



13<sup>th</sup> International Conference on Industrial  
Engineering and Industrial Management

XXIII Congreso de Ingeniería de Organización

The sculpture is a large, dark-colored concrete structure with a central archway. It is set against a clear blue sky and a green ground. The text 'Organizational Engineering in Industry 4.0' is overlaid on the archway.

**Organizational  
Engineering  
in Industry 4.0**

**BOOK OF ABSTRACTS**

**Gijón, 11th-12th July 2019**

## **Book of Abstracts**

**“13<sup>th</sup> International Conference on  
Industrial Engineering and  
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**NAZARIO GARCÍA FERNÁNDEZ**

**RAFAEL ROSILLO CAMBLOR**

**BORJA PONTE BLANCO**

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[servipub@uniovi.es](mailto:servipub@uniovi.es)

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## **Evaluation of the effects in the changes of tides on the productivity of a Colombian port**

**Vargas L<sup>46</sup>, Arango C<sup>47</sup>, Bravo JJ<sup>48</sup>**

**Keywords:** Discrete event simulation; investment decisions; port operations; dredging; tides

### **1 Introduction**

Ports are a significant part of the current economy of nations, thanks to the generation of economies of scale and the advantages for the final customer on sale prices they bring. This phenomenon should lead the governments to encourage competitiveness and efficiency in their ports' activities (Khalid, Muda & Zamil, 2004). Bearing this in mind, Colombian ports become a case of study due to the opportunities for improvement of their efficiency. Low depth of access channels is the main restriction of Colombian ports. In order to prevent higher costs and decrease times in port, it is planned to intervene the access channel so that it can obtain a minimum depth of 15 meters. Thus, this article studies the impact that this investment would have on the productivity of the port under study.

### **2 Objectives**

To study the effects in the changes of tides in the access channel, on the productivity of a Pacific Colombian port.

### **3 Methods**

First, we compared the indicators of the new and current systems. A simulation model was developed, since discrete event simulation is recommended by authors such as Demirci (2003), Parola and Sciomachen (2005); Arango, Cortes &

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<sup>46</sup>Leidy Carolina Vargas (e-mail: leidy.vargas06@usc.edu.co)

Facultad de Ingeniería. Universidad Santiago de Cali. 760035 Colombia.

<sup>47</sup>Carlos Arango Pastrana (E-mail: carlos.arango.pastrana@correounivalle.edu.co)

Facultad de Administración. Universidad del Valle. 760043 Colombia.

<sup>48</sup>Juan José Bravo (e-mail : juan.bravo@correounivalle.edu.co)

Facultad de Ingeniería. Universidad del Valle. 760034 Colombia.

Muñuzuri (2010). The simulation model was generated using the ARENA software version 14.0. The probability distributions were calculated using the statistical software EasyFit 5.4. In addition to that, the selection of the appropriate metrics was made reviewing reports, such as Nathan Associates INC (2006). Finally, the number of replication were determined by using the two-step sampling method proposed by Cox in 1952, to validate the simulation results. To define the warm-up period and eliminate the effect of the initial conditions, the Welch Method was used.

## **4 Results**

The simulation analyzes the current operations of the port and two scenarios: the first examines the current conditions and the dredging of the canal, while the second examines the dredging of the canal and the increase in demand. The port, with the current visit volume, achieves the service standards that are commonly required. The average times differ in the two scenarios proposed, however, the simulation showed that the improvement of depth of the access channel allows a more efficient operation, decreases the waits seen as waste, and conserves the use of resources in average levels.

## **5 Conclusion**

The current depth of the access channel to the port area of Buenaventura is not sufficient for the leading type of ships in the international freight transport. For this reason, the increase in the depth of the access channel is adequate to improve the productivity indicators of the port. Nevertheless, it is important to consider that the construction of new ports and their growth will bring an increase in traffic and size of ships, which maybe will turn it into a bottleneck again in the port area of Buenaventura.

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