Chapter 9
An Analytical Model to Estimate the Optimum Production Rate of Picking Processes in a Modular Warehouse Environment

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ABSTRACT

One of the most important, complicated and expensive processes in a warehouse is order-picking. The cost associated with order preparation and picking typically varies between 40% and 60% of the total cost of all the processes in a warehouse; therefore, improving the productivity in order picking would result directly in cost reduction. In any attempt to reduce costs in order picking, one has to take into account: (i) the design of the warehouse so that the pickers' work may be controlled at all instances, (ii) the existence of standards on the pickers' work so that performance measurements may be compared and contrasted reliably, and (iii) the analysis of the phases of the picking process so that the pickers' productivity may be measured and maximized. Such a series of concerns and parameters leads to the necessity of developing a mathematical parametric model which may serve as a useful tool for the warehouse manager in his efforts to not only measure productivity but also to intervene in the process and proceed to improvements. The present work deals with the development of such an analytical parametric model for the order picking process in a modular warehouse. The research attempts to address and solve three distinct, yet relevant, areas of focus: (i) to produce a generic and analytical framework to model the order picking process, (ii) to define practical and easy to adopt performance measures for

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the order picking process, and (iii) to provide the tools for a warehouse manager to set goals, measure performance and identify areas of improvement in his areas of responsibility. In addition to these, the research sets the foundations to further expand on other warehouse processes, such as loading/unloading, products receipt, etc., that supersede the boundaries of order picking. The analysis is corroborated by a real case study, among the many monitored in a pragmatic setup, accompanied by ABC analysis of the warehouse operation and a presentation of a fair frame to measure workers' performance.

INTRODUCTION

The increased competition among 3PL firms has led them to make efforts to provide the highest service level and, at the same time, to decrease the cost. The latter may be achieved in several ways, among which is the improvement in the personnel productivity and the increase in the correctness of order execution.

One of the most important, complicate and expensive processes in a warehouse is *order-picking*, and is a key process for cost reduction. The cost associated with order preparation and picking typically varies between 40% and 60% of the total cost of all the processes in a warehouse; therefore, improving the productivity in order picking would result directly in cost reduction. Some common immediate concerns that arise when trying to achieve this goal are: How can we improve the order-picking productivity? How can we set realistic goals and monitor everyday performance? How can personnel and resources utilization be maximized? How can the productivity of each picker be tracked? How can we define the warehouse capacity with respect to order execution?

At the same time, one has to take into account the following parameters: (i) the design of the warehouse so that the pickers' work may be controlled at all instances, (ii) the existence of standards on the pickers' work so that performance measurements may be compared and contrasted reliably, and (iii) the analysis of the phases of the picking process so that the pickers' productivity may be measured and maximized. Such a series of concerns and parameters leads to the necessity of developing a mathematical parametric model, aiming to monitor accurately the order-picking process and improve productivity. This model may serve as a useful tool for the warehouse manager in his efforts to not only measure productivity but also to intervene in the process and proceed to improvements.

The present work deals with the development of an analytical parametric model for the order picking process in a modular warehouse. The modules of the warehouse are considered to be the distinct sections where operations reside; typically, each operation corresponds to one customer. This research attempts to address and solve three distinct, yet relevant, areas of focus: (i) to produce a generic and analytical framework to model the order picking process, (ii) to define practical and easy to adopt performance measures for the order picking process, and (iii) to provide the tools for a warehouse manager to set goals, measure performance and identify areas of improvement in his areas of responsibility. In addition to these, the research sets the foundations to further expand on other warehouse processes, such as loading/unloading, products receipt, etc., that supersede the boundaries of order picking.

This article is structure as follows. We provide a brief literature review on performance measurement in the supply chain and in order picking, in particular. Then, we describe the parameters that compose the model and overview the steps towards the model development. We also record and classify the elementary movements involved in any picking process, we provide the definitions for basic, normal and standard times for picking movements, and explain how these result from