INTEGRATING SIMULATION INTO A WEB-BASED DECISION SUPPORT TOOL FOR THE COST EFFECTIVE PLANNING OF VESSEL DISMANTLING PROCESSES

Charalambia Pylarinou, Dimitrios Koumanakos, Antonios Hapsas
Nikos Karacapilidis and Emmanuel Adamides
Industrial Management and Information Systems Lab, MEAD, University of Patras, 26504 Rio Patras, Greece

Keywords: Decision Support Systems, Simulation Modeling, Vessel Dismantling.

Abstract: Vessel dismantling is a complex process, which requires advanced planning subject to environmentally safe as well as cost and energy effective standards. Aiming to facilitate stakeholders involved in such activities and augment the quality of their related decision making, this paper presents an innovative decision support system that takes into account the diversity of the associated constraints (i.e. available resources, environmental issues, health and safety of the workforce, etc.). The proposed system aids stakeholders make decisions on qualitative issues such as the appropriateness of a disposal methodology or the level of the safety of the workforce in a specific dismantling yard. Being seamlessly integrated with a visual interactive simulation environment, the system facilitates the collaborative design and redesign of dismantling processes.

1 INTRODUCTION

Ship dismantling related activities like scheduling, control, and capacity planning require information, knowledge and experience that reside in a diverse set of organizational assets (including employees, structure, culture and processes). Due to the need of conducting experimentations before making decisions and the usefulness of simulation models to manage long range planning decisions, the overall management of these activities can be significantly aided by the employment of a simulation-based Decision Support System (DSS).

The exploitation of advanced information technology in the area of ship dismantling and recycling is focused on the electronic recording of ships' characteristics, materials and associated technologies (Ahluwalia and Govindarajul, 2005), as well as on shipyard simulation modeling (Peters et al., 2001). Systems like the one described in (Kuhl et al., 2005), which allows planners and managers to enter information into the models and generate output reports enhancing decision making, and DOVE (Dismantling of Obsolete Vessels), which encapsulates a large database (Rashpal et al., 2004), neglect a series of important analysis and collaboration features.

On the contrary, this paper proposes an innovative simulation-based DSS for the collaborative modeling and management of dismantling processes through dynamic simulation, allowing strong analytical modelling of the related processes. The overall approach followed during its development aims at strengthening the synergy of knowledge management and decision making by the integration of experimentation features. The proposed web-based system supports collaborative design, planning, execution and improvement of dismantling and materials absorbing processes. It is based on the Co-LEAN software suite (Adamides et al., 2006), and is able to share knowledge and information across different dismantling yards, as well as between yards, obsolete ship brokers and customers.

2 THE PROPOSED SYSTEM

The proposed system utilizes discrete-event simulation models to produce generic guidelines and rules for scheduling the dismantling process of vessels with respect to environmental and

Pylarinou C., Koumanakos D., Hapsas A., Karacapilidis N. and Adamides E. (2008).
INTEGRATING SIMULATION INTO A WEB-BASED DECISION SUPPORT TOOL FOR THE COST EFFECTIVE PLANNING OF VESSEL DISMANTLING PROCESSES.
In *Proceedings of the Tenth International Conference on Enterprise Information Systems - AIDSS*, pages 544-547
DOI: 10.5220/0001710105440547

occupational safety, health, cost and energy effective issues.

Large databases, built in Microsoft® Access, are linked with Microsoft® Excel tables, which in turn are exploited by the Extend simulation software, where a generic model of the dismantling process taking place at a ship yard has been designed. The dismantling process comprises a series of hierarchically structured sub-activities, for which all necessary parameters have been taken into account (including capacities, resources, average demand and dismantling rate). The end user has the capability to populate fields in a user-friendly web interface and obtain the results of a dynamic analysis on appropriate output interfaces.

2.1 DSS Architecture

As mentioned above, the proposed system exploits a simulation model built in Extend simulation software, which is installed in a server. Components of the simulation model are connected through ODBC (Open Database Connectivity) technology with the database. A runtime development kit allows the simulation model to run at the background, without (direct) user interference. In this way, any user who is not familiar with simulation modeling can run the model directly from the web interfaces, without having the burden to deal with simulation technicalities.

The system's interfaces have been designed by exploiting an open source Content Management System (CMS). Their content consists of html pages, dynamic asp pages, forms, icons and forums to support communication among users. Moreover, other features offered through those features include document repositories, flowcharts, and support for information search. Depending on user's requests, some outputs are the outcome of simple data processing (e.g. comparisons, matching, etc.), while some others are the result of modeling simulations.

Records can be easily withdrawn from a data repository, while new documents, guidelines and regulations can be uploaded or downloaded in the database through an appropriate link.

2.2 DSS Web interfaces

The system aims at serving the following types of users; *i) dismantling site owners, ii) broker companies, iii) third party official delegates,* and *iv) environmental and energy related organizations*. Users have the ability to populate the databases, select from predefined data and models, obtain results based on selected inputs and retrieve information from historical records.

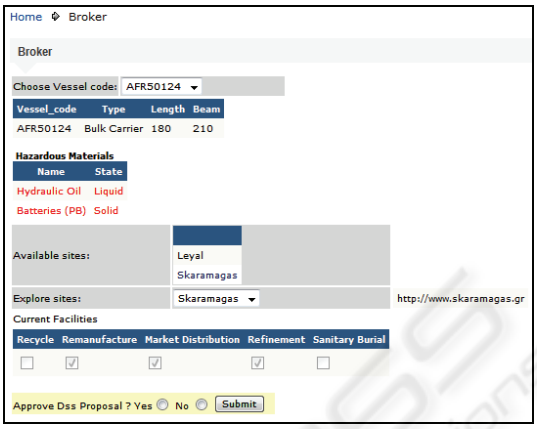


Figure 1: Broker input page.

A broker company can see in advance all the available (and suitable) yards to dismantle environmentally and cost effectively a vessel, provided that the characteristics, properties and functions of the particular vessel are known (Fig. 1). The system will propose the "best fit" yard found, showing its characteristics in detail. The system compares all technical, environmental, occupational, and recycling characteristics of the existing yards (stored in the database) with the characteristics of the vessel that needs to be dismantled.

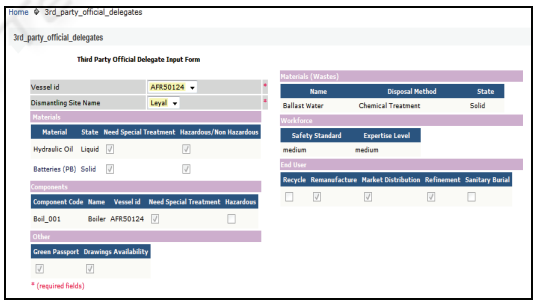


Figure 2: Third party official delegate input page.

Third-party delegates (i.e. European Union IMO, ILO, etc.) want to assure the compliance of a vessel's dismantling process against environmental, safety and energy guidelines. These requests, which are time irrelevant, are handled through the appropriate information processing (matching). For example, a user can indicate a specific vessel that is about to be dismantled in a specific yard (see Figure 2), and automatically know if some materials will not be able to be treated or disposed safely, or what the chances of a human accident are due to inadequate safety conditions at this yard. Moreover,

they can get information about whether a specific yard has experienced staff to execute a dangerous or high skilled technology or how safe the treatment and disposal of produced wastes can be.
Similarly, environmental organizations are able to view information about the materials and the components produced, as well as their disposal and treatment history.

3 SIMULATION-BASED DECISION MAKING SUPPORT

The simulation models incorporated in our approach provide sufficient information regarding resource utilization, lead times and costs both for each operation of the dismantling process and in total. The calculated critical parameters include the resources capacity, the total cost of the dismantling process, and the total time the process is about to last. Other parameters of high interest are each activity's cost and lead time. Provided that these parameters are known, it becomes easier for a user to identify critical activities which need improvement or seem to be extremely costly. The accurate scheduling of the dismantling operations, through simulation modeling, will evaluate the performance of these critical parameters and eventually lead to an energy and cost effective dismantling process.

3.1 Integration of Simulation Modelling

A generic dismantling process, consisted of nine activities, is modeled in Extend. All input data are inserted in the model through a web interface, where the user can select activities and enter numerical values.

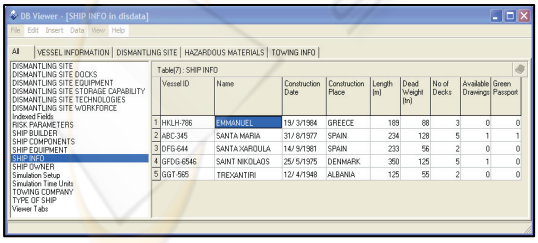
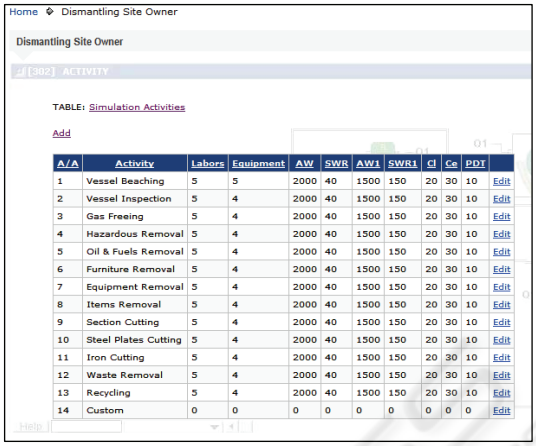


Figure 3: Inserted data in Extend.

Simulation blocks draw data from appropriately structured files (Fig. 3). Data resulted from simulation runs are demonstrated through appropriate user interfaces.



A/A	Activity	Labors	Equipment	AW	SWR	AW1	SWR1	CI	Ce	PDT	
1	Vessel Beaching	5	5	2000	40	1500	150	20	30	10	Edit
2	Vessel Inspection	5	4	2000	40	1500	150	20	30	10	Edit
3	Gas Freeing	5	4	2000	40	1500	150	20	30	10	Edit
4	Hazardous Removal	5	4	2000	40	1500	150	20	30	10	Edit
5	Oil & Fuels Removal	5	4	2000	40	1500	150	20	30	10	Edit
6	Furniture Removal	5	4	2000	40	1500	150	20	30	10	Edit
7	Equipment Removal	5	4	2000	40	1500	150	20	30	10	Edit
8	Items Removal	5	4	2000	40	1500	150	20	30	10	Edit
9	Section Cutting	5	4	2000	40	1500	150	20	30	10	Edit
10	Steel Plates Cutting	5	4	2000	40	1500	150	20	30	10	Edit
11	Iron Cutting	5	4	2000	40	1500	150	20	30	10	Edit
12	Waste Removal	5	4	2000	40	1500	150	20	30	10	Edit
13	Recycling	5	4	2000	40	1500	150	20	30	10	Edit
14	Custom	0	0	0	0	0	0	0	0	0	Edit

Figure 4: Dismantling site owner output interface.

Data contained in the database include generic vessel and dismantling site attributes, as well as specific information associated with components, materials, workforce, technologies and recycling methods. Fig. 4 refers to a list of a ship dismantling process. The user may edit the values of the parameters (i.e. the number of equipment, the cost of workers per day, the cost of tools, etc.) of the existing activities in the yard under consideration (the interface also allows the user to define new activities).
When the whole process has been fully described (numerically), the "*Next*" button triggers the execution of simulation in Extend. When the simulation run is completed, the associated results (concerning well-defined cost and time related parameters) are being displayed in a new window (Fig. 5).

Activity	PDT	PDT_l	PDT_e	TC_l	TC_e	Tc
Vessel Beaching	10	25	1	2500	300	2800
Vessel Inspection	10	10	2,5	1000	300	1300
Gas Freeing	10	10	2,5	1000	300	1300
Hazardous Removal	10	10	2,5	1000	300	1300
Oil & Fuels Removal	10	10	2,5	1000	300	1300
Furniture Removal	10	10	2,5	1000	300	1300
Equipment Removal	10	10	2,5	1000	300	1300
Items Removal	10	10	2,5	1000	300	1300
Section Cutting	10	10	2,5	1000	300	1300
Steel Plates Cutting	10	10	2,5	1000	300	1300
Iron Cutting	10	10	2,5	1000	300	1300
Waste Removal	10	10	2,5	1000	300	1300
Recycling	10	10	2,5	1000	300	1300
Custom	1	1	1	1	1	2

Figure 5: Dismantling site owner output interface.

According to these results, the user can reconfigure the input values, run again the model and obtain new results. Consequently, managers can simulate the

process scheduling and plan the breaking and recycling activities based on tested and accepted parameter values (liable to cost and energy effectiveness).

3.2 Results and Rescheduling

The simulation model considers not only a list of scheduling parameters, such as the already mentioned input data, but it also incorporates a variety of performance metrics. Descriptive tables and charts can demonstrate graphically the performance of the metrics in interest, and give necessary information for the user's decision making (Fig. 6).

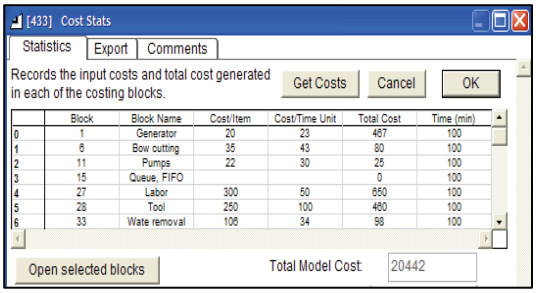


Figure 6: Simulation results concerning performance metrics.

The advantage of employing a simulation environment in the core of the proposed DSS is the ability of users to dynamically specify process parameters. In this way, a user is able to know in advance the performance of the process and decide about its appropriateness. When the results are not satisfying, the user can change the input parameters until achieving the desired level of results.

4 CONCLUSIONS

This paper has described a DSS that effectively integrates simulation modeling to help diverse types of ship dismantling stakeholders decide on the appropriate planning of the breaking and recycling processes. Simulation is used to dynamically measure the performance of the individual operations and the overall process as far as the capacities, delay times and costs are concerned. The system is easy-to-use and requires no particular simulation expertise. Moreover, it comprises a knowledge repository that may facilitate and enhance various (both individual and organizational) knowledge management processes.

Future work directions concern the enhancement of the proposed system towards alleviating the need of requiring a simulation facilitator, and the expansion of the associated databases in order to add more detail in the scheduling of the dismantling process.

ACKNOWLEDGEMENTS

The work presented in this paper is partially funded by the European Union, through the "ShipDismantl: Cost Effective and Environmentally Sound Dismantling of Obsolete Vessels" Project (Specific Targeted Research Project, IST FP6-2003, Transport-3 Call, TST4-CT-2005, Contract No: 012561).

REFERENCES

Adamides E.D., Karacapilidis N., Pylarinou H. and D. Koumanakos and Hapsas A. (2006) , "An integrated Information system for supporting lean and green ship dismantling", In K. Mendibil and A. Shamsuddin (eds.), Moving up the Value Chain. Proceedings of the Euroma 2006 Conference, Glasgow, Scotland, June 18-21, Vol.2, pp. 645-654.

Ahluwalia, R.S. and Govindarajulu, S. (2005), "A software tool for disposal of obsolete vessels", Journal of Ship Production, Vol. 21, No. 1, pp. 1-7.

Kuhl M. E., Steiger N. M., Armstrong F. B., and Joines J. A., eds.(2005) Simulation optimization decision support system for ship panel shop operations, *Proceedings of the 2005 Winter Simulation Conference*.

Peters B. A., Smith J. S., Medeiros D. J., and Rohrer M. W., eds. (2001). Hierarchical modelling of a shipyard integrated with an external scheduling application, *Proceedings of the 2001 Winter Simulation Conference.*

Rashpal S. Ahluwalia, Pooja Sibal, and Sriram Govindarajulu. Database for dismantling of obsolete vessels, Proceedings of SPIE - Volume 5263, Intelligent Manufacturing, Bhaskaran Gopalakrishnan, Angappa Gunasekaran, Peter E. Orban (eds.), March 2004, pp. 188-194.