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Containers in Ports can be Tracked Smartly:
Lessons Learned From a Case Study

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ABSTRACT

This article introduces a web platform to monitor cargo in containers status in real time using telematics and simulation practices. The platform was the main deliverable of a research project which aimed to strengthen security in the logistics handling procedures in port terminals. A systematic approach has been followed for its development and a pilot test was applied for tracking containers in a main port terminal. Lessons learned from this pilot study are also presented and discussed. According to the results of the pilot study, the proposed platform proved to be a useful tool for management, monitoring of the status and confrontation of security threats events, transforming the container to a "smart" container that uses sensors and systems to track and report data such as contents, unauthorized access, and physical location.

KEYWORDS

Containers, Maritime Logistics, Port Terminal, Sensor Technologies

1. INTRODUCTION

Reported cargo theft incidents doubled in the first quarter of 2016 in Europe, Middle East and Africa (EMEA) region with an average of nearly five incidents every day culminating in millions of euros of losses for manufacturers and logistics service providers, according to the Transported Asset Protection Association (TAPA, 2017). BSI's 2015 Global Supply Chain Intelligence Report identified US$22.6 billion worth of losses due to cargo theft in 2015. It is worth mentioning that it is difficult to collect accurate data for cargo theft losses owing to limited reporting by the transport industry, as well as, the lack of an international law enforcement system to ensure consistency in reporting and tracking (ECMT, 2001).

Moreover, the main objectives of the European Transport Policy for the next decade as set out in the Commission's White Paper are: first, developing and deploying sustainable new fuels and propulsion systems, second, optimizing the performance of multimodal logistics chains, including better using energy-efficient modes of transport, and third, increasing transport efficiency and infrastructure use with market-based information and incentive systems. Maritime transportation plays an important role in the development of the international trade of the European Union (EU)

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as 90% of the international trade volumes, and 40% of the internal trade volumes are transported by maritime transport (Eurostat, 2016). The total gross weight of goods transported as part of EU short sea shipping is estimated at almost 1.9 billion tonnes of goods in 2016. However, there is a prediction for an unbalanced evolution in the various EU countries. For example, even if the Black Sea offers numerous opportunities for regional cooperation as an important crossroad of commerce, its location facilitates illicit trade issues and security threats. Such threats should not be underestimated as they fuel political movements and disrupt regional economies. Furthermore, since Bulgaria and Romania are becoming the external boundary of the EU, border security in the Black Sea area is becoming extremely significant for Europe as a whole.

The problem of security is also a critical success factor for the development of sea transportations which is the main transportation means in the targeting region. According to Varbanova (2010), an increase of volumes transported on feeder lines in the Black Sea region enhances the opportunity to attract more cargoes on short sea shipping routes and ensures for higher capacity utilization in order to achieve higher efficiency of transportation. Therefore, by effectively confronting with security issues Black Sea ports can provide better services and enhance maritime trade. Additionally, and considering today that container ships represent the most dominant transportation mode in globalized supply chain networks, the development of effective container is critical for the reliable and efficient operation of these networks.

Under this context, some research initiatives have been focused on the cargo security in the transport industry and some of them in the maritime industry. However, there is a limited bibliography concentrated on the security of containers' cargo in port terminals (next section). Moreover, in the majority of the above studies either an optimization model/algorithm or the architecture framework of an information system is proposed; only a very small number present their use and operation in a real case.

The purpose of this paper is first to introduce a simple sensor-based system for supporting of containers handling in port terminals, which requires mainly business than technical background by the users, and second, to present and analyse its application in a real case study. It is one of the key deliverables of an EU research aiming to achieve secured container handling mainly during its stay and transportation between different port container terminals. The proposed platform supports:

- The identification of the exact positions of the container (depiction in a real map) from its entrance in the post to its placement in the ship;
- The recording of the control outcomes of the container content (in predefined or not control points);
- The recording of the status of the container regarding temperature, humidity and violations;
- The notification of the decision makers (operations and security officers) for an exceptional event (e.g., violation, move, not checking, and high temperature); and,
- The export of reports and stats regarding the above,

by exploiting the Internet of Things (IoT) and sensors technologies. The sensors collect data from: 1. The control points, as well as, the gate and storage area, via RFID tags and the data that are entered by the personnel of the port, 2. Global Positioning System (GPS) tracking system, and 3. Sensors inside the container (e.g., for recording temperature, humidity, and movement/violation). Furthermore, the paper presents the application of the proposed system (web platform) in practice by identifying the corresponding procedure and parameters in a Black Sea country's port terminal and highlighting the expected benefits and challenges.

The paper is organized as follows; in the next section, research initiatives regarding the application of IoT and sensor technologies for the container management operations are identified and analyzed. Then, the systematic approach, architecture and key parts of the proposed platform are presented. In

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