Lean Warehousing: A Case Study in a Retail Hypermarket

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Abstract

Lean principles have been increasingly used in the field of manufacturing over the last decades, and their applicability has recently spread from production to warehousing. In this context, a number of studies have reported that lean warehousing, a relatively new concept, can play a significant role in decreasing the cost of logistics operations and reducing delivery time, thereby increasing customer satisfaction. However, the subject of lean warehousing is still in its infancy, and there is a need for more empirical studies to confirm its usefulness. In response to this need, this paper reports on work done on the application of lean concepts to the shipping process in the warehouse of a major hypermarket chain. The results show that time savings up to 16% might be achieved in the cycle time of the shipping process, and the labor cost can be reduced by 25%. The findings of this study are valuable to practitioners who are interested in implementing lean warehousing.

Keywords
Retail Hypermarket, Lean, Warehouse Processes

1. Introduction

Lean manufacturing came into existence from a research program that scientists from the Massachusetts Institute of Technology began in the 1980s. However, the idea and principles for lean manufacturing were derived from the Toyota Production System (TPS) that started in the early 1940s, which Toyota Motor Company developed to produce the best quality cars at the lowest cost and with the shortest lead time. This was done through eliminating waste on the basis of two pillars, Just-In-Time and Jidoka (Bhamu and Sangwan 2014). Just-In-Time (JIT) is a quantity control technique of providing the right quantity at the right time at the right location. Jidoka is the second pillar, which means "humanized automation," is a sequence of cultural and technical matters concerning the use of equipment and manpower together; it involves utilizing individuals for specific tasks they can perform and allowing devices to self-regulate the quality. Jidoka technically uses approaches, such as Poka-yoke (a technique for fool-proofing a procedure), Andonis (Lights which are visual displays to indicate the status of the procedure specifically; the abnormalities in the procedure) and 100% examination by machines. Lean thinking is grounded on five principles; value, value streams, flow, pull, and perfection:

1. Identify the value – Identify and specify the process (products/services) from the client's perspective to add value and ensure full client satisfaction. Value can be identified with tools like value management, simulation, and function deployment.
2. Map the value stream – Investigate the essential steps necessary to make a product/service by excluding the non-value steps and create a value stream. A mapping value stream will help knowing how the value for the customers is created through the steps.
3. Create the flow of the processes – Create efficient steps, which are defined as the value stream. Exclude steps, such as batch-and-queue, which possibly cause delay, backflow, or damage, from the workflow.
4. Establish pull – Supply and produce only upon customers' demand to minimize the waste of resources.

5. Seek perfection – Attempt for perfection by supporting the above-listed actions with continuous improvement and repetitively eliminating uncovered successive layers of waste.

With the necessary adaptation, the applicability of lean principles has expanded from the automobile industry to other industries, including construction, textile, service, food, medical, electrical and electronics, ceramic industry, furniture, etc. (Bhamu and Sangwan 2014). According to Liker (2004), every organization business regardless of its type can benefit from lean not necessary by imitating the tools that Toyota utilized in a specific manufacturing process but also by developing principles that are correct for the organization or businesses and by practicing them, to attain high performance that continues adding value to customers and society. A literature review revealed that despite the increasing attention that lean warehousing has received in recent years, the related body of contributions is still limited, particularly in the food industry warehouses which is characterized by the short life cycle of the perishable and non-perishable items (Gopakumar et al. 2008). In warehouses, employing "lean" concepts for identifying and eliminating the wastes is one method that can be implemented to maintain a short turnaround time for the goods while increasing the utilization of the warehouse resources like put-away personnel, fork-lifts, and storage aisles. As shown in Table 1, all types of waste recognized in manufacturing are also transferrable to warehouse environment (Ackerman 2007):

Table. 1 Production wastes in a warehouse environment

Waste Type	Production	Warehouse
Waste of production (overproduction)	A waste of materials is caused by overproduction in manufacturing.	Inventory excess is considered an overproduction waste in warehousing.
Waste of time (waiting and idle time)	Waste of time	The same as in production
Waste of transportation	Needless material and tools movement	In the process of handling materials, unneeded movements cause waste.
Waste of inventory	Inventory waste happens when purchasing or storing excessive supplies, materials, and other resources.	When stock-outs are frequent, poor inventory control causes waste.
Waste of processing	This waste comes from unnecessary processing that does not add value to the item produced.	When over-checking happens, it is considered as waste.
Waste of motion	Needless movement of workers	When there is a search for items or tools that cannot be located, this causes waste in movement.
Waste of defect	Items that are defective are a waste of production resources.	Errors result in waste.
Waste of creativity	Workers' unused creative ideas are considered a waste of human resources.	The same as in production

Lean warehousing is a relatively new subject. This is perhaps due to the fact that the lean philosophy focuses on the reduction of inventory, which is considered as waste. Nevertheless, in practice, most warehouses add value to customers by creating time and place utility. One important way to maximize the value added is to practice lean distribution. Lean distribution can be defined as minimizing waste in the downstream supply chain while making the right product available to the end customer at the right time and right location (Reichart and Holweg 2007). According to Mahfouz (2011), lean warehousing aims to increase responsiveness to market demand and reduce the total cost by simplifying distribution operations. The literature review reveals that the studies on lean warehousing have focused on three issues: (1) lean warehouse design (e.g. Dharmapriya and Kulatunga 2011; Shah and Khanzode 2015), (2) lean warehouse operations (Abdoli et la. 2017; Buonamico et al. 2017; Gopakumar et al. 2008, Chen et. al. 2013; Dotoli et al. 2015; Shah and Khanzode 2018), and (3) assessing lean warehousing (Wu et. al. 2016; Sharma and Shah 2016).The study by Gopakumar et al., 2008 is perhaps one of the few studies that demonstrated the use of "lean concepts" to reduce the process wastes in the food distribution industry by optimally assigning trucks to the receiving docks.

The above brief literature review reveals that the topic of lean warehousing is still in its infancy, so there is a need for more studies to further validate the applicability of lean principles from a production environment to the context of warehousing. In response to this need, this paper reports on work done on applying the concept of lean principles in the central warehouse of a large hypermarket chain as a case study.

2. The Study

As shown in Figure 1, the warehouse of the hypermarket is divided into three areas—area 1, area 2, and area 3. Each area consists of two storage sections—one for food and another for non-food. The food section consists of six shelves that are two sided, whereas the non-food section consists of eight shelves that are also two sided. The material handling equipment used inside the warehouse includes 5 forklifts, 18 manual hydraulic lifters, and 8,000 pallets. Shipping and receiving processes are performed by 75 workers who rotate between three shifts in a day. Three steps were carried out to conduct this study —evaluating the current warehouse operations to identify possible wastes, identifying and assessing alternative improvement options, and recommending actions for improvements. These steps are carried out for the receiving and shipping processes in each section (food and non-food). In the following, we describe the work done for the shipping process in the food section.

This warehouse receives orders from 28 branches of the chain. As shown in Figure 2, once the orders are received, requisitions from different branches are printed and then sent to the pickers in charge. Each picker has a specific region that he/she is responsible for. The collected items form the shelves are placed on pallets. Once a pallet becomes full of items, it will be sent to the waiting area, which is located nearby the exit point. The same pickers who were in charge of picking the items from the shelves will perform an operation called "products undergo evaluation." In this operation, the collected items are checked in terms of quantity and make sure that they are damage free. Subsequently, pallets are loaded in the trucks to be shipped.

A value stream map (VSM) was created to identify possible wastes. VSM is a lean management tool used to represent all of the product or service processes/activities (value added and non-value added) from start to end, showing both materials and information flow. In the warehouse environment, value-added time indicates the time when the item moves through the processes of the warehouse. The first step in creating a VSM was to collect current information by walking along the actual pathway of material and information flow (Summers 2011). Then, based on the data obtained by conducting the time study, the current value mapping for the food section shown in Figure 3 was created. This map helped classify the operations into two categories: value added and non-value added. As shown in Table 2, products undergo evaluation, which is a major non-added value operation. The estimated average duration of this operation is about 30 minutes, i.e., approximately 23% of the time required for the shipping process is spent on this operation.

3. Improvement Solutions

Two alternative improvement suggestions were identified to minimize the time spent on products undergoing evaluation—the use of barcode technology and the use of radio frequency identification (RFID). A barcode is an optical machine-readable that presents information related to the item to which it is appended. The code is a small image of bars basically consisting of a patterned group of lines, spaces and sometimes numbers designed to be scanned and read by a barcode reader. A laser beam comes out of the scanning machine and then reads and translates the reflected light (from the lines and spaces) into numerical data that are then transferred to a central processing unit (CPU) for direct action. The purpose of barcodes is to transfer product information from an item to an automated system. Barcodes have many different classifications; the major ones are one- and two-dimensional barcodes, and each major type includes minor ones, as well. Barcodes are overlooked as a technique for reducing cost and saving time. An important and practical method that can be used by industries aiming to increase efficiency and reduce overhead, barcodes are both cost-effective and reliable (Groover 2018). When running a busy store, you must keep track of all the items sold in order to manage your inventory and ensure that you have enough in stock of what customers want. One of the simplest ways to do this is to check each shelf and look for an empty space and refill it. Otherwise, you could write on a sheet of paper what customers bought at checkout and then make a list of all purchases and reorder your stock. This is acceptable for a small store, but when it comes to large industries, such as the warehouse in the present case study and its branches storing and selling thousands of items, barcode technology will be much more beneficial and efficient in keeping a centralized record on a CPU system, as barcodes have the ability to track goods, prices, and stock level accurately. RFID involves a wireless system that uses radio-frequency electromagnetic fields to transfer data from the products assigned a label to enable the automatic identification and tracking of records. The RFID system consists of a reader and a label. The label associates itself with the reader by transferring a unique identification digit through a radio link. For example, in passive RFID, the reader can read or write records from/to the RFID label by using radio indications. In logistics processes, RFID entrances are often used to read labeled objects (Groover 2018). However, because of its low cost, the first alternative, i.e., barcode technology, is preferred by the decision makers in the current case study. According to the constructed future VSM (Figure 4), implementing this alternative will lead to reducing the duration of the tackled non-added value operations by 90%, and consequently, the cycle time of the shipping process is expected to be reduced by 16%. Implementing this alternative is also expected to reduce the labor cost by 25%.

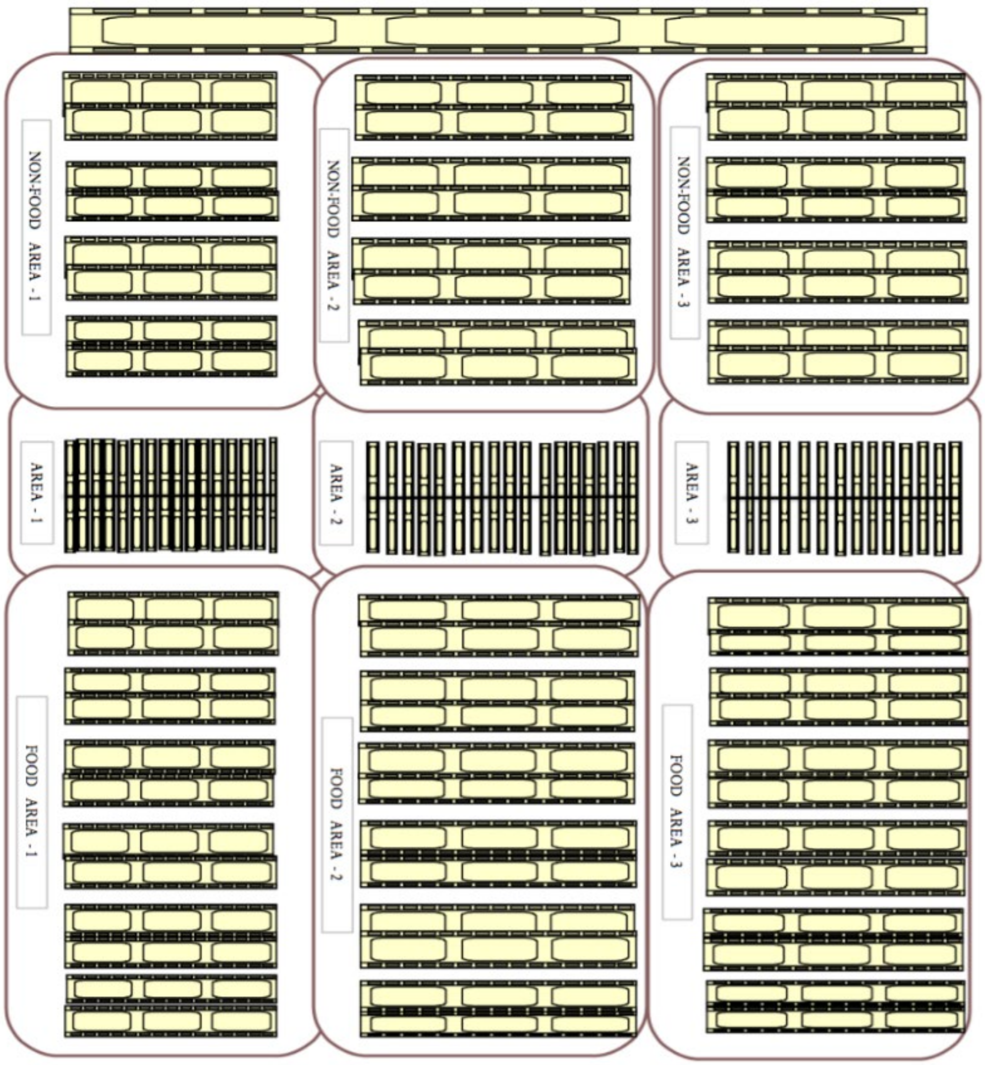

Figure 1. Warehouse layout

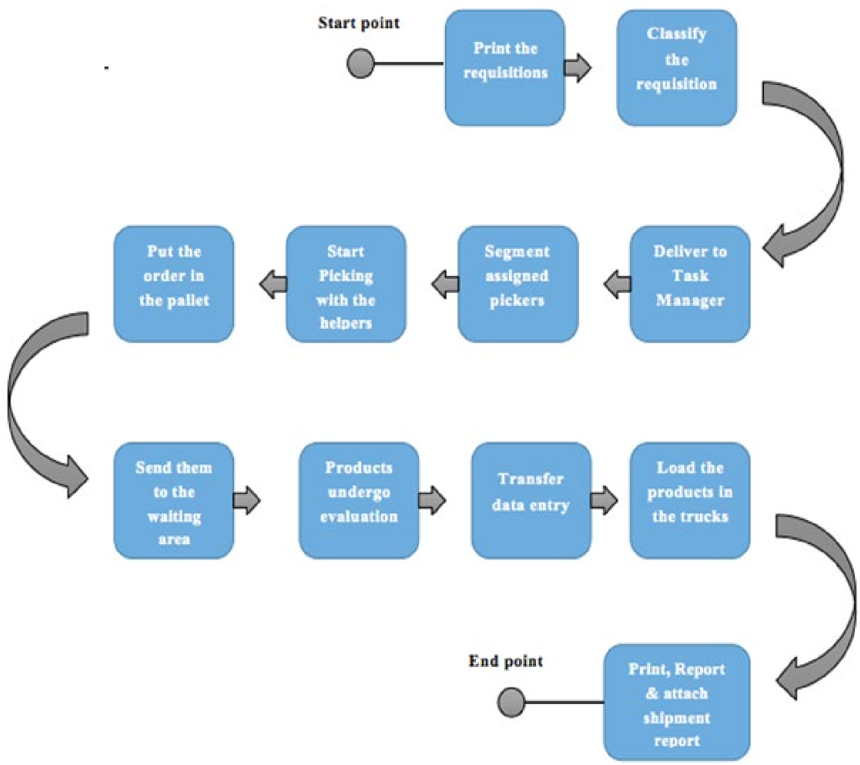

Figure 2. Shipping process operations

Table 2. Value-added and non-value-added operations

Operation	Value-added time	Non-value added time
Print the requisitions	15 minutes	
Classify the requisitions	10 minutes	
Segment the assigned pickers	10 minutes	
Start picking with the helpers	11 minutes	
Put the orders in the pallets	28 minutes	
Forward them to the waiting area		3 minutes
Products undergo evaluation		30 minutes
Transfer data entry	8 minutes	
Load the products into the truck	13 minutes	
Print, report, and attach the shipment report		10 minutes

4. Conclusion

This study was conducted to provide further support to the findings of previous studies on the benefits of applying lean principles to warehouse operations by using the central warehouse of a major hypermarket chain as a case study. VSM was used to evaluate the current operations of shipping and receiving processes of both sections (food and non-food) of the warehouse. However, what we presented in this paper is work done concerning the shipping process of the food section only. The results confirmed that using lean concepts can lead to significant reductions in warehouse order processing time and labor cost. One limitation of this study was the use of deterministic data to construct VSM. Alternatively, a stochastic version of VSM could be used in future studies.

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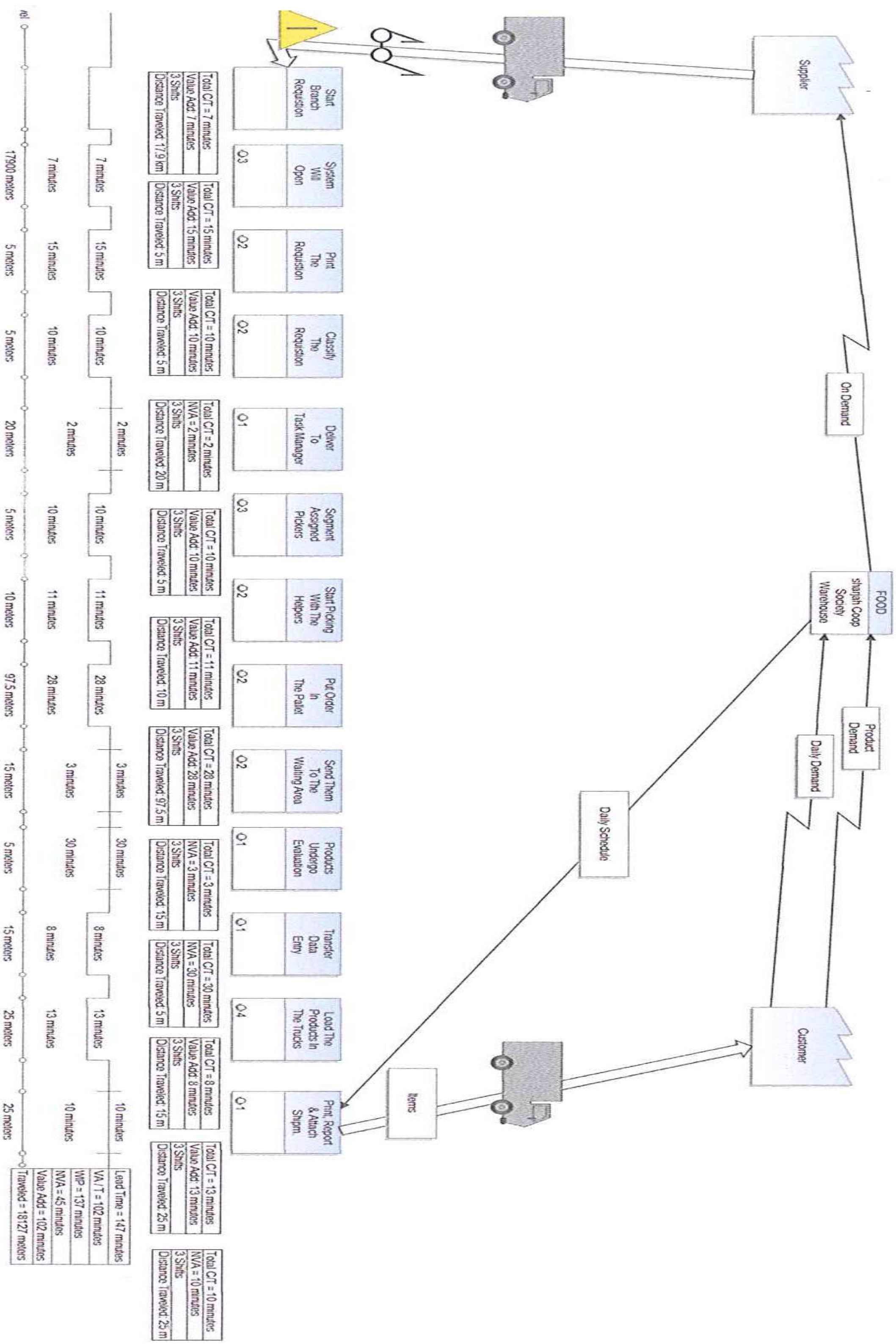

Figure 3. The current VSP

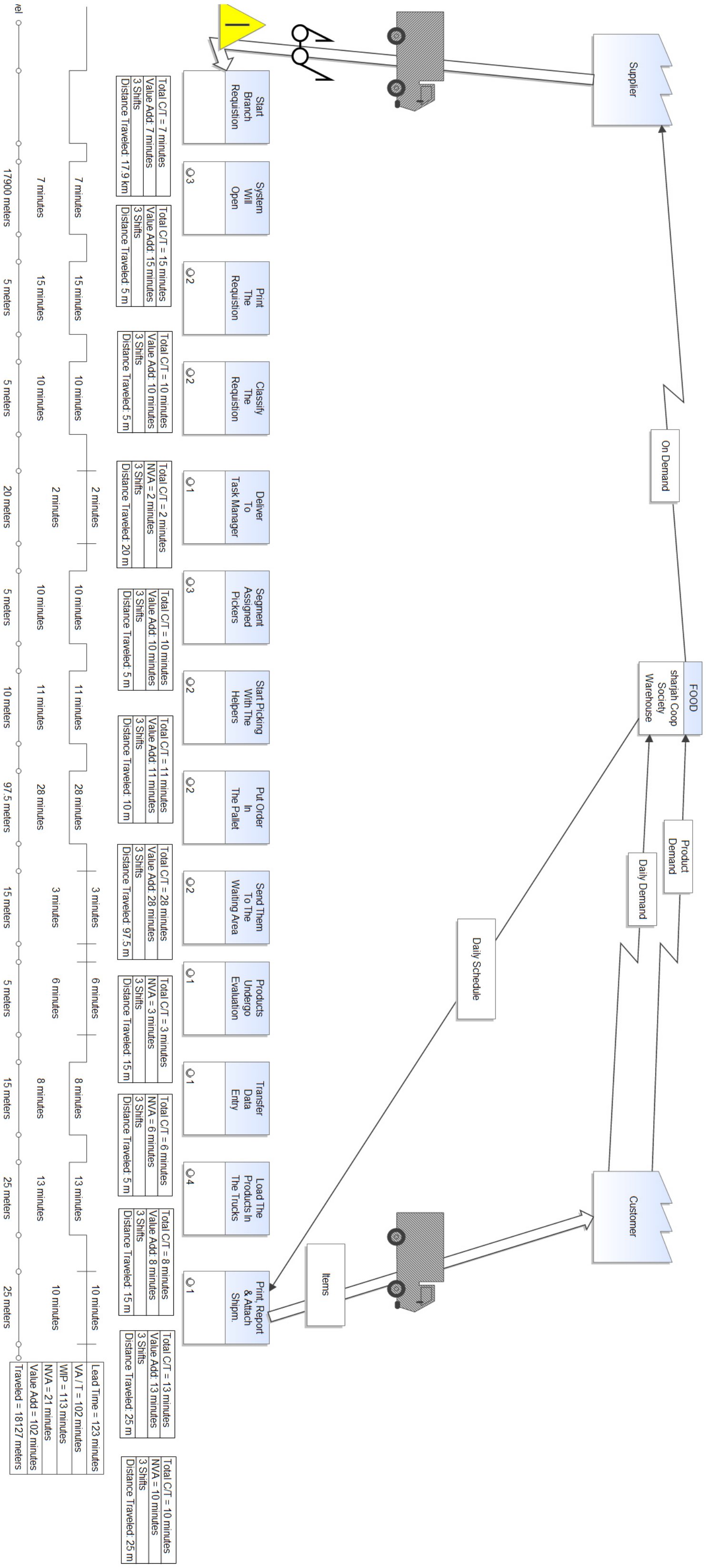

Figure 4. The future VSP

Biographies

Hamdi Bashir received his PhD degree in 2000 from McGill University, Montreal, Canada. Currently, he is an Associate Professor of Industrial Engineering and Engineering Management at the University of Sharjah. Prior to joining this university, he held faculty positions at Sultan Qaboos University, University of Alberta, and Concordia University. His research interests are in the areas of project management, manufacturing systems, quality management, and healthcare management. He is a senior member of the Institute of Industrial and Systems Engineers (IISE).

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