<td>a <strong>Presentation static tool DES:</strong> Tuning talks between CZ and I&amp;B parties are held regularly (even before the start of this project and this will be continued in 2005). Involving the project team of area plan NW-hoek. Certain PoR employees have been interviewed by the TUD</td>
<td>-</td>
</tr>
<tr>
<td>2. <strong>Designing prototype static tool:</strong> architecture has been proposed which serves as a basis for the development of a prototype of the static tool.</td>
<td>b <strong>Presentation &amp; demonstration prototype design:</strong> A presentation of the progress of the project to some PoR employees of I&amp;B/DDD, I&amp;B/MIL, CZ/PM and STRAT/OL. A presentation of the progress of the project to the head, managers and some employees of I&amp;B. A presentation of the progress of the project to OTA</td>
<td>-</td>
</tr>
<tr>
<td>3. <strong>Building prototype static tool:</strong> At the TUD (Technical University Delft) an operational prototype is build and tested. Some preliminary interviews regarding technical specs took place at OTA (Design &amp; Drawing Department).</td>
<td>c <strong>Testing prototype:</strong> planned for second quarter 2005. A presentation of the progress of the project to CZ (12-01-2005). A peer group (NW-hoek area planning group) will test a prototype in order to evaluate its merits (usefulness, usability and usage). At the end of this phase a formal decision is required as to continue the project which will require a reasonable amount of resources from the PoR. A presentation of the progress of the project to OI</td>
<td>-</td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. <strong>Preparing prototype for implementation:</strong> planned for 2005. Based on the technical specs and additional user requirements deriving from testing the prototype a definitive version will be delivered. This version should be sufficiently evolved prior to the implementation and operationalisation.</td>
<td>d <strong>Implementation &amp; operationalisation:</strong> Planned for 2005. Before the conceptualisation phase (concerning the dynamic tool) start it is necessary to have a version of the static tool up and running</td>
<td>-</td>
</tr>
<tr>
<td>5. <strong>Conceptualisation dynamic tool DES:</strong> Planned for 2005. A major component of this tool deals with the visualization of both geographical and simulated data.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. <strong>Designing a prototype dynamic tool:</strong> A prototype of the dynamic tool will be integrated in the already developed platform.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 8.1. Overview of activities and deliverables**
9 Epilogue

9.1 Evaluation

The architecture, design, and prototype implementation have been evaluated with different parts of the PoR organisation at several occasions. In September 2004, a large group of experts discussed the initial design of the studio, and judged the feasibility of the architecture. Furthermore, the group specified several requirements that were used as inputs in the successive steps of the project. Later meetings were organized for employees of OTA (Design and Drawing Department), CZ (Commercial Affairs), Strategy, and employees of several other departments.

Overall, the reactions were positive in all the meetings that were organized. It was clear that the added value of having area planning instruments available can enhance the quality of the matching processes in the port. The meetings with the OTA department showed that the available computerised information in the port is excellent, and very well suited for matching purposes. Furthermore, the value of the knowledge about the area planning process for both the shorter term processes and the long-term planning processes became apparent. Therefore, the Commercial Affairs department can benefit from the saved knowledge in the decision enhancement studio for its operational planning processes. The Strategy department, on the other hand, can use the collection of area plans for its long-term port planning processes.

9.2 Recommendations

Based on the positive reactions from the organisation, there is a strong recommendation to continue with the project. In this first phase of the project, the pace was very high, and sometimes it was hard to carefully plan the execution of some of the steps. In the next phase of the project, the Decision Enhancement Studio will be carefully used in real port planning processes, and planning should be much more precise. It would be advisable to include a risk analysis in the plan of the next phase, because there will be more dependencies on co-operation with and information from different departments of the PoR.

9.3 Plan for 2005

A project plan for 2005 will define the follow-up activities of this project. Important components of the project plan for 2005 are:

- Test of the prototype in a port setting conform the guidelines of chapter 7.
- Based on the feedback of the test, further analysis, design, implementation, and testing of the decision enhancement studio (the next phase in the spiral model).
- Enhancing the model components of the architecture, to give insight into the dynamic aspects of area planning.
- Careful embedding of the tool in the organisation, for instance by shadow testing of the methods and tools in an actual area planning process.
- Embedding of the tool in the technical architecture of the Port of Rotterdam. This involves close co-operation with the OTA department.
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Area plan
An area plan is a vision on the possible spatial development that optimises the availability, accessibility, liveability, sustainability and commercial attractiveness of an area, in a flexible way and in harmony with its environment.

Co-siting
The concept is that companies are positioned in such a way that possible cluster advantages can be strengthened. Cluster advantages can be supplying neighbours with your feedstock, semi manufacture or residual product. Furthermore Co-siting is sharing facilities like fence security, offices and public utilities. The endless possibilities to create synergy have led to efficient and profitable business climate for all chemical industries active in the Rotterdam port industrial zone.

Criterion:
Expression objective or task that officiate as judgement-aspect to evaluate options. Example: there must be nautical access.

Issuing area
Fit in of a potential customer in a lot based on availability, accessibility, liveability, sustainability and commercial attractiveness.

Lot
Piece of land available or used by a company.

Main objective:
Abstract expression of what is desirable and what to pursue. Example: the needs of a potential customer must be satisfied as much as possible.

Means:
That which should satisfy the objective. Example: build a Rail Feeder Point near the distribution-centre.
| **SE** | Systems Engineering group |
| **Sub-objective:** | Expression of pursue concrete related to an object that is of such an abstraction that cannot be quantified. Example: the annoyance to residents caused by new developments needs to be minimised. |
| **Target-value:** | The value of the goal-variable pursued. Example: the net present value should be around 1.1. |
| **TUD** | Delft University of Technology |
| **Value:** | Abstract expression for what is roughly desirable. Example: development in connection with its environment. |
| **Weight:** | A measure of importance between an objective (or task or criterion) and another objective. Example: revenue is 5 times as important as employment in the consideration of future development of area. |
Appendix: Decision Support Suites and Studios


Decision Support is a long-established set of skills. Decision Support New Generation (DSNG) extends those skills to address a new generation of decision situations, enabled by a new generation of technology and a new generation of methods. DSNG is built on five principles:

1. Target Decision Support to decisions that matter. The more complex and important the decision, the less likely executives and teams have been to rely on computer tools, for very valid reasons. DSNG changes that. Effective Decision Support combines three “U”s – the usefulness of tools and methods: the value that they add to decision processes; their usability: the mesh between people, process and technology; and their usage: their flexibility, their adaptivity, and their suitability to the organizational, social and political context.

2. Help decision-makers visualize scenarios and alternatives: our adage is “If you cannot see it, you cannot get it.” It is in this sense that DSNG helps them rehearse the future. The major difference between the technology base of traditional Decision Support and the base that DSNG draws on is the new generation set of tools for seeing it, such as multi-media interfaces, aids to visioning, and dynamic animations that enable insight, foresight and visual thinking and communication.

3. Provide interactive interfaces to information resources that enable action rather than just provide for reporting, analysis and “knowledge” management. The only purpose of gathering information is to use it effectively. In many ways, CRM (customer relationship management) and knowledge management are the data side of Decision Support. They represent a huge opportunity and one that has often been wasted because they have lacked decision-oriented interfaces to their data resources.

4. Embed “suites” of modeling, information and communication tools within an effective support process, via “studios” that help frame the decision-making situation, provide facilitative services and apply proven and adaptive “recipes” of successful DSNG in specified contexts. Effective decision-making rests on effective processes. The three “U”s of Decision Support demand carefully designed studios that build comfort, confidence, convenience and collaboration: usefulness, usability and use. Two out of three is not enough.

5. Develop DSNG capabilities within a Business Architecture. Most models and traditional decision support systems have been built bottom-up and case-by-case, with little attention to the dynamic organizational economic, financial and technical context in which they must come alive if they are to be more than technical artifacts. The business architecture for DSNG links enterprise strategy and vision to decision process methods and tools and vice versa. The technology architecture is a part of this: information resources must be coordinated for them to be enterprise platforms that any Decision Support studio and suite can draw on. But the technology architecture must set the business direction for DSNG, ensure appropriate incentives and governance rules – including decision rights and responsibilities. The Business Architecture forms the link from leadership and vision to decision.