ABSTRACT

The purpose of this research was to investigate the relationships with storage location assignment and location of I/O points in details in the warehouse operation planning. Dedicated storage warehouse design and three different allocation methods (throughput-to-storage ratios, space-filling curve with X and Y type) were studied using the simulated annealing method. The computer program was implemented with the Access software by Microsoft. The result shows that cost of the storage method of throughput-to-storage ratios can achieve the lowest cost, and then the space-filling curve with X and Y type. However, the storage method of throughput-to-storage ratios may result in the discontinuity of the storage locations.

KEYWORDS

I/O Points, Simulated Annealing, Space-Filling Curve, Storage Location Assignment, Storage Planning

INTRODUCTION

Storage planning has increasingly become an issue of strategic importance to reduce inventory cost or to improve order picking efficiency (Hsieh & Tsai, 2001; Muppani & Adil, 2008). Storage is one of the most traditional aspects of logistics. A good storage system facilitates the identification of physical material, thereby increasing productivity and reducing the cost of manpower, because it facilitates the management of inventories (Fontana & Cavalcante, 2014). According to Coyle, Bardi, and Langley (1996), 50-75% of the total operating costs of a warehouse can be attributed to the order-picking operation. Order picking is the costliest part of the warehouse operations (Hou et al., 2009; Pan et al., 2012). It has been a major study topic that reduce management cost of order picking with storage planning and most research have focused mainly on the development of travel time or distance models for various storage assignment, picking routing and order batching policies (Pan et al., 2012). For maintaining competitive advantages, companies should consider warehouse storage planning that reduce management cost and enhance management efficiency, so storage planning has been the most comprehensively studied one.

In the competitive atmosphere of today, efficient storage planning increases the competitive power of firms. In the past two decades, numerous models and solution approaches have been developed to deal with storage planning problems, special the relationship between storage allocation methods and location of input/output points. In the case of the storage planning, Fontana and Cavalcante (2014) proposed Promethee method to determine the best alternative for warehouse storage location assignment; Pan et al. (2012) considered both the travel time and the waiting time simultaneously in a multi-picker system; Goetschalckx and Ratliff (1990) developed two heuristic policies for more complex systems based on the duration stay of unit loads; Kovács (2011) proposed A MIP model to optimize the storage assignment in a warehouse served by milkrun logistics; Petersen et al. (2004)
improved order-picking performance through the implementation of class-based storage. However, they did not propose the solution about how to consider some relationships with storage location and location of I/O points in details. To solve the above problem, this research is to use Access software of Microsoft and implement a human computer interaction that was executed in three storage location assignment models including throughput-to-storage ratios, space-filling curve with X-OSCILLASTORY and Y-OSCILLASTORY types (space-filling curve with X and Y types) using the simulated annealing method in this paper.

The rest of this paper is organized as follows. Section 2 provides a literature review, and section 3 provides the research model. The research results are described in section 4. The conclusion, limitation and future research direction are presented in Section 5.

LITERATURE REVIEW

Effective storage planning has become a potentially valuable way of competitive advantage and improving organizational performance. Warehouse storage planning involves determining storage location assignment policies and storage location assignment methods (Muppani & Adil, 2008a). Storage policies related to decide how to allocate the various storage locations of a uniform storage medium to a number of SKU’s (Malmborg, 1998). The storage location assignment problem involves the placement of a set of items in a warehouse in such a way that some performance measure is optimal (Kovács, 2011). In this section, we present storage policies and describe the most important storage location assignment methods.

Storage Policies

A storage location policy is a set of rules which determines where the unit loads of different products will be located in a warehouse. A storage location policy is considered optimal if it minimizes the average time required to store and retrieve a unit load while satisfying the various constraints placed upon the system (Goetschalckx & Ratliff, 1990). With regard to unit load storage, there are four storage location assignment policies (Hausman et al., 1976; Francis et al., 1992) including dedicated storage, randomised storage, class-based storage, and shared storage.

Dedicated storage location policies require that a particular region only be reserved for each item (Fumi et al., 2013; Lee & Elsayed, 2005). The randomized storage location policy shows that each item has an equal chance of being stored in any of the storage locations. The class-based storage location policy distributes the items among a number of classes and for each class it reserves a region within the storage area (Petersen et al., 2004; Yang, 2003). The implementation of class based storage location assignment involves determining number of classes, product assignments to classes and storage locations for each class. In fact, randomized and dedicated storage locations are extreme cases of the class-based storage location policy. Randomized storage location considers all products in a single class and dedicated storage location considers that each item assigned to a separate class (Francis et al., 1992; Muppani & Adil, 2008a).

Shared storage location policies allow the successive storage of units of different products in the same location (Goetschalckx & Ratliff, 1990). Shared storage location policies allow more flexible use of space than dedicated storage policies (Goetschalckx & Ratliff, 1990). Shared storage location policies provide the potential to reduce the maximum effective storage area and to better utilize the more desirable storage locations (Kulturel et al., 1999).

If only order-picking cost is considered, dedicated policy may yield the lowest cost; on the other hand, if only space cost is considered, the completely random policy (one class) will yield the lowest cost solution. However, if we consider both the costs simultaneously, the best solution may be neither of these. The approaches reported in the literature for class formations primarily consider order-picking cost (Petersen et al., 2004) even though class-based policies may offer reduction in cost through space savings in situations when space cost is significant in relation to picking cost (Muppani & Adil, 2008a).