


Chapter 6

A Case Study of Decision Support System and Warehouse Management System Integration

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ABSTRACT

A warehouse is an indispensable part of the logistics. A warehouse management system (WMS) is designed to improve efficiency in warehouses to increase their throughput and potential. The rise of IoT and its commercialization enabled ‘smart things’ to be widely adopted by hobbyists and companies. Cheap sensors and smart devices triggered better automation opportunities. Many devices and sensors that are being deployed in the industry and warehousing are affected by this trend. A well-designed WMS is needed to connect devices and humans in a heterogenous warehouse environment. This chapter introduces a prototype of a WMS powered by a decision support system (DSS) based on real-life requirements. In order to have fast, reliable, and efficient decision making in warehousing, the importance of employing DSS in the WMS is emphasized. Warehouse-related IoT technology is briefly introduced, and its security considerations are discussed thoroughly. The main contribution of this chapter is to show how warehouse operations can be modeled in business process model notation and executed in a DSS.

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INTRODUCTION

Logistic is one of the major powerhouses to advance human civilization from the old times to the modern age. Many civilizations collapsed due to famine and lack of resources in the past. However, the improvement in logistics enabled resource sharing between nations in a cost-efficient manner and the industrial revolution enabled large-scale production with low cost. The Internet was a game-changer for traditional commerce where customers needed to go to stores for shopping. Rapid development in e-commerce triggered storage problems for produced products as well as for raw materials. Therefore, industrialization and logistics contributed to human welfare to help fight against famine and prevent the collapse of civilizations in the modern age. Industrial mass production helped to reduce the purchase cost and bring improvement in logistics - distribution of these products made them available in the global market at a fair price. A **warehouse** is an integral piece in the supply chain concept to store and forward goods. Many warehouses are being used for storing goods or processing the products in a custom manner like repackaging and bundling/knitting etc. The performance of the warehouse operations affects the overall productivity and cost for all stakeholders. The whole supply chain is tightly coupled with warehouse operations. In warehouse operations, repacking/preparing an order can be considered a labor-intensive and high-cost operation. In order to overcome this tedious manual-intensive labor, Amazon Inc. built semi-autonomous warehouses, which utilize almost 200,000 robots in operation within its warehouses in the US¹. Amazon Inc. also cut jobs to replace manual work with automation and robot workers to optimize warehouse operations². Amazon Inc. tries to increase the efficiency and throughput in warehouses with the power of automation. Any performance issues or complications in warehouse operations may result in congestion and delays in logistics, which causes financial loss, reputation loss, and reducing customer satisfaction, and affect the overall standing of an enterprise and other unwanted conditions.

The fundamental of warehousing is to provide essential services such as receiving shipments (inbound), storing, pick & pack process and sending (outbound) shipments. The pick and pack process is usually considered the most manual-intensive process in warehouse operations and it gets complex based on many different parameters such as working with many customers, managing a mix of large inventory (please see Figure 1). Major issues are inbound shipment scheduling, item processing in the warehouse (cleaning, repackaging, bundling, etc.), outbound shipment scheduling, optimizing financial cost, reconciliation process between customers.

The end-to-end warehouse process starts with a third-party logistics company transporting the delivery with a truck that docks the warehouse. Warehouse operators need to empty the truck at a given time. Based on the warehouse capacity, there are a

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