

ED Maritime

References



INCONTROL
Simulation Solutions

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1. Introduction

Enterprise Dynamics® is a leading simulation platform to design and implement simulation solutions. It allows a problem solver to model virtually any problem and, by experimentation, look for a solution for a given problem or an answer to a specific question.

Most of the problems or questions for which simulation is used are:

- Capacity investigations
- Investment evaluations
- Time-to-Market vs. Costs evaluations

To be able to perform simulation studies, a solid simulation platform is required. A good simulation platform does not only provide easy-to-understand modeling capabilities and advanced visualization features, but it also provides the possibilities for the re-use of previous made models, segments of models, and components used in early stages.

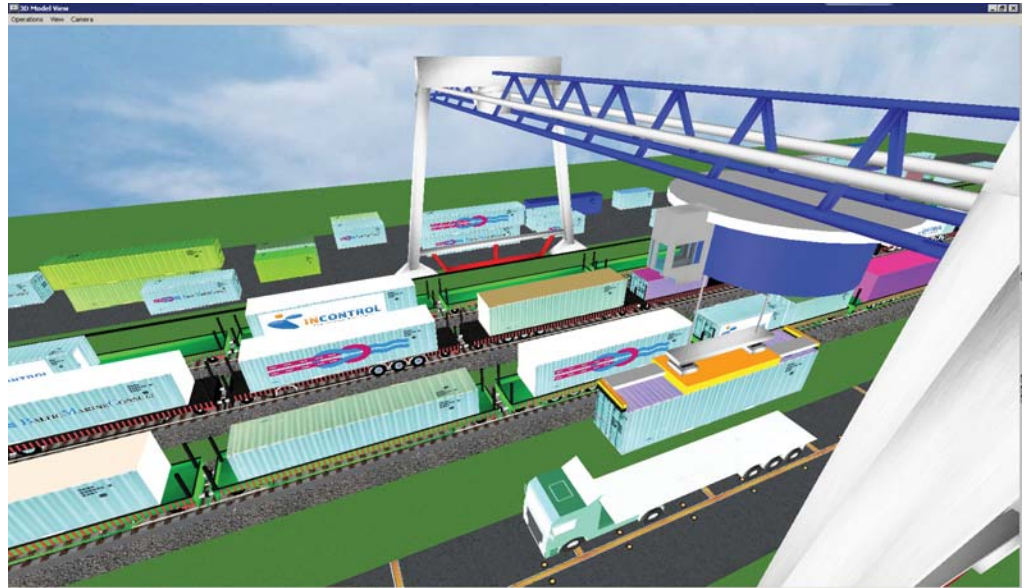


This document describes an overview of maritime solutions developed with ED Platform. The purpose of this document is to give the reader with little knowledge of simulation and Enterprise Dynamics a good understanding of the capabilities of Enterprise Dynamics and our maritime experience.

2. Maritime simulation

2.1 Functionality evaluation of intermodal freight handling systems

Intermodal freight handling between road and rail is one of the main modes of transport. The intersection between high-frequency but low-capacity operating truck-based cargo transport and the low-frequency but high-capacity acting rail freight services give rise to storage in transit. Dwell time of cargo units is the key influencing capacitive factor beside limitations of design, technical equipment and transport connections. Due to rising customer variety and soaring relations of loading equipment operation become more and more inhomogeneous. Analytical techniques are overextended to describe the characteristics, even if the data base of material flow is profound and the essential influencing factors are well known. Using the vast stochastic capability of Enterprise Dynamics appeared promising to reproduce that volatile system performance within a simulation model.



Baltic Marine Consult GmbH (BMC) is member of an international project team that has been assigned to redesign a major scandinavian terminal-hub in spring 2008. Fundamental condition of the contract was the ability to handle all kind of carrier, like 20 feet and 40 feet container, several swap types and trailer, even if mixture and/or volume will undergo predicted changes of market requirements. The hub is central control unit in order to indemnify the changeover between rail and road. The planning process has been divided into several subprojects:

- Design of rails and layout of handling areas,
- Layout based performance measurement for varying technical equipment,
- Determination of terminal module capacity and utilization,
- Cost-benefit analysis of the preferred design.

The huge simulation expertise of INCONTROL and the comprehensive branch specific knowledge of BMC has been merged to work out the model specifications for this challenging task. Some of the main issues are

- Modular design of model and building blocks in order to back up the design process, but also indemnify reusability,
- Appliance of train schedules, delays, loading structures and capacity utilization,
- Modelling of all handling operations using detailed stochastic distributions,
- Reproducibility and accessibility of all model parameters and activities to the client,
- Flexible application of different operation strategies to optimize terminal performance and energy consumption,
- Flexible integration of several cargo scale scenarios to verify the predicted carrier mixtures and hub schedules,
- Capable model structure to enable long-term experimentation of one year or longer,
- Appealing 3D visualization

The project has been realized by simultaneous modelling and process development with consecutively increasing level of maturity for booth partitions. The resultant synergetic effects influenced not only quality and speed of the planning. In fact even more potential approaches have been ad hoc tested within the flexible structure of Enterprise Dynamics, often before they caused additional planning costs.



In the final stages of the project the client received a mellow and operational reliable system that meets the requirements of today as well as the future performance increase.

2.2 Decision support tool for Europees Massagoed Overslagbedrijf (EMO)

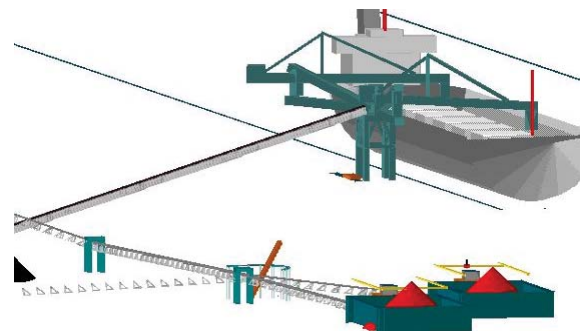
Description

EMO operates a transshipment terminal for dry bulk goods in the Port of Rotterdam. The past few years, the transshipment of dry bulk goods has grown considerably. It is expected that this growth will continue over the coming years, which makes it necessary to find a way to increase the capacity of the installations at the terminal.

Important parts of the installation are the four discharge bridges, which take the coal and the iron ore out of the large sea ships and deposit the bulk material on conveyors which convey the bulk to its destination. The two oldest discharging bridges, which are capable of hoisting a maximum of 50 tons of bulk each, were planned to be renovated. It was desirable to increase the capacity of these bridges by shortening the unloading cycle or to increase the maximum hoist weight.

Assignment

As the discharge cycle exists of a combination of factors which influence each other, it is complicated and time consuming to predict the final capacity of the installation. To be able to realize the desire to increase capacity in a cost effective manner, it was nevertheless necessary to gain insight in the working of the discharge cycle of the installation. INCONTROL has developed a simulation model of the cycle in which all the factors, including their combined action, have been integrated. The model provides insight in the effects of different combinations of changes to the discharge bridges on the capacity of the bridges.



Result

Based on the results of the study, enhancements could be implemented on the bridges that were to be renovated. The developed tool makes it possible to substantiate assumptions regarding consequences of adjustments to the bridges. Several scenarios with combinations of adjustments can be tested. Obviously, this resulted in the selection of the most operational and cost effective scenario. Furthermore, results generated by the model can be used to inquire with suppliers if predicted capacities are achievable in practice. Incontrol has provided insight in the installation capacity consequences of adaptations in the installation production process. EMO now is able to better decide which changes have to be adapted to increase capacity.

2.3 Decision support for temporary methanol storage capacity

Description

One of Royal Vopak's customers ships methanol from a plant in Chilli to Rotterdam. There, it is stored by Royal Vopak and subsequently transported to end customers. This takes place by inland navigation tankers, rail transport, road transport or pipeline. The shipping from Chilli to Rotterdam will be taken over by a super tanker under construction in the "Aframax"-class. This new generation super tanker draws too deep to be able to call at the usual Botlek-harbour, and therefore it will be discharged at the Europak Terminal instead. Here, its content will be temporarily stored before the methanol is transported further through a pipeline to the Botlek-terminal.

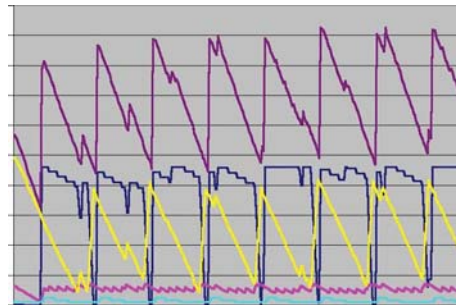
Assignment

The demand for methanol is characterized by strong fluctuations. Because of this, besides the standard storage capacity at the Europak Terminal, it is also possible to make use of so called spot capacity. This spot capacity is mainly of interest when demand for methanol stagnates, but also in case of cancellation of a delivery by the Aframax tanker. In this case, methanol charges are purchased at the spot market, involving very irregular delivery patterns through small ships. In case several so called spot-ships arrive in a short period just after delivery of a large shipment of methanol by a large Aframax, spot-capacity must be called upon. Most important question is: how much spot capacity must be purchased? Furthermore, a cost/benefit-analysis was required for different tariffs for fixed and spot storage capacity.



Result

For this assignment, it was a big challenge to map the purchase patterns. INCONTROL provided Royal Vopak with a simulation model, incorporating among other things the arrival characteristics of the Aframax and the spot ships, capacity characteristics of the variety of storage tanks at different locations and purchasing characteristics.



Stochastic variables in particular were the inter arrival times and delivery sizes of the spot ships and the purchase pattern for each storage tank through different transportation modalities.

With a runtime of one or two years, insight is given about how much additional storage capacity is needed, how often deliveries of methanol could not be facilitated assuming a certain storage capacity scenario and the continuous change of stock levels of the different storage tanks.

Based on the simulation model, Royal Vopak made the decision to implement the entire project.

2.4 Simulation of the Noordzeekanaal and the complex of locks of IJmuiden

Description

The North Sea-channel area forms the gateway for the port of Amsterdam but is at the same time an important determining factor of the accessibility of the port. To safeguard the (inter)national competitiveness of the Noordzeekanaal-area and the port of Amsterdam and to attract more commercial activities, the Directorate-General of Public Works and Water Management has drawn up a policy plan for the improvement of the quality of the North Sea-channel. The point of departure of the policy plan is a number of variations of infrastructural adaptations of the North Sea channel, in which in particular attention is paid to the IJmuiden complex of locks. An important aspect of the decision making process is the waiting time ships will undergo with the application of each of the infrastructural adaptations. As a starting point, forecasts of the shipping traffic in the year 2015 have been used.



Given the complexity of the problem domain and the impossibility to determine the effects of the infrastructural adaptations through analytical means, it was decided to apply simulation as an instrument to deliver the required insights and data. For this, Incontrol Enterprise Dynamics has developed a simulation model of the whole North Sea channel including the IJmuiden complex of locks.

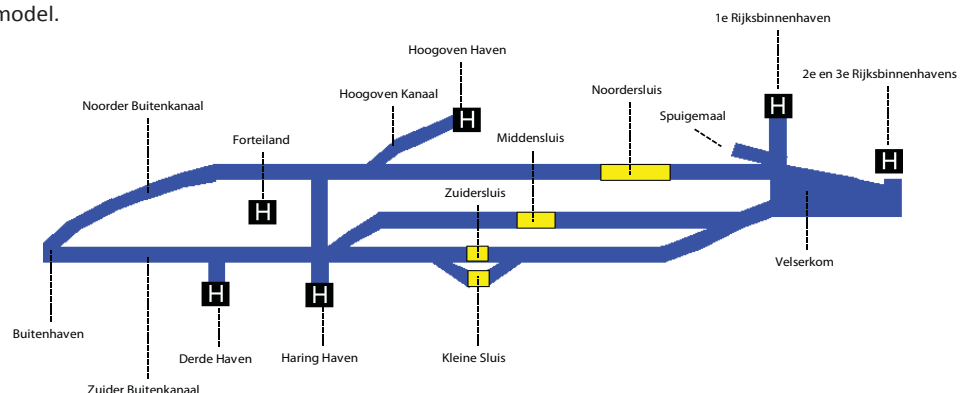
Assignment

The problem domain to be simulated is characterized by:

- A large number of different type of ships.
- The infrastructure of the North Sea channel and the IJmuiden complex of locks
- Influence of water levels and the rates of flow
- Weather conditions
- The interdependent interaction between the ships
- Lock allocation strategies
- Swinging of ships
- Length of stay of ships in harbors and at docks

The simulation model provides a flexible means to model the volume of shipping traffic, the processes involved in handling the shipping traffic (for instance a strategy for the allocation of certain locks to ships) and the infrastructure which support these processes.

With the simulation model, a number of different infrastructural adaptations of the North Sea channel have been evaluated. Amongst these adaptations are a new lock, deepening of the waterway at the seaside of the complex of locks, a new route for the transportation of sand beyond the complex of locks and the capacity increase of the Hoogovens-terminal. Combined with the possibility to take no measures at all, a total of 20 viable combinations have been yielded which have all been evaluated with the simulation model.



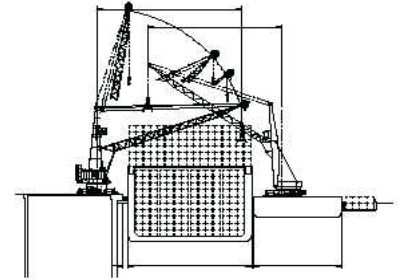
Result

The model provides insight in the waiting times of ships, the utilization of the locks, the degree of congestion in relationship with the way ship traffic is handled and the influence of factors as the weather and the tide. The simulation model has provided important insights which have increased the quality of decisions.

2.5 Simulation of the vessel unloading process in a container terminal

Description

The authorities of a new developed container terminal have disposal of mobile harbor cranes to unload large container vessels. A simulation model of the process is used to convince potential customers and investors that the unloading can be done within a reasonable time with the proposed configuration. INCONTROL Simulation Solutions developed a 3D simulation model that calculates the total unloading time and crane performances and animates the unloading process. The model is built with the Enterprise Dynamics simulation platform.



Model description

A vessel with adjustable sizes moors along the quay. The user can define the total load of the vessel in TEU and the distribution of 20' containers and 40' containers. The model then allocates the containers to positions of the ship, defined by row number and column number. The user also defines the call size (how many containers or TEU need to be unloaded) and the model will make an unloading plan that assigns which containers to remove.

The cranes all have user-defined parameters such as crane radius, traveling speed, rotation speed, spreader positioning time and speeds for slewing, luffing, hoisting and lowering. Three cranes start unloading from the quay; a fourth crane is placed on a floating pontoon. The quay cranes deposit their loads at the quay, the pontoon crane deposit its loads at the pontoon.

Each crane is allocated to a fixed sector of the ship; so they collect the containers in one of the four sectors. These sections are introduced to reduce the chances of crane interference and each of them covers approximately 25% of the total number of containers.



Results

With this simulation model the user gets results about the time each crane is busy with unloading, the total time for completion of the unloading process and other performances like moves per hour and number of loads per crane. As the user can change both crane parameters and the load characteristics of the container ship, it is possible to run several scenarios and experimentations to evaluate the consequences of alterations for every performance indicator.

The animation provides a complete visualization of the process, including all crane movements, and dynamical graphs of the performance indicators. Furthermore, it is possible to upload the loading positions for planning (stacking) purposes before the ship arrives at the port.

2.6 STAA

"Operational planning system through simulation"

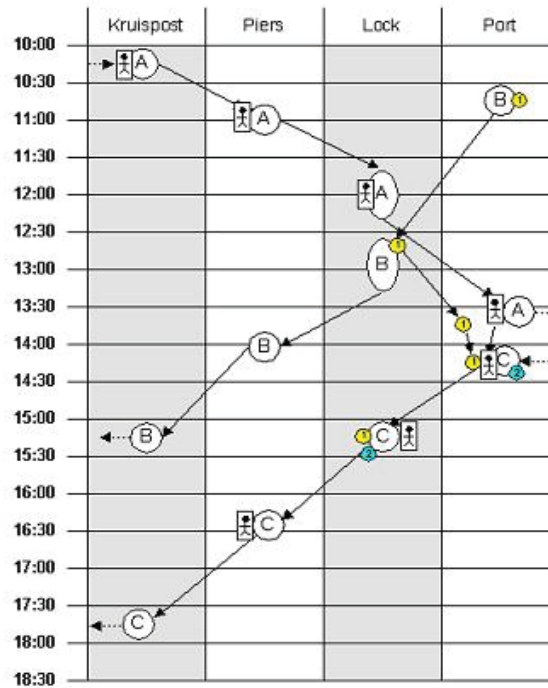
Under the authority of the Port Authority of Amsterdam, INCONTROL examined different possibilities to improve the allocation of pilots, tugboats and the largest lock ('Noordersluis') to the incoming and outgoing ships which call in at the port of Amsterdam.

The result of this research is STAA, a system developed by INCONTROL. STAA is an innovative decision support system and planning system to coordinate the 24/7 operational processes and to control the arrival and departure of sea ships.

The Process

Every year more than 5,000 sea ships call in at the Port of Amsterdam. Due to current economic expectations, this number is increasing heavily and, at the same time, the size of the ships tends to enlarge over time.

Every ship needs a tugboat, a pilot and a passage through the big lock. The following example shows the complexity caused by (only) three ships.



Ship A makes a journey from the Kruispost (located 5 miles offshore) to the harbor. On its way, the ship passes the piers at the city of IJmuiden and later on the journey the lock complex. Ships B and C are making exactly the same journey in reverse order from the harbor to the sea.

(1) Ship B uses the big lock after ship A and for that reason:

If Ship A has a delay, ship B has a delay as well.

(2) The same tug which is allocated for ship B, is allocated to ship C and for that reason:

If Ship B has a delay, ship C has a delay as well.

(3) The pilot navigates ship A to the harbor. In the harbor the pilot is transferred to ship C and for that reason:

If Ship A has a delay, ship C has a delay as well.

This simple example shows that ships are, so to say, connected to each other with invisible lines. If the planning exceeds, ships will be dependant of each other and a certain, in practice a common term, knock-on effect will arise with delay to delay as consequence.

The Control

Many parties are involved in the execution and the planning of this process. Each of these parties operates on different locations spread all over the harbor. The following parties are currently involved in STAA:

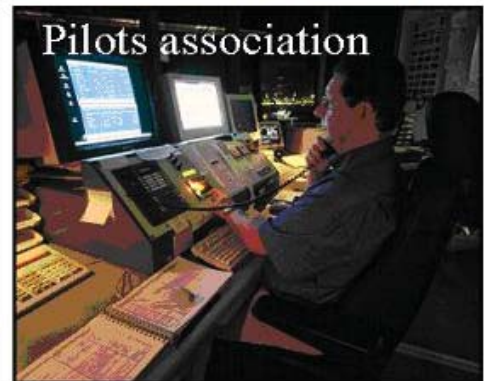
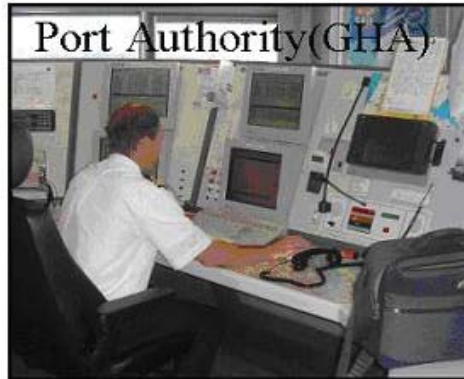
- Port Authority of Amsterdam
- Switzer Wijsmuller (tug company)
- Het Loodswezen (pilot association)

The Solution

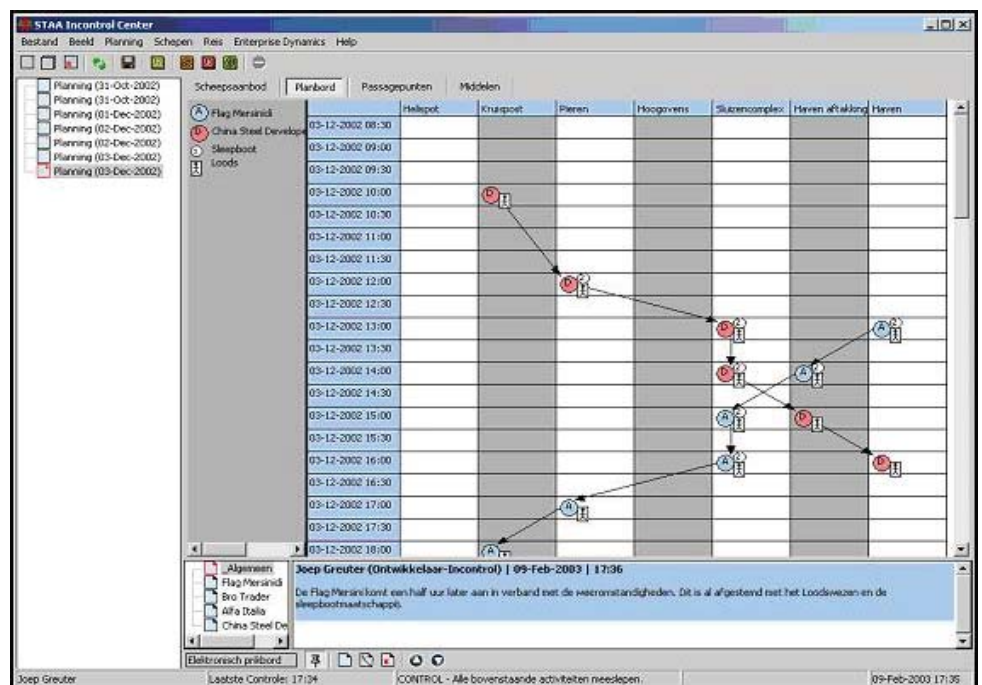
The Port Authority of Amsterdam and INCONTROL have executed an analysis of the complex interdependencies within the harbor and have provided a solution based on three concepts:

- A virtual collaboration working environment
- A common plan of the capacity requirement of tugboats, pilots and the big lock
- The same view of the plan and operational information is shown to all parties

All operational locations are equipped with the STAA Incontrol Center. The STAA Incontrol Center is an internet application based on Microsoft .NET technology.



The STAA Incontrol Center is able to contain an unrestricted number of plans. Every plan contains three sorts of information. First, the plan contains a time-table filled with information of the expected arriving and departing ships. Besides that, every plan has a plan board which contains the journeys of the ships and the allocation of tugboats and pilots. Finally, a plan has an electronic bulletin board. The bulletin board contains messages with operational information and operational agreements.



Decision supportive tools

The STAA Incontrol Center provides three tools:

(1) Conflict detection

Using a simulation model, the STAA Incontrol Center detects where and when a plan has conflicts due to the non-availability of capacity. The user is able to watch the animation of the simulation and receives a status report in the STAA Incontrol Center.

(2) Compare different plans

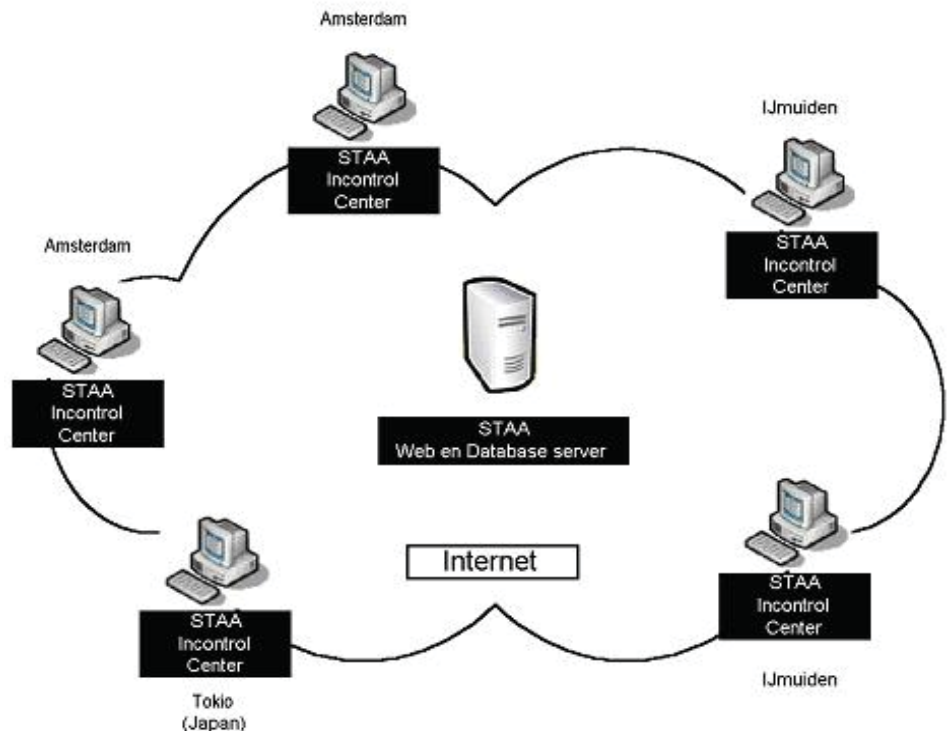
The same simulation model is also used to compare the robustness of different plans. The question is: how sensitive is a planning for disruptions and what is the relationship with other plans? A robust plan is in many ways preferable over an optimal plan since delays happen frequently due to non-controllable factors (like for instance the weather).

(3) Propose a plan

Using a tailor-made planning engine, the STAA Incontrol Center makes a proposal for the daily plan of the journey of the ships. The plan considers the availability of tugboats, pilots and the lock sequence of the big lock and whether ships are able to call in at the harbor due to the tide. The planning engine considers the fact that tugboats are not only scarce resources, but that the tugboats are moving resources as well. This means that the planning engine considers time and place.

STAA Web server and Database server

The STAA Web Server and Database server, in which all information is stored, are located in the middle of Amsterdam. Just like the STAA Incontrol Center, the STAA Web and Database server are developed in the Microsoft .NET platform. An internet application makes it redundant to build a special network at the client and the application makes it possible to use the system in all places all over the world. For example, the system can be used if somebody brought his own laptop to Tokyo, Japan.



The Method

An important feature while developing an innovative decision support system such as STAA, is the acceptance of the system by the operational people. The core of the method is that INCONTROL treated the common practice as a source of experiences and not the cause of the problems. The members of the INCONTROL project team were in close contact with all operational people regularly to develop the concepts and ideas of the new system. The members of INCONTROL actually attended some night shifts to

gain the insight in operational processes they needed to successfully develop the system.

Besides this, INCONTROL equipped all operational working stations with the first prototype of STAA in a very early stage of the project. A core group of potential users used this prototype to gain ideas and wishes. A series of prototypes followed before INCONTROL completed a final version. In this project, INCONTROL did not produce endless piles of documents with specifications of the system. The concepts were presented on easy-reference memos to the board of the Port Authority of Amsterdam, but just as important, to the people who should work with the system.

The entire project extended over nine months. The flexible approach resulted in completing the STAA system within time and budget.

2.7 Simulation study of the opening regime of the Calandbridge



On the authority of Royal Haskoning, Incontrol has performed a study on the effects on the circulation of ship traffic of a modified regime of openings of the Calandbridge at the Brittany-harbour.

INCONTROL has been asked to develop the simulation model and, together with the engineers of Royal Haskoning, calculate and analyze different scenarios. In addition, the consequences of the different opening regimes on crossing times and waiting times have been mapped.

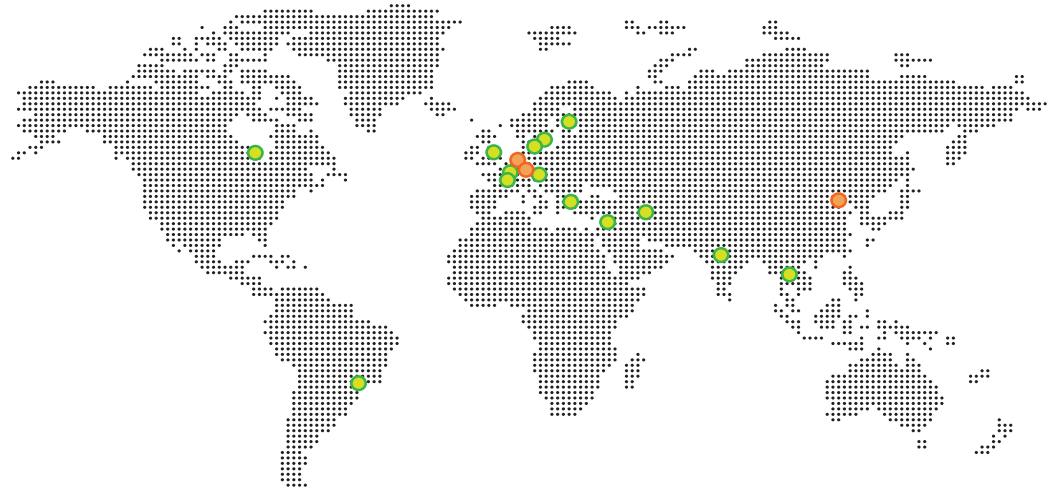
2.8 Simulation of working methods for the Fairway Marking Authority

The Fairway Marking Authority in Den Helder is a Department of the Netherlands General Directorate of Shipping and Maritime Affairs which, in turn, is supervised by the Netherlands Ministry of Transport and Public Works. From its Den Helder base, the Fairway Marking Authority marks the trade routes in the North Sea and the Wadden Sea. In addition, it conducts the management of lighthouses, buoys, and beacons, and marks obstructions, offshore platforms, wellheads, and wrecks. To do this work, the Authority has at its disposal of major warehouse and yard facilities in Den Helder, and it operates two modern beacon vessels named Breeveertien and Nieuwediep.



For the Fairway Marking Authority, a simulation study has been conducted aimed at investigating which work method results in the lowest amount of work on hand. In addition, it has been investigated to what extent the merge of two workshops and the partial putting out of activities would result in stock reduction and large scale benefits.

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