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# Use of Model Simulation at the Panama Canal for Resource Estimation

**Martín Varela** [1]

Model simulation has been widely used for many years for strategic planning and optimization. It allows for experimenting with different scenarios before implementation which results in cost savings as the objective is to do it right the first time. The Panama Canal has taken advantage of this technology as it has developed several models for different purposes.

The transit of vessels through the Panama Canal is a complex process that requires a plural and diverse number of resources working in a synchronized manner throughout all the geographic areas and phases that the transit involves. These resources are distributed accordingly and their assigned radius of activity depends on the planned logistics corresponding to each of the 365 days of the year. Some of them remain within a confined zone, others follow the vessel throughout the transit, and others mobilize within one of the two major defined geographic sectors: Pacific and Atlantic.

Equal to the complexity of the transit is the estimation of resources needed per day considering that the sequence and the mix of vessels (by size, market segment and direction) varies every time. In the year 2006 the Panama Canal consequent to this reality, began the development of simulation models that could estimate with better precision and confident level some of these resources. Model simulation would then replace the manual estimates utilized at the moment.

The models mentioned above include the resources of tugboats, launches and On Deck- Line Handlers and they are described as follows:

1. Two models were developed corresponding to the two major geographical sectors: Pacific and Atlantic. This separation was made since the majority of the resources are assigned within this two specific sectors.
2. The software utilized was ARENA by Rockwell Automation which permits the development of process simulation models for a wide range of business or public environments. The main developing mechanism consist of incorporating modules, provided with the software, and construct logics from scratch via flow charts and the use of visual basics for the incorporation of interactive windows (see Fig. 1).

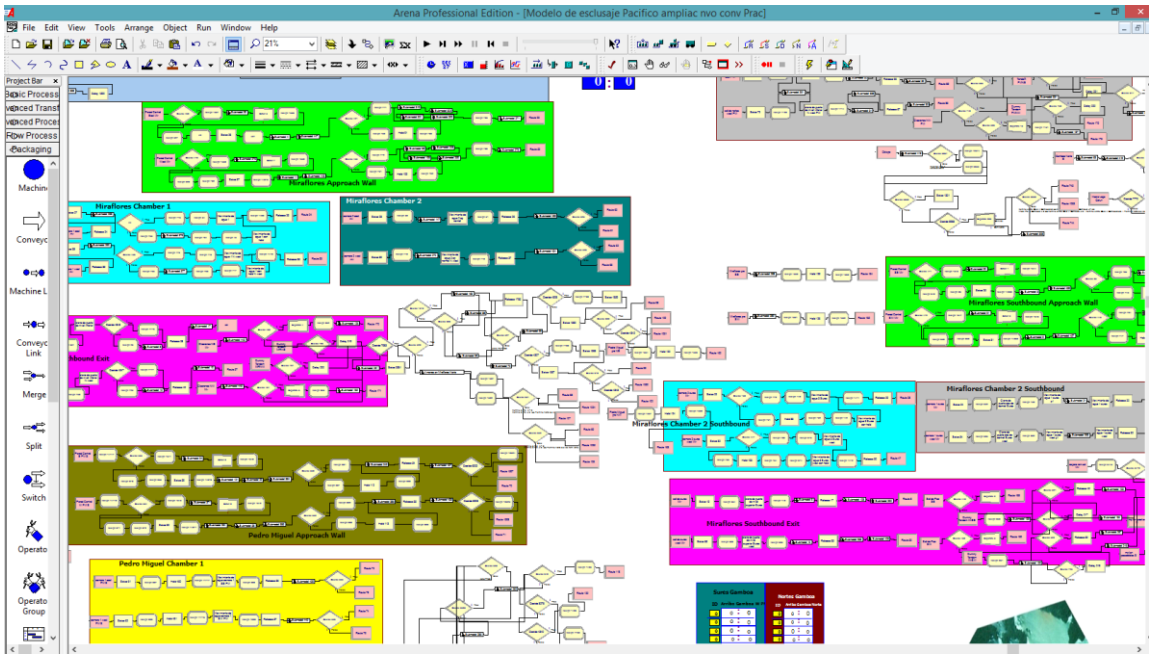


**Figure 1: Example of the model logics**

3. The models simulate the vessels transit process, and as the vessels go through all the navigational channels and locks they are assisted by: 1- launches in a way of embarking and disembarking personnel (such as Pilots and On Deck-Line Handlers) and 2- tugboats which assist in the maneuverability and safety in specific navigational channels, in the approach to the Lock Entrance Walls and within the Third Set of Locks.

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4. The models were developed with a very high graphical visual approach (see Fig. 2 and Fig. 3) with the purpose for the developer or user to see clearly the events taking place. This characteristic is very helpful during the developing and debugging stages. Also, the animation helps the presenter to transmit his message and transmit the results and very importantly: for the audience to help assimilate the issues being discussed.

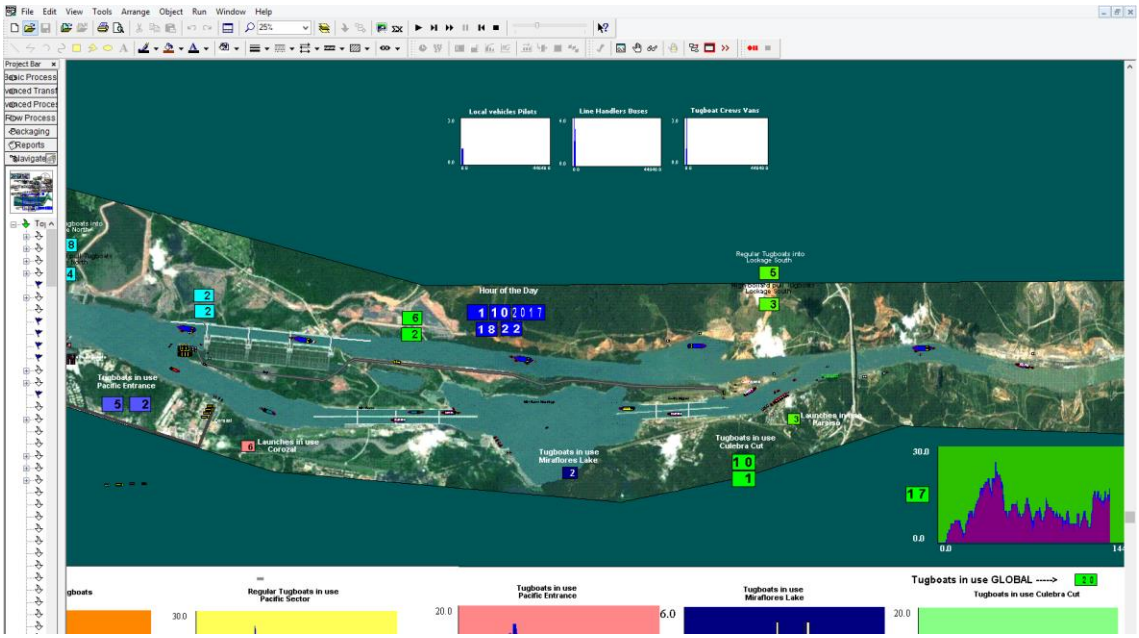


**Figure 2: Pacific Sector Resources Model**

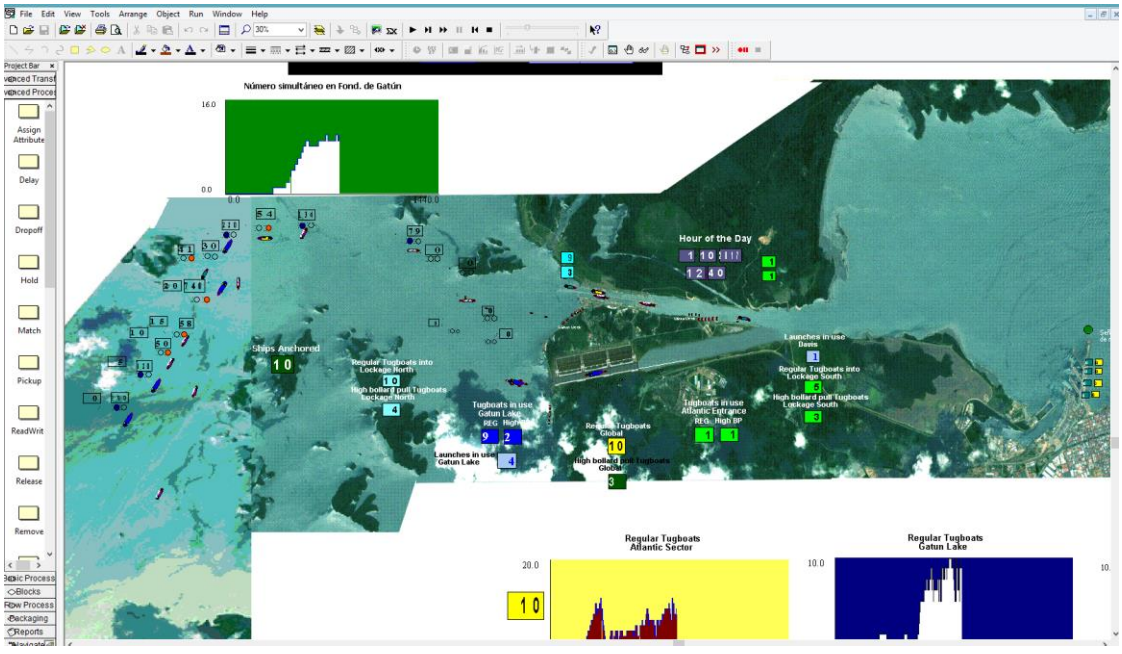


**Figure 3: Atlantic Sector Resources Model**

5. The main input that feed the models are the vessel schedules, which correspond to either a few days or an entire year, that could be obtained from three different sources: 1-real historical data, 2-manual schedules, and 3-from the new Capacity Model that can generates, automatically, schedules for a desired period of time. The schedules received are then processed into an Excel file designed specifically with data and formulas linked to the logic structure of the models.

6. As the models run, they record the number of the different resources in use, at ten minute intervals, corresponding to the established geographic sectors or operational berth (launches). At the end of each day this data is exported to another Excel file. This Excel file automatically generates demand curves (see example in Fig. 4) which allows the establishing of the number of maritime equipment's required and the corresponding operating structure (shifts and schedules during the day). For the tugboats, it relates to each of the two major geographical sector and for the launches it relates to each operational berth.

7. The models also generate demand curves for the On Deck-Line Handlers which helps optimize the shift schedules (most appropriate reporting times and quantities of personnel), as they permit to visualize the match or gaps between the supply and demand curves during a twenty four hour day.

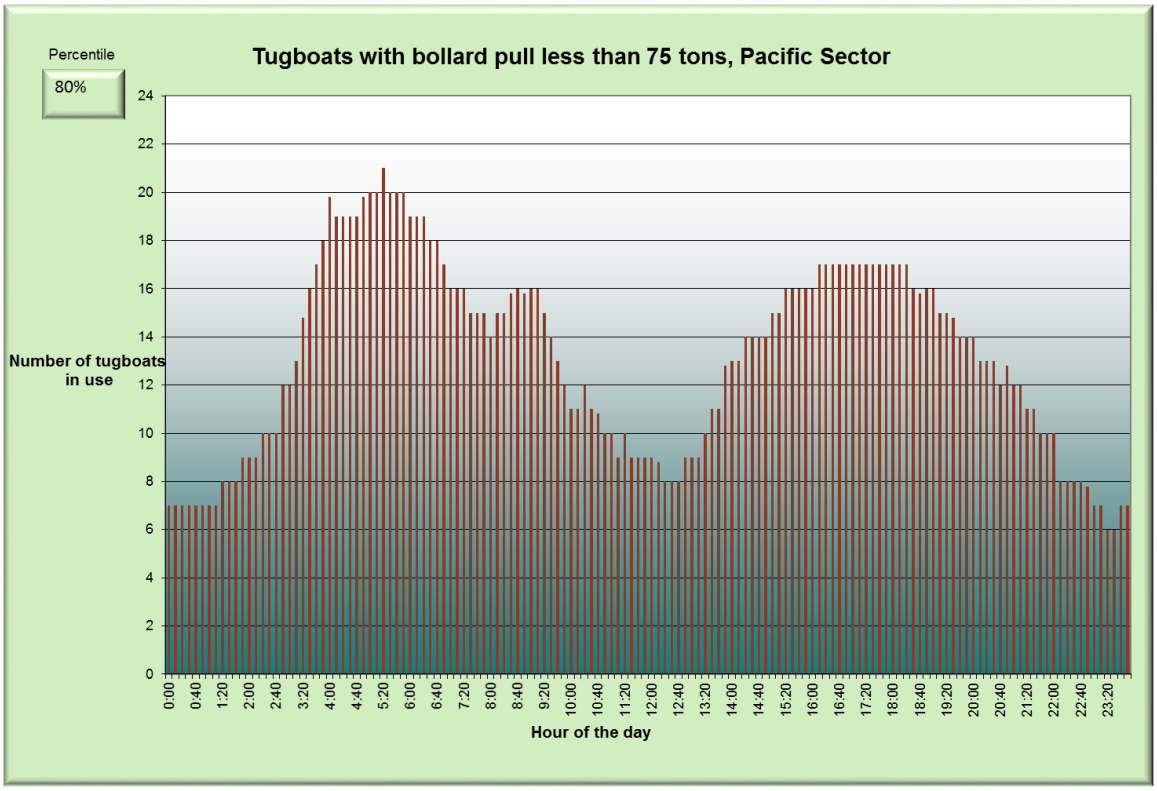


**Figure 4: Tugboats demand curve for the Pacific Sector**

8. With these two models the Panama Canal, throughout the years, has been able to experiment with diverse number of scenarios to generate important information related to future equipment investments, budget planning, and strategic decisions.

9. Besides these two models many others, representing other processes, have been developed at different times for different purposes.