An Area Planning Studio for the Port of Rotterdam

Roy Chin\textsuperscript{1}, Stijn-Pieter van Houten\textsuperscript{1}, Alexander Verbraeck\textsuperscript{1}
Joop Smits\textsuperscript{2}, Priscilla Veenstra\textsuperscript{2}, Jan-Willem Weststrate\textsuperscript{2}, Erik Schalkwijk\textsuperscript{2}

\textsuperscript{1}Faculty of Technology, Policy and Management
Delft University of Technology
The Netherlands
R.T.H.Chin@tbm.tudelft.nl
S.P.A.vanHouten@tbm.tudelft.nl
A.Verbraeck@tbm.tudelft.nl

\textsuperscript{2}Port of Rotterdam
Rotterdam
The Netherlands
J.Smists2@portofrotterdam.com
P.Veenstra@portofrotterdam.com
J.Weststrate@portofrotterdam.com
E.Schalkwijk@portofrotterdam.com

Abstract

One of the challenges faced by the Port of Rotterdam is to get a coherent overview of future situations in area planning due to the complexity of the process and the content. Lacking such a coherent overview led, amongst others, to long area planning processes. In this paper we present an area planning studio suitable for the Port of Rotterdam. The challenge is to use today's state of the art computer-based technologies, such as Geographical Information Systems (GIS) and simulation, in combination with a process-oriented approach in order to support area planning. These technologies are expected to provide a means to give decision makers more insight in current and future situations, enabling better informed decision makers and more tailored and faster decision making. The studio consists of a number of software programs (services), which each support different parts of the process, such as designing of scenarios using simulation models for ‘what-if’ analysis, matching of supply and demand of areas with industries based on a balanced set of aspects (e.g. sound, dust, pollution and logistics), and visualization using GIS based technologies. First implementations of the services are implemented in Java, thereby supporting web-enabled, distributed usage. Before a meeting, an area planner is able to view the current situation and to test future alternatives not only based on his own information, but also on information put in the studio by others. Using the APS meetings can be prepared in a better-informed way, enhancing their effectiveness and efficiency. The design of the studio from a services-oriented view facilitates maintenance, reusability and future expansions. Future research will focus on a further development of the designed services and integration in a stable business information system. Furthermore future research and development will focus more on the dynamic aspects involved in area planning.

1 Introduction

The Port of Rotterdam (PoR) functions as a major transportation hub to mainland Europe. The PoR is responsible for developing and exploiting 10000 acres of the Rotterdam port and industrial zone. In this zone the PoR facilitates the daily operations of a large number of companies, ranging from major oil companies, and container trans-shipment companies to distribution centers and transportation companies. Well-considered and conscious development of the Rotterdam Port and Industrial zone, also known as Port Industrial Complex (PIC), is becoming ever more important because of the substantial economical, political and social influence on the region. Because of the high population density in the port region, which is situated close to the city of Rotterdam, decision-making is far from trivial. The effects of decisions made about the PIC often stretch far outside the boundaries of the PoR organization and the port and industrial zone. These effects are both positive and negative as the activities at the PIC provide e.g. employment and income, but also causes noise and pollution.

In the past the spatial development of the PIC was mainly based on experience, a mainly \textit{qualitative} analysis with a limited scope of space and time and intuition. However, recently the need for more well-considered and conscious development of the scarce available land lead to a new way of working. There was a shift to interdisciplinary teams working together up to ten months in projects to develop a vision on the development of a specific port area. These projects are called area planning projects. Area planning constitutes a systematic preparation of activities for the
development of parts of the PIC. The result is a vision on the spatial development to optimize the availability, accessibility, livability, sustainability and commercial attractiveness of an area. This vision consists of a feasible and most promising set of adjustments or actions to develop the area.

One of the major difficulties of area planning is providing a coherent view on the information available, which leads amongst others to a time consuming area planning process. When the PoR would agree to every request of a potential or existing customer the use of available space might become fragmented. Therefore interdisciplinary teams try to combine knowledge and information from different domains in order to develop a balanced spatial development plan. For example, well considered placing of companies could favor the bundling of services such as roads, electricity, quays, cables and pipelines. However the amount of information to deal with is huge and covers multiple domains. During the area planning process information is brought in by domain experts and discussed in interdisciplinary team meetings. Because of the amount of information the involved actors have to make a quick shift between relevant and irrelevant information. There is always the danger of overlooking crucial information.

To support the area planning process and provide a coherent view on the available information we aim to use today’s state of the art Information Technologies (IT) in what we call an Area Planning Studio (APS) (Chin, R.T.H., S.P.A. van Houten, et. al. 2005). In section 2 we introduce the concept of an APS, which we work out in terms of the enabling technology in section 3. Section 4 provides an overview of the services we identified to be specifically required to support area planning. Hereafter, section 5 provides a glimpse into future research and development after which we end with conclusions.

2 An Area Planning Studio

Carlsson and Turban (2003) stress the role of new intelligent software systems to deal with the overwhelming flow of data and information produced in complex decision making processes. We see the possible benefits of using state of the art web technologies to support area planning at the PoR. We consider personalization of the way in which actors interact with information as a major challenge. Considering the time-span and the amount of information it is important that the involved actors are able to keep track of the area planning process: e.g. who did what, what information is available, the status of information, what was decided etc.

An APS is a virtual environment in which people, process and technology come together (Keen and Sol 2005). Together they create an environment where successful decision-making is more likely. The payoff of an APS lies in increasing the effectiveness of the decision-making processes. It does, however, not impose solutions; it tries to provide a way to support human judgment. According to (Keen and Sol 2005) the effectiveness of an APS should be expressed in a combination of three U’s: (1) the usefulness of tools and methods: the value that they add to decision processes (2) their usability: the mesh between people, process and technology (3) their usage: their flexibility, their adaptively, and their suitability to the organizational, social and political context.

As described by Keen and Sol (2005), the APS supports the involved actors in landscaping the organization’s business vision, time horizon, partnership strategies and imperatives – “must do’s” on the immediate business agenda. An initial team is formed with the skills, credibility and domain expertise to attract, motivate, coordinate and help the actors move to a decision commitment. The involved actors go through a well-structured process guided by recipes, which are built on experience. They rehearse future scenarios and try out different design options supported by suites of software services, which are focused on enhancing the decision making processes.

We worked out the generic studio concept to a set of functional requirements for an APS, which is specifically aimed at supporting area planning processes

Basic assumption for the APS is that extensive use will be made of:
- existing sources of data such as a Geographical Information System. At this moment the PoR owns a tremendous amount of data and sources of data. Many of them can be useful for area planning;
- existing models

The Outline of the Functional Requirements of the APS is described in the following sections: 2.1-2.3.

2.1 Support both process and content

The APS should aim to support both process and content of the area planning process. The support of the process focuses on the way to ‘manage’ the interaction between the experts/decision makers during the planning process. From the content perspective the support aims to give decision makers insight into all relevant aspects and their relations.
2.2 Process support requirements

2.2.1 Support multiple users with different backgrounds to enhance Integral Approach
Multiple users who look at the problems from their own perspective go through the area planning process. The presentation of the expert information from the various different backgrounds should be combined and integrated in such a way that a clear and overall judgment is possible for all participating decision makers, taking into account their cognitive limitations.

2.2.2 Accelerate the decision making process
Acceleration of the decision making process is of vital importance from a business point of view, without losing quality in the decision making process.

2.2.3 Provide a corporate memory on area planning decisions
To prevent ‘re-inventing the wheel’ processes the APS should provide (at the ‘right’ level of detail) a ‘corporate memory function’ for storing experience in the area planning process.

2.3 Content support requirements

2.3.1 Insight into all relevant aspects through support by a suite of software tools
The concept of an APS should include a suite of existing and new software tools to support decision makers. These software tools are e.g.: traffic models, noise emission models etc. In the context of area planning in the Port of Rotterdam there are relative static and dynamic properties. Dynamic properties have the tendency to change more rapidly compared to static properties. In the end the APS should be able to cope with both properties.

2.3.2 Rehearsing scenarios
The APS should be able to pay attention to past, present and future by enabling the analysis of various scenarios since consideration of past, present and future are relevant for guiding decisions for developing areas in a sustainable way.

3 The architecture of the studio
Different stakeholders need to be supported, having different knowledge, experience and backgrounds. Their different perspectives require APS to provide them with information at their own level. We aim to 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 in area planning, multiple aspects of the situation under consideration must be highlighted. Information from different domains should be combined to provide an integral and coherent view on the area under consideration. To obtain maximum flexibility, loosely coupled models can be plugged into a generic backbone that takes care of data exchange and controls the process (Figure 1).

![Figure 1 Architecture](image)

Visual thinking is crucial: if you cannot see it you cannot get it. The outcome of APS must be presented in an understandable and customized way that makes sense. Involved actors 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.

A portal as the host of the presentation layer in the area planning studio, enables the integration of loosely coupled services, which are tailored specifically for area planning. We consider a portal as the enabling technology. Abdennur and Hepper (2003) define a portal as: “a web based application that -commonly- provides personalization, single sign on, content aggregation from different sources and hosts the presentation layer of Information Systems” (page 13). In the next section we describe some of the services in more detail. Every actor in the area planning process becomes a user of the system, who plays a certain role in a certain context. Roles that can be distinguished are: domain experts, decision makers, modelers, administrators, etc. The context is the setting in which the user is involved in the area planning process. This could be an individual expert analysis, or the user can be part of an interdisciplinary team meeting. As the user logs in to the portal he or she is provided with a personalized environment that best suits the individual needs of the user.

4 The services of the area planning studio
As was described in the previous section the area planning studio consists of a set of software services that are loosely coupled in a personalized portal environment. Some of these software services are quite common in modern information systems. For example content management and communication services are widely available for existing portal environments. These services play an important role in documenting the area planning process. The history of the area planning process will be captured in reports, memos and other documents that can be managed by a Content Management System CMS that is part of the studio. Also the rise of so-called Wiki systems (Web01) might enable collaborative document writing. Furthermore involved actors may make notes or provide comments during the process. Common communication services such as bulletin boards can be configured to support the area planning process. In this respect the APS should follow, or hook up to the main stream in modern information systems development. But in the first place it should also hook up to existing information systems available in the PoR, e.g. GIS and ERP systems. However, next to these generic and already available software services we identified a number of new services, which we expect to be particularly useful for area planning. In the following subsections we describe some of these services.

4.1 The evaluation matrix

Currently area planners are using a (paper) table which they call the “matrix”. This matrix is an overview of the required characteristics of combinations of industry types and relevant aspects. For example, the matrix shows the characteristics of a typical container terminal with respect to availability of space, accessibility, livability, sustainability and commercial attractiveness. Similarly these characteristics are shown for other industry types operating in the PIC. This matrix is used as a checklist to make a quick scan of the possibility and desirability of locating a certain industry type, or (land-) use in an area of the port.

Digitizing this matrix as a software service opens new possibilities, which we expect to make the matrix more useful. We call the digitized matrix the “evaluation matrix” (Figure 2). The evaluation matrix is configurable, which means that area planners can configure the industry types, or other uses as well as the involved aspects to match the situation at hand. For example, there is a considerable difference between area planning projects, which focus on the Maasvlakte-area and those that focus on the inner city areas. The Maasvlakte is located outside of the highly populated urban area and therefore an aspect such as noise will be less relevant to study in detail. Similarly a large container terminal will not be interested in a location in the city harbors due to nautical accessibility. Therefore configurability of the evaluation matrix is an important improvement over the conventional paper matrix.

Another difference with the paper variant is that the evaluation matrix is actually three dimensional as it does not only show the characteristics of uses and aspects, but for every lot a combination of use and aspect can be evaluated. As a result there are three axis: uses, lots and aspects. By fixing one of the axis tabular views of the other two axis can be generated. For example, when a lot is selected an overview of uses against aspects can be generated. The evaluation shows how well a use fits an aspect for the selected lot. Evaluations can be automatic or manual, which means that a rule base can be implemented to automatically generate a quick scan. However, being able to manually overwrite the automatic results is important, as the rule base can never capture the human knowledge of area planners.

![Figure 2 The evaluation matrix](image)

4.2 Map service

Area planners make extensive use of geographical information. Maps are produced and managed by the Design and Drawing department. Area planners use printouts of these maps as an important basis for their discussions. Often they draw on the maps to communicate their ideas. By linking directly to the available GIS systems from the APS it is possible to digitally access geographical information. Digital maps can be coupled to the evaluation matrix to show the latest design of the area under consideration (Figure 3). Furthermore we consider digital sketching services to make quick illustrations of design alternatives. Making digital sketches instead of paper sketches eases the management and retrieval of design drawings as these can immediately be imported in content management and versioning systems.
Furthermore, the use of digital maps opens up the possibility of projecting modeled and simulated data directly on a geographical representation. Different layers of information can be combined in a geographical view, such as traffic and environmental information. This helps to find the inter-relationships between different sources of information, which results in a more integrated view on the port region.

Figure 3 Example of a map service

4.3 Geographical event service

Based on the idea of using digital maps, we developed a geographical event service (Figure 4). This service shows a geographical representation of the area combined with a time line. The user can use the time line to select a time interval. Next, dots are plotted on the map of the area at places where events happen in the selected time interval. When the user moves the mouse cursor over a dot a small pops-up window appears which shows information about the selected event. Area planners can use this service to search for events that might influence their area plan, or add new events to the map.

Figure 4 Geographical event service

5 Conclusions and future research

At the moment of writing, we implemented prototypes of the previously described services, however these are not yet integrated into a stable business information system as yet. Therefore a logical next step is to make these services comply with a web portal implementation such that we can deploy these next to existing information services. Furthermore future research will focus much more on the dynamic aspects involved in area planning. Area plans are currently often presented as a static design of a future situation in a specific port area. The translation from the current situation to the future situation should get more attention in area planning. Therefore simulation services which support visualizing this translation to find possible bottlenecks in advance is expected to improve the effectiveness of area planning.

And finally a second order of dynamics could be incorporated in area planning: using simulation models to analyze and evaluate dynamic effects such as road and waterway traffic. Re-arranging a certain port area changes the traffic pattern in that area, but possible it also influences the traffic density in the entire port region and beyond (e.g. in the city of Rotterdam). Integrating simulation models in area planning to rehearse future scenarios and get a grasp on time dependent effects of design options is expected to further increase the effectiveness of area planning.

We introduced the concept of an Area Planning Studio for the Port of Rotterdam. This studio is expected to increase the efficiency and effectiveness of area planning projects in the PoR. These projects can take months, which makes it difficult to keep track of the process as the amount of information is increasing and new team members get involved. To support the area planning process we identified
a number of services specifically targeted at supporting the actors involved in area planning. These services will be integrated in a business portal to fully integrate these with geographical and other information systems available in the PoR.

References


Web sources: