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Automation in port container terminals

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Abstract

This paper introduces the concept of automation and port container terminals and addresses some general considerations vis-à-vis automation in this type of port facilities. It further advances current knowledge on this topic by introducing an automation philosophy that adapts the implementation of automation technologies currently available on the market to the particular needs of each PCT. Finally, it concludes by summarising the main advantages and challenges regarding the automation of PCTs.

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Keywords: automation, port container terminals, methodology, functional approach, process reengineering, advantages, challenges

1. Introduction

Industrial automation consists in the use of mechanic, hydraulic, pneumatic, electric, electronic and computerised elements or systems to control equipment and processes, thereby reducing the involvement of humans in such activities. This is possible to the extent that this is a systematic and repeated process that follows rules and conditions that can be identified and programmed. To this effect this discipline covers both the field instrumentation used for data gathering as well as the management of the aforementioned data and the control of operations.

It makes it possible to reduce human intervention in industrial activities, allowing for a higher control of the equipment and processes involved. This results in the standardisation of performance and service levels, the elimination of uncertainty in response times and the reduction in operational costs and human errors. These advantages, coupled by technological developments and given that the current volume of worldwide trade means that an economy based only on manual labour is nowadays unconceivable, convert automation into a global flow which is present, to a greater or lesser extent, in nearly all industrial fields.

The logistics sector and the supply chain are not oblivious to this reality. In this sense, it is important to note developments in the management of large transport infrastructure towards the total or partial automation of their processes.

In the port domain the greatest proponents of automation are port container terminals. This paper faces the automation of these facilities.

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2. Port container terminals

A port terminal is a modal interchange facility that usually has an inland storage area to coordinate the flow of the arrival of goods by sea or land (Montfort et al., 2001). Its objective is to provide the necessary means and organisation for the interchange of such goods between the land and sea transport mode to be carried out in the best conditions in terms of time, efficiency, security, respect for the environment and economics.

In addition, port container terminals (PCTs) have certain features that confer them the ability to reach a much higher level of systematisation than other types of freight terminals such as:

- The standardisation of the means of transport - containers;
- The standardisation of the manner in which freight is handled;
- The high level of interchanges taking place;
- The high impact of technology on the profitability of terminals.

This level of standardisation and specialisation is what allows for a high degree of automation of equipment and processes in this type of port facilities. The planning and management of this type of terminal manifests a radical break from the conception of conventional terminals.

3. Automation in PCT

The launch of the ECT Delta Terminal in the Port of Rotterdam in the Netherlands in 1993 introduced the concept of "automated terminals" to refer to the highest level of automation to date. It was equipped with Automated Stacking Cranes (ASCs) and Automated Guided Vehicles (AGVs), allowing it to manage, without operators, the handling of storage and interchange equipment respectively.

Since the nineties many PCTs have embraced automation, consolidating itself as a global and permanent trend in the sector. In fact European and Spanish port policies have for a long time supported automation initiatives (COM (2007) 616 final; MFOM, 2012). As such the technological advances and the management tools dedicated to automation account for a large share of the equipment and software market for this kind of terminal.

However, when implementing these commercial automation solutions it is necessary to consider the particular needs of the PCT in question with respect to the level of automation sought and its current level of development, as well as to fully understand trends in the automation of PCTs.

3.1. Level of automation: major and minor automation

Nowadays the term "**automated terminal**" is used to refer to PCTs which in reality have only automated the movements in the yard and dock-yard interchanges like the ECT Delta Terminal. In such PCTs crane-ship operations are still manual whilst the interaction between yard cranes and the inland transportation means of reception and delivery remain assisted by remote controllers. This is, however, only one of the many automated possibilities in PCTs.

An intermediate solution between automated and manual terminals is, for example, the partial automation or semi-automation of principal movements. The term "semi-automated terminal" is used for terminals where, whilst yard movements are automated, dock-yard interchanges are carried out by conventional equipment, or vice-versa.

Automated and semi-automated terminals implement **major or total automations**, resulting in automated equipment such as the previously mentioned ASCs and AGVs.

The term 'semi-automated' can however also refer to the use of equipment controlled remotely or the systematisation of some of the functions of the equipment through **minor or partial automations**.

Major or total equipment automations are the sum of a comprehensive and integrated group of technologies or systems which separately could be considered minor automations. Thus, at times, it is possible to completely automate conventional equipment by implementing the necessary low level automations following a **retrofitting** process. This is a solution for terminals in operation that have not yet depreciated their initial investment in equipment (Monfort et al., 2012).