An Investigation of Problem Allocating Resources to Different Priorities Packing Areas: RS Components Warehouse as a Case Study

Al Bazi, A. & Madi, F.

ISSN 1737-9288

Publisher: IPCO

International Review of Economics & Strategic Business Process Management is a quarterly open access journal

International Conference on Control, Engineering & Information Technology (CEIT'13)
Economics & Strategic Management of Business Process - Vol.1, pp. 20-25, 2013

An Investigation of Problem Allocating Resources to Different Priorities Packing Areas: RS Components Warehouse as a Case Study

Faris H. Madi[1], Ammar Al-Bazi[2]

[1]*Faculty of Computing and Engineering, Coventry University*
Coventry, UK
hamdanmf@uni.coventry.ac.uk

[2]*Faculty of Computing and Engineering, Coventry University*
Coventry, UK
ammar.albazi@coventry.ac.uk

***Abstract*— This ongoing MBA work shows what main problems a leading warehouse management faces nowadays and attempts to tackle one of the problems within the packing area. It also suggests ways to improve warehouse productivity using simulation technology. Research problem of allocating resources to two different prioritised packing areas is addressed. A framework for a simulation model is developed to initiate the packing operations for both regular and important areas which called VIP packing areas. Case study of one of the warehouses located in Nuneaton, UK is considered. A logical diagram is developed to reflect the workflow in the packing area. A future work "As-Is" and "What-If" scenario will be developed to manifest problem areas.**

***Keywords*— warehouse, simulation, packing area, optimisation, packaging, modelling, resources allocation.**

I. INTRODUCTION

The world of business is in continues rapid change. The powers of the marketplace fluctuate where having stability in it became a challenge. Business organisations have to be in continuous reorganising of their operations and processes to meet the demands of the marketplace. As supply chain become extended and more complex, technological aid is a necessity to bring everything together and give a better advantage for the organisation.

In warehouses, where materials are stored, repacked, staged, sorted [1] and prepared to be delivered to customers, managers seek not only for effectiveness, but for efficiency too. "Warehouse management is the art of operating a warehouse and distribution system or, better still, of operating it efficiently. Excellent logistics performance can open up new markets while customers expect speed, quality and minimised costs. Warehouses and material handling systems are the core elements within the goods flow and build the connection between producer and consumer" [2].

Warehouses help organisations to process customer orders carefully within an organised space. There are different types of warehouses each according to the nature of the business. Channel suppliers sometimes use private warehouses for their own distribution activities like supplying different wholesalers in different regions. Public warehouses can be leased for short term by companies, which have the need for extra space to store their products in case of their own warehouses reached the limit or for an overseas trade, where a company do not own an overseas warehouse.

Automated warehouses are computer and robots operated. Their capabilities ranges from fully robotics where only few supervisors and technicians are needed to partially robotics operated. In Climate-Controlled warehouses, different types of products can be stored within it. This type of warehouses is more complex since it requires special conditions to operate such as controlling temperature, humidity or dust free environment for storing (example: computer products). Warehouses that serve as points in the distribution system called Distribution Centres where products are stored in for short time to be quickly shipped out to customer. Such products held in this warehouse in the early morning and get cleared but the end of the day.

Here are a number of problems that warehouse management faces: Ineffective storing, picking and routing policies, Altarazi, S. & Ammouri, M. (2010) [3], search and retrieving times through the picking process, Broulias el al. (2009) [4], inefficient shelves replenishment and order picking process, Gagliardi et al. (2012) [5], high cost of inventory, ordering operations and product transportation, Zhou (2005) [6], inefficient warehouse layout, routing and storage allocation strategy, Merkuryeva (n.d.), waiting time for various processes is very long in a warehouse [7], Liong & Loo (2009) [8], Forward-reserve allocation problem in a warehouse with unit-load replenishments, Berg et al. (1997) [9].

It has been noted that few works have been conducted in the area of packing products and its efficiency, and hence this project is initiated.

In this work, packing area in one of the leading warehouses will be looked at in terms of performance and productivity. This paper is organised in research problem as section 2 shows. Section 3 is about previous work and related work. The proposed methodology and framework are presented in section 4 and 5 respectively. A brief on a case study explained in section 7. Logic identification has been described in section 7 and future work on this study is presented in section 8.

II. RESEARCH PROBLEM

In warehouses, managers seek the balance between number of workers employed and the amount of work to be done in short period of time. Most common problem in this industry is inadequacy of resource utilisation, which eventually gets reflected on low performance and inefficiency.

Based on the nature of products a warehouse is processing, managers divide and sort the products according to their size, weight, type and priority. Once issuing a sales order from the sales department to the warehouse, the system usually directs the order to the right section according to the type of the order and a certain process will put into action to pick, pack and dispatch the order.

This paper focuses on one problem within warehouse management, which is the packing process. Packaging requires human labour which makes it more difficult and costly compared if it was automated. At this stage, workers receive the orders with their priorities so they know which to be processed and sent to dispatcher first. On receiving a prioritised order, one of the workers should interrupt his work on low priority order and start packing the higher priority order. Fig. 1 shows a general layout of packing area in a warehouse.

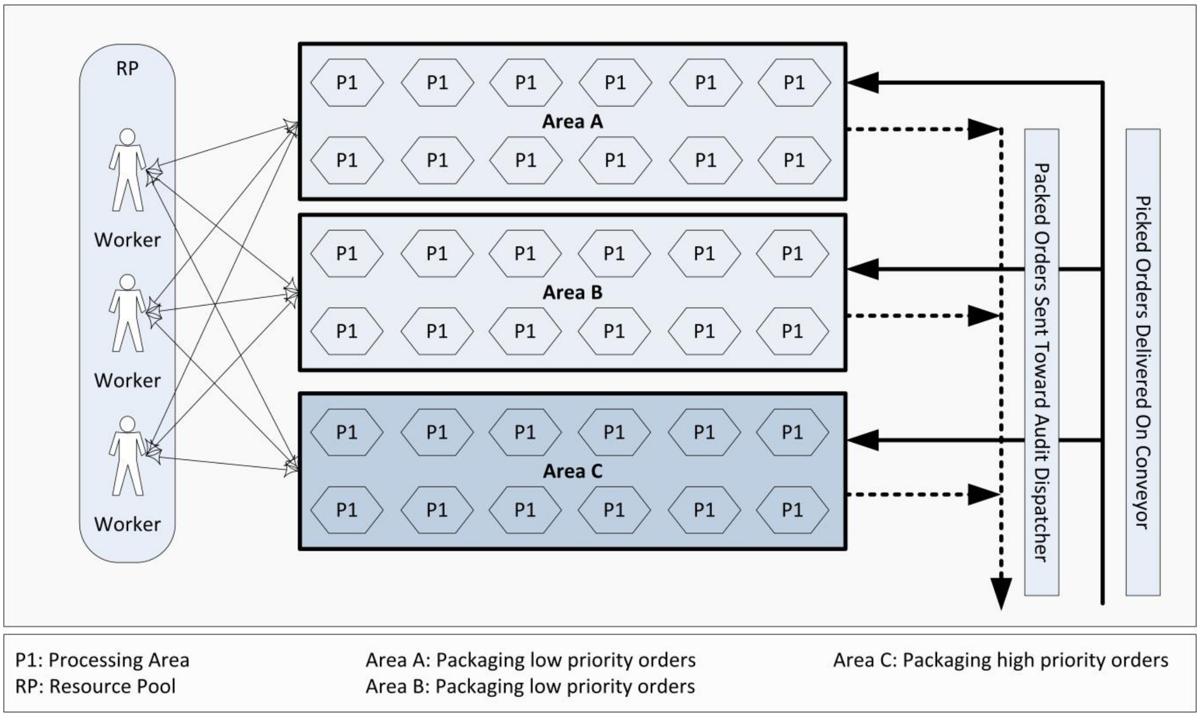

Fig. 1: General Layout of Packing Area in a Warehouse

With human error factor, interrupting the packaging process of a low priority order and put it on hold to process a different order then return to complete the previous one creates large margin of latency and inefficiency. If the worker was determined to finish the order in hand then start processing the high priorities order, it will move the error from one place to another. This might affect the consumer satisfaction on the long run.

The aim of this ongoing study is to develop an innovative intelligent resource allocation algorithm based on discrete event simulation modeling of warehouse operations. The packaging area is the focus of this study as it is considered as one of the main warehousing operations that needs reconsideration and subsequently improvement.

In order to deliver the aim above, a number of initial targets are set to reflect the steps required to reach the overall target:

- To review of the previous/current practices in the area of resource allocation based warehousing operations.
- To identify the logical operations associated with the packing operation.
- To address the interchanging relations between resources of packing process with all other related operations.
- To model the currents situation to identify bottlenecks/wastages.
- To improve the currents practice of packing operation by proposing an intelligent resource allocation plan.

III. LITERATURE REVIEW

Many factors influence the packing performance in the warehouse. For example, the size, type and the nature of the order which might require special type of packaging affects the speed of packing process. In addition, the priority of which order needs to be processed first affects directly the overall packing process.

Several research projects using simulation technology to improve the performance of warehouse operations have been conducted. Most of the recent researches were conducted on the picking operations and only few on packing area or resource allocation: Patlola P., (2011) developed a statistical model using simulation that helps optimising machine, material-handling equipment and labour performance during pre-picking stage. A warehouse implemented this model resulting in operational and economic performance improvements after four months [10]. Shiau & Lee (2009) developed a hybrid algorithm to generate a picking sequence for combining picking and packing operations using linear programming model. The results of this research were helping the warehouse eliminating storage buffer and reducing picking and packing operation time [11]. Chow et al. (2006) proposed an intelligent system model that incorporates case-based reasoning technique, route optimizing programming model as well as automatic data identification Radio Frequency Identification technology. The outcomes were significant enhancement of logistics service providers in resource planning and execution [12]. Macro & Salmi (2002) developed four warehouse design concepts: Selective Rack Concept, Flow-Through Rack Concept, Pushback Rack Concept and Maximum Rack Concept. This work provided for a warehouse owner varying options of warehouse capacity, complexity and cost strategy [13]. Zhou M. & Setavorphan K., (2005) developed a pattern-based model using simulation model on in-bound, truck-dock and out-bound operations in a distribution centre. The outcomes of this research helped to identify the sub-activities in a warehouse and enhance the performance [6].

The literatures above provide the researchers a number of ideas regarding the potential tools and techniques that can be used to satisfy objectives and hence the aim. The next section presents the proposed methodology that can be adopted in such work.

IV. THE PROPOSED RESEARCH METHODOLOGY

A number of techniques are expected to deliver the objectives and subsequently the main aim of this study:

- Flowcharts/ Process Mapping of resource allocation for different priorities order packaging.
- Activity Cycle Diagram to show the entities and how they interact, activities and queues in the system.
- Simulation Technology to mimic the real world situation and show the problems within the system.
- Heuristic Approach to successively evaluate the problem and find a resolution for it.

V. THE PROPOSED FRAMEWORK (FUTURE WORK)

The research framework is proposed in terms of how to enhance the performance of packing area by reallocating resources according to the amount of orders received.

The aim of this framework is to outline the guiding key structural elements on any packing area within a warehouse, including:

- Processes to identify and assess the performance.
- Sub-routines and any temporary processes.
- Mechanisms of allocating resources.

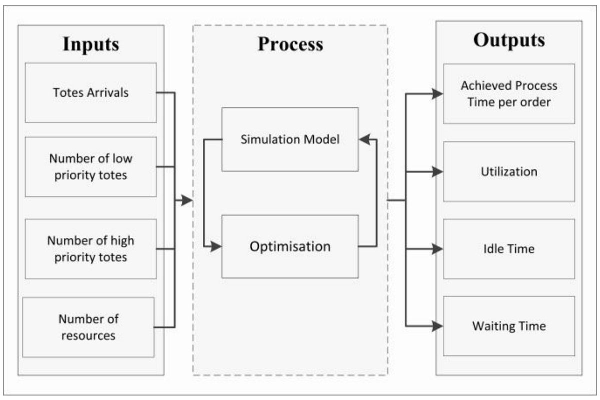

Fig. 2: The proposed framework for packing process in a warehouse

Fig. 2 illustrates the proposed framework of the simulation of the packing process. The model expects to receive orders of low and high priority and their inter-arrivals to simulate mathematically the packing process. Four key performance indicators will be measured during the simulation time: Process Times which it should be at its minimum, Resource Utilisation which it should be maximised, Idle Time and Waiting Time should be both at their minimum levels. The simulation process will try to optimise these values to reach the optimal values, if possible.

Deliverables of this ongoing research are:

- Sheet of collected primary data.
- Modelling "As-Is" scenario on a current practice of packing process.
- Modelling different "What-If" scenarios.
- Report on testing "What-If" scenarios.
- Written analysis on the optimised models.
- Written evaluation on the effects of implementing an optimised model.

Fig. 3: Nuneaton Distribution Facility

VI. CASE STUDY

RS Components and Allied Electronics is a world's leading high service distributer of electronics and maintenance products (Fig. 5). It operates in 32 countries. The biggest warehouse of RS Component is in Nuneaton, United Kingdom.

RS catalogue now has over 2,500 products and its sales exceed £1 million per month with £1 billion annual revenue. As one of the two major RS distribution facilities in the UK, Nuneaton warehouse plays a significant role in providing stocks to other operating companies and customers around the world. Since the site opened in 1995, it has continued to grow in terms of both workforce and capacity. Today it employs approximately 600 staff and despatches 40,000 order lines (150,000 items) every day from the stocked ranges over 160,000 products [14].

Nuneaton main operational functions include Goods Inward, Picking and Packing for small and palletised products and Export.

On a site visit of the warehouse, researchers have identified various problems in different areas. Some of these problems were identified by the manager in an interview. Researchers will focus on the packing area in this warehouse because it was identified as crucial problem need to be solved. In the packing area which is known by FPF – Jiffy/Carton Packing, all operations are done manually (Fig. 3).

On completion of picking, totes are transported to relevant packing areas:

- Home market cartoon.
- Home market jiffy.
- Satellite packing.
- Export packing.

One of the packing lines is dedicated for VIP orders which have the highest priority to be processed and send over as soon as possible to be dispatched on time.

Allocating resources between the packing area and other areas is critical. Utilizing a resource from one area to another will not solve the problem. Instead it will divert the issue from one place to another.

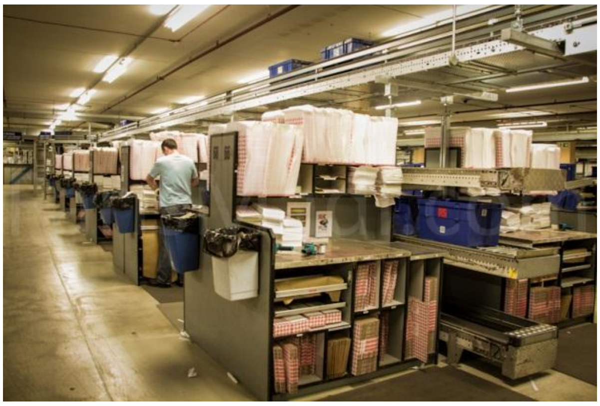

Fig. 4: Nuneaton Warehouse Packing Area

VII. MODEL DEVELOPMENT AND LOGIC IDENTIFICATION

Flow Chart diagram is one way to represent the processes and sub-processes in a system. This diagrammatic representation also helps in identifying the logic and mechanisms of elements flow (orders). This diagram can be used to analyse and design a better simulation model.

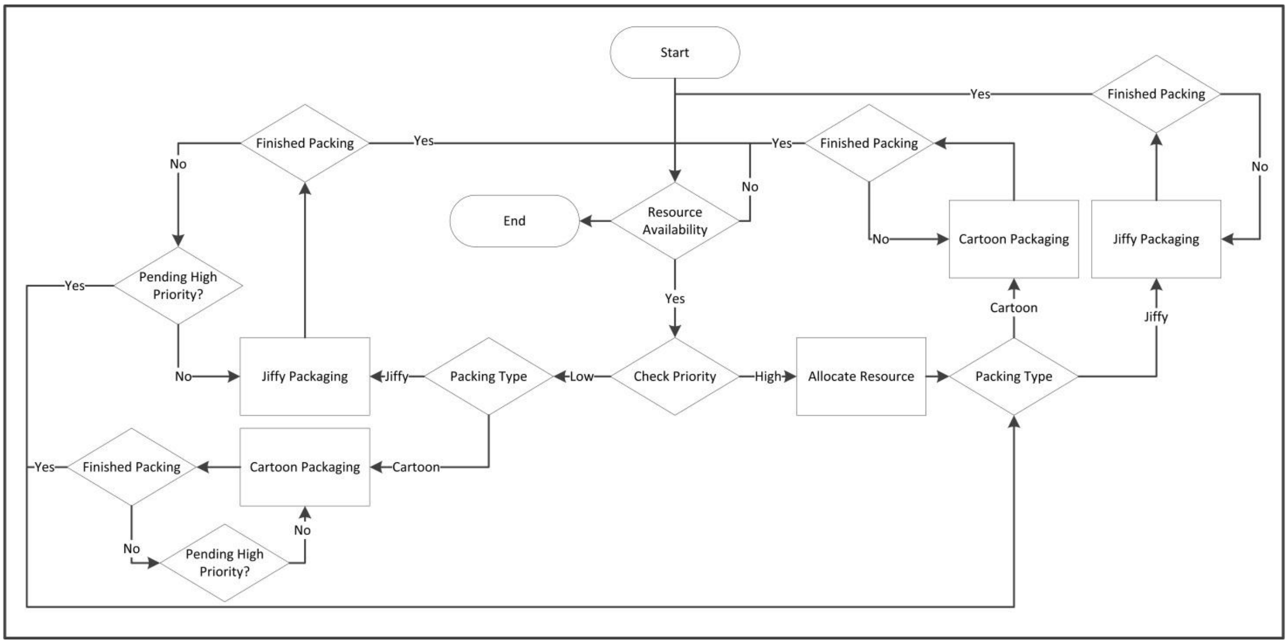

Fig. 5: Resource Allocation Flow Chart of Packing Area – Nuneaton Warehouse

Fig. 5 illustrates the flow of work for both priorities and how it is currently a resource being allocated a in the packing area at Nuneaton Warehouse.

A resource will be allocated once it is available to start packing the order. The system separates the orders into low and high priorities into two separate packaging spaces. The resource will start processing the packing procedure after determining what type of packaging the order requires (Jiffy or Cartoon) depending on the size of it. In case of processing low priority, the resource gets in an endless loop where it needs to check whether there is any pending order with high priority or not while doing the packing and after finishing the process. According to the policy that will guaranty no high priority (VIP) orders will have to wait for long until they get processed.

In high priority orders packing process, the resource will be available once finishing the packing and sent to dispatching area. All of the resources will return to the Resource Availability pool for further orders. They process will stop when the resource are released (i.e. break time or end of the day).

Different parameters should be measured and collected such as the inter-arrival time of each order, average packing time for each order, resource utilisation at normal and high priority packing lines within the picking area and the average time of the total packing for the whole day in regard of the total number of the received totes.

RS Nuneaton site management has been looking on how many people working at the packing area, when they start working and for how long but it doesn't seem to be able to resolve the problem or which direction it should go for.

VIII. NEXT PHASE OF THIS WORK

Based on the case study, a simulation model will be developed using real collected data. A heuristic algorithm will be developed to be embedded in the simulation model. This algorithm shows how intelligently resources can be allocated from normal areas to other VIP areas when required with minimal process disruption.

REFERENCES

[1] Bozarth, C. and Handfield R. (2007) Introduction to Operations and Supply Chain Management, 2nd Edition. Pearson Education, Incorporated.

[2] Ten Hompel, Michael Schmidt, Thorsten, Warehouse Management: Automation and Organisation of Warehouse and Order picking Systems, Heidelberg, DEU: Springer, 2007.

[3] Altarazi, S. & Ammouri, M. (2010) 'A Simulation-Based Decision Making Tool for Key Warehouse Resource Selections'. Proceedings of the World Congress on Engineering 2010 Vol III. WCE 2010, June 30 – July 2, 2010, London, U.K.

[4] G.P. Broulias, E.C. Marcoulaki, G.P. Chondrocoukis & L.G. Laios (2009) 'Warehouse Management for Improved Order Picking Performance: An Application Case Study from the Wood Industry', Department of Industrial Management & Technology, University of Piraeus.

[5] Gagliardi, J. P., Renaud, J. & Ruiz, J. (2007) 'A Simulation Model to Improve Warehouse Operations'. Proceedings of the 2007 Winter Simulation Conference.

[6] Zhou M., Setavorphan K. & Chen Z., (2005) 'Conceptual Simulation Modeling of Warehousing Operations'. Proceedings of the 2005 Winter Simulation Conference.

[7] Merkuryeva, G., Machado, B. C. & Burinskiene, A. (n.d.) 'Warehouse Simulation Environments for Analysing Order Picking Process'.

[8] Liong, C. & Loo, C. S. E. (2009) 'A Simulation Study of Warehouse Loading and Unloading Systems Using Arena'. Journal of Quality Measrements and Analysis 5(2) 2009, 45-56.

[9] Berg, J., Sharp, G., Gademann, A. & Pochet, Y. ‘Forward-Reserve Allocation in a Warehouse with Unit-Load Replenishments’. European Journal of Operational Research 111 (1998) 98--l 13.
[10] Phanindher Patlola & Edward J. Williams (2011) Simulation Improves Stretch-Wrap Packaging Logistics in Warehouse
[11] Shiau, J. & Lee M. (2009) ‘A Warehouse Management System with Sequential Picking for Multi-Container Deliveries’. Elsevier Journal, Computers & Industrial Engineering 58 (2010) 382–392.
[12] Harry K.H. Chowa, King Lun Choya, W.B. Leea & K.C. Laub (2006) ‘Design of a RFID Case-Based Resource Management System for Warehouse Operations’. Elsevier Journal, Expert Systems with Applications 30 (2006) 561–576
[13] Macro, J. & Salmi, R. (2002) ‘A Simulation Tool to Determine Warehouse Efficiencies and Storage Allocation’. Proceedings of the 2002 Winter Simulation Conference.
[14] RS Components Nuneaton Site Guide, 2013.