HarborSym and the Glass Box Philosophy

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HaborSym is a simulation based decision support application that the Corps is in the process of finalizing for use in port improvement studies. HarborSym, like other decision support applications recently developed by the Corps, is designed with the intention of offering a wide range of generic application opportunities. Such decision support tools provide more flexibility and avoid the pitfalls of previous applications that were hard coded to specific projects and thus were of limited use once the particular project was completed.

The generic nature of the application is maintained by designing the embedded models to be data driven. In other words, more of the model functionality is driven by user input. A computation kernel then takes this input and simulates what could be expected in terms of benefits if specified navigation improvements were implemented. HarborSym in particular was designed to enable the evaluation of potential benefits of port based navigation improvements such as the widening of port entry channels. The HarborSym application and underlying model was built with the support of the Galveston District. With each application the model has underwent modifications that make it more generic so that researchers from other Districts can adopt it and use it.

Following IWR's "glass box" (as opposed to "black box") philosophy of trying to develop models whose internal implementation is known and fully visible, it is the hope that the computation kernel used in HarborSym can be reviewed for computational correctness. HarborSym has been designed with windows that permit analysts to see what is driving the model. The application's Graphical User Interface (GUI) also permits a user friendly option for mapping the study network and inputting data.

Other principal features of the application and internal model include the user's ability to build/define the system to be simulated and provide application parameters (navigation rules) for the system. Once the system has been defined and all parameters specified, HarborSym can simulate vessel movements through the system and capture vessel delay times. Comparing vessel delay times for with- and without-project conditions permits HarborSym to estimate potential benefits of proposed navigation improvements.

Questions and Issues

- During the presentation, a clarification was requested on exactly what the model does. In response, it was clarified that the model was designed to move vessels. Shipments lists are provided to the model and in turn the model processes the vessels through a defined system and calculates when a navigation rule would be violated and thus causing a delay.

- One participant wondered whether the HarborSym model was a WAM-based model. In response, it was mentioned that HarborSym was a data driven model and was similar to a WAM-based model.

- Clarification was requested on the meaning of "data-driven". Data-driven was explained to imply that many of the model's functional components are determined or influenced by user specified data inputted into the model.

- A question was raised regarding the model's forecasting capability. In clarification, it was mentioned that the model was not designed to perform forecasts but to run simulations. Commodity and fleet forecasts can however be used as inputs to the model.

- One participant inquired on the model's backcasting capability. Backcasting was said to be problematic in the model due to data issues.

- Participants asked whether the model and interface was geo-referenced and whether the different segments of the waterway system were mapped to scale. The presenter responded by mentioning that the system was geo referenced by the longitude and latitude positions of system nodes but it was not mapped to scale. One reason for not mapping the waterway segments to scale was because it allowed analysts to focus on the segments of interest by expanding these sections while minimizing those of less importance.

- Several inquiries focused on navigation rules and restrictions that are incorporated in the model. Participants wanted to know whether specific navigation conditions and rules associated with those conditions have been addressed in the model. For example, participants wondered whether navigations rules for different related navigation conditions had been incorporated. One participant wondered whether navigation rules were site-specific or pilot-specific as well. In response to all these questions, the presenter noted that in one form or another, it was possible to add nearly every conceivable navigation rule to the model. However, it was a question of resource and time optimization and determining what rules are essential and adequate for most types of project evaluations.

- With regard to whether users will have the ability to add external events to the model, the presenter indicated that a programmer would have to go back into the programming code to build a new rule.

- A question was raised on how uncertainty is treated. The presenter indicted that Monte Carlo simulations are used because of uncertainty.

- One participant observed that many of the questions raised were very relevant but applied to different hierarchies or operational perspectives. The participant warned of possible information overload if all these issues were addressed within one model. One possible solution was the development of a hierarchy of models. Each model would focus on a different level of detail. As an example, the Freight Analysis Framework (FAF) model developed by the Federal Highway Administration (FHA) was developed to simulate freight movements for the entire nation and was considered the baseline model. To accommodate regional and state level analyses, the FHA developed step down models to simulate smaller regional entities based on a hierarchy.

- Regarding HarborSym's applicability to other harbors, the presenter explained that HarborSym has the advantage of maintaining the same functionality. Additionally, the model saves time because the algorithms are the same. The hope was that once the current study was completed, the model could easily be applied to other harbors.

- Why was Tampa chosen for the case study? Why not New Orleans where there are more vessels? Tampa was chosen because it was manageable and has no seasonality. New

Orleans has seasonality and other complications making it not suitable as an initial model study area. HarborSym model development and analysis is also tied to particular studies and funding.

- Consideration the prevalence of the cruise ships in Tampa Bay, one participant wondered whether cruise ships get any preferential treatment in the model. In response the presenter indicated that one of the rules in the model specifies the protocol of vessel preferences. A rule could be set so as that cruise ships are preferred.

- One participant was very pleased with the HarborSym model and its application. The participant's opinion was that if the model is implanted incrementally project by project, it should become the model of choice for channel widening applications.

Other Questions and Issues Not Directly Addressed

- Clarification was also requested on how delays are calculated.

- The participants wondered whether the MicroSaint software offered any benefits to the HarborSym model.

- How is seasonality accounted for?

- In calculating arrival times do you put in Poisson distributions?

- How does this approach compare with running regressions on delay?

- How is time optimized?

- What would be the impacts of LNG, weekend rates, etc.?