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Methodology to assess ports and waterways on safety and capacity

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Curriculum Vitae

Xavier Bellsolà Olba is a PhD Candidate at the Delft University of Technology since January 2014. Prior to his current position, he obtained a 5-year Bachelor and MSc equivalent degree in Civil Engineering (2011) at the Polytechnic University of Catalonia (UPC), in Barcelona, Spain. As part of his studies he participated in an international semester exchange program at the Chalmers University of Technology in Sweden (2010).

Before starting his PhD trajectory, he worked as a Project Engineer in the development of infrastructure and hydraulic engineering projects both in Spain and Chile.

His PhD research, funded by NWO, mainly focuses on relation and estimation of safety and capacity in vessel traffic in ports and waterways.

Contents of the research

Globalization trends in maritime transport are leading to rapidly growing ship dimensions and increasing flows in ports and waterways. Ports and waterways are quite inflexible infrastructures and difficult to expand. This implies that the aforementioned increase in vessel movements leads to more hazardous situations.

Furthermore, ports need to handle a higher traffic demand that implies longer waiting times for vessels, which reduces the capacity of the system. Because of the increasing demand, ports and waterways need to be optimized or expanded or new ports have to be designed. In all cases, both safety and capacity of the system should be guaranteed.

The aim of this research is the development of an assessment methodology relating several indicators for ports and waterways, including safety and capacity. Moreover, vessel behaviour and vessel interaction with the port infrastructure and its traffic performance will be analysed. This is a multidisciplinary research and it involves many different aspects, resulting in an assessment methodology with general applicability.

This methodology will be based on a simulation model that is currently being developed by TU Delft. This model will include vessel behaviour, human factors and external conditions, like hydraulic and weather conditions. Furthermore, based on game theory, bridge team behaviour will be the base for this innovative microscopic traffic simulation tool.

AIS (Automatic Identification System) records vessel's motion and manoeuvring, among other relevant information, and it will provide new data for the calibration and validation of the model and it will be useful to have better knowledge of vessel navigation and it will help to develop and improve the resultant methodology. Port designs will be analysed in deep to get relevant information from different possible designs and their effects on safety and capacity in these infrastructures.

The process to develop this methodology will consider the current state of the art and AIS data analysis as an assessment of the model input or for new model requirements. These will be used as the base for the development of the method. Additionally, the new requirements will be evaluated also in accordance to the needs and requirements from port stakeholders or other actors related, that will assess both, model and methodology. All these steps will lead to other relevant indicators to be included inside assessment tool, as environment or others.

From the output of the model, the different performance indicators will be analysed and assessed in order to link them and develop the assessment methodology in busy waterways and ports with a dynamic analysis.

Once the main criteria and performance indicators are analysed and identified, it will allow to an economical quantification and the generation of some multi-criteria analyses (MCA), which results will be the base of this suitable tool for the assessment of safety and capacity in ports and waterways. It should allow to be used and applied in any desired scenario, based on the cited MCA. The tool will be tested and applied to real cases both in the Netherlands and China.

The research and possible applications in the real world

Since there is an increasing social conscience about avoiding hazards, dangerous situations and accidents, especially in urban areas, an extensive research already exists related to quantitative risk assessments or risk based index assessments, mainly based in collision avoidance or terminal operations. Port authorities are aware of these problems and try to mitigate the existent hazards, and anticipate future hazards. Higher densities lead also to a higher amount of vessels into the system, that raises its capacity, but there is no research developed considering both, safety and capacity.

Due to the complexity of the problem and the lack of research and tools to support port authorities, this project will be developed.

In order to complete the whole research, needs or requirements from different stakeholders, actors or policy makers, that are related to the Port and vessel navigation and directly involved in the field, will be identified and considered. This will be done in order to create a method generally acceptable and applicable by them, as well as to connect the research with the real world .

Furthermore, as introduced before, real AIS data and port designs will be analysed with the aim of obtaining a better insight into the reality of navigation issues and infrastructure characteristics.

Moreover, since all infrastructures need high investments, decisions have to be evaluated under the economical perspective. Because of this, one of the most important factors to take into account to expand or build new infrastructures is the cost of each component and how it should influence the choice of one thing or another depending on economic aspects. Main costs will lead to the definition of some relevant economical indexes for the development of MCA.

After the development of the methodology, test and assessment of real scenarios will be carried out in order to show its applicability. MCA results will be the base of this suitable tool for the assessment of safety and capacity in ports and waterways and all the different actors should be able to use it for their different needs, as it could be to improve port designs, navigation rules or traffic management strategies.