
POSSIBILITY OF CASE UNITS ORDER PICKING AUTOMATION - PRESENT TRENDS

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Abstract: *Trend of requirements continual increase related to the level of warehouse performances, as well as achieved technology level, have led to use increase of automated solutions in this field of logistic systems. At this moment, in the warehouses, great set of different automated technologies/solutions has been implemented, from automation of certain operations/processes to complete automated processes. Order picking, as specially complex, demanding and significant warehouse process, presents particularly and interesting field related to automation due to direct influence on warehouse performances, and therefore supply chain performances. Therefore, this paper aims to give preview of present trends in this field, where the primary is limited to case-units picking automation. Also, the paper considers possibilities of appliance of particular automated solutions through analyzes of relevant parameters / input values necessary for decision-making/ choice of particular case-picking technological solutions.*

Keywords: *warehouse, order-picking, case-units, automation*

1. INTRODUCTION

Present market conditions, reflected in the steadily increasing range and reducing the size of the batch of products forced the research, development and application of new solutions in production. Also present are the increasing requirements in the sphere of realization of logistics processes, which are characterized by an increasing level of service. This is characterized by a tendency for faster delivery, lower level of error and others, with simultaneous requirements on reducing logistics costs. In such conditions warehouse systems, as certain elements of the supply chain, are also met with increasingly complex tasks and requirements. These requirements are reflected in the reduction of response time for the ordered items (increase of working speed), error reduction in the formation of delivery units and damage, but also in the increase of the accuracy level, energy efficiency, humanization, labor safety, etc. [1], [2], [4] Comprehensive surveys on warehouse and industrial warehouse system topics have been proposed by De Koster et al. [2], Gu et al. [4] and Dallari et al. [1].

The introduction of automation in warehouse systems is one of the reactions on the presence of such requirements. It is for a longer period encountered in the field of the use of different variants of AS/RS, AGV, etc., but also in considerable automation related to IT [7]. The results of these automation solutions had significant effects on some warehouse processes. It is noted that applied solutions or order picking (OP) technologies have primary influence on the performance

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of the warehouse system at the warehouses in which order picking is the dominant task. OP is one of the prime components of labor and warehouse-associated costs.

The researches have shown that manual technology is dominant in this area even today [2], [8]. Since case-picking (CP), as one task class of OP is still very present in warehouses [10], the automation of these processes has increased significance. From that reason, the presentation of results of these researches and present trends in area of CP technology are the aim of this paper, and the authors intended to make the evaluation of given technologies and their convenience for usage in some OP task classes.

Having that in mind, the paper has several chapters. After the introduction, the second chapter gives definition of OP, but also (a) review of classification of technologies present in OP of unit loads: with (b) special accent on typical automation solutions. The third chapter is dedicated to the relevant parameters which allow comparison of given alternative automated CP conceptions. The fourth chapter gives recommendations to logistic experts, who deal with the development of warehouses systems, on what they should have in mind when developing and deciding on choosing the solution of automated CP. The final, fifth chapter, gives comment on some other aspects of present trends, also tendencies of automated solutions for OP of broken case units.

2. BRIEF DEFINITION AND CLASSIFICATION OF THE ORDER - PICKING TECHNOLOGIES

OP is the collection and consolidation of required quantities from an assortment of articles due to given orders. [5]. VDI 3590 have defined as a process to assemble, and to organize within a specific time, based on customer orders, placing the stock directly in order-lines, releasing the order downstream and providing a picking process at the right place at the right time. In other words, OP can be defined as order fulfillment, from withdrawing items from storage to satisfying a number of customer orders.

The use of very wide range specter of different solutions is possible for realization of OP task - in theory there is over 1000 OP systems (OPS), from which around 50 basic OPS are met in praxis [5]. These OPS are, depending on aim, classified in different ways [2], [5], where different classification criteria were used: the ratio of the movement of goods and/or orderpicker(s), applied technical level of MH (mechanization, automation, etc.), appearance of OP unit (allocation), etc. For the purpose of this paper the classification of OPS according to the type of the load unit and according to the level of process automation applied picking is used.

2.1 Classification of order picking technologies according to the OP load unit type

In relation to the type of the OP units, the literature meets three basic forms: - pallet unit, case unit and piece unit. With *pallet OP unit*, the whole pallet unit with content meets the requirements of order. *Case OP unit* meets the requirements of orders has the characteristic that demands for amount of good in orders are the same with content in the box (this type of order picking task is in the focus of this paper). *Piece OP unit* has the characteristics that the order for order picking amount is less than content of the box (usually is equal to the piece unit).

2.2. Classification of CP technologies according to the automation level

The solutions in this domain are met in versions of separation of some case units and version of separation of complete layers from pallet. Due to limited space, this paper will give the review of some CP automation solutions based on use of AGV/robots, conveyors, gantry/robot system, AS/RS and Layer picking.

- **Automated guided vehicle (AGV)/mobile robot-based case picking systems (CPSs)**

Appears in form of robot (Figure 1) within two basic OPS types „picker to load“ and „load to picker“. The development of AGV and robots with different picking devices created the preconditions to replace man-picker with the combination of robots set on AGV that allows palletizing and depalletizing. In practice, these solutions may be appropriate in the case of relatively small productivity and lower range of forms of goods, because it reduces the number of different picking devices. Otherwise, the price of the picking devices, their frequent replacement and adjustment of operating conditions can be irrational.

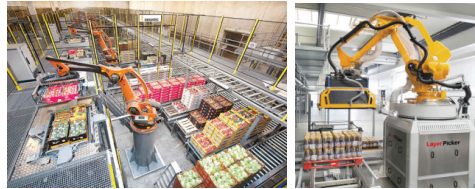


Figure 1. Mobile robot-based case picking systems with AGV

- **horizontal and vertical conveyor based CPSs**

Conveyor based system solutions can be used for intensive OP processes. In **horizontal conveyor based solutions** version (Figure 2a) unit delivery is done by roller or a belt conveyor where they are directed to the one of the lines which are only provided for the respective orders through an automated device (that scans the tag to the unit). After completing the units according to the order, the content of one line is delivered to the further process (usually palletizing) for shipping.

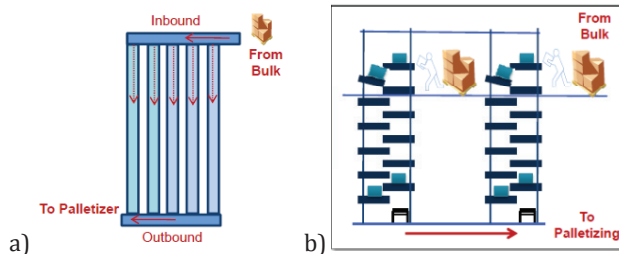


Figure 2. Horizontal (a) and vertical (b) conveyor based solutions

The key innovation of **vertical conveyor based solutions** is the **design of vertical SKU “pick/dispensing towers,”** (Figure 2b) which consists of short cascading trays or gravity flow conveyor sections. The towers are loaded with product at the top (the towers can be filled and replenished either automatically, via a conveyor running across the top of the towers, or manually via operators.), and (as shown in the illustration below) dispense cases at the bottom in any sequence required for customer orders and pallet building. These cases then travel on the shipping conveyor system from the pick area to the order consolidation shipping sorter [3].

- **Gantry robot-based solutions CPSs-**

These systems (Figure 3) involve use of a “gantry”. For these purposes a gantry as a bridge-like structure which moves horizontally back and forth along a set of overhead tracks connected to conveyor for pallet delivery. Attached to the gantry are any of various devices capable of selecting individual cases or groups of cases from pallet – typically using some form of vacuum head. Picked cases are then delivered by the gantry to a takeaway conveyor for sorting/shipping (see Figure 3). [3]



Figure 3. Examples of Gantry robot based CP solutions

Because of their techno-exploitation characteristics, these solutions are very suitable for systems with high productivity for palletizing and depalletizing. The number of different engagement devices that are installed on a working device is in operation range of forms of goods.

- **Automated storage and retrieval system (AS/RS)-based CPSS**

Solutions are based on this technology (Figure 4) enables to pick/put unit from/to the storage areas (stored in the racks) by different variants of the engagement devices. Since these units are easy to handle, the speed of operation of these systems is high, especially in versions with the shuttle - devices.

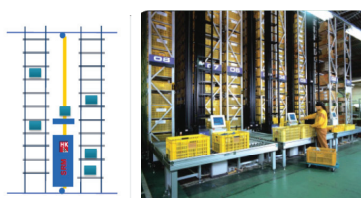


Figure 4. Principle of AS/RS based solutions CP

In order picking process, ordered unit is delivered to the entry/exit point of rack passage where it is grabbed and sent to the further phases of shipping process.

Layer picking

In situation of frequent orders - grabbing number of units that matches the layers of units on pallet, so called Robotic Layer Picker is suitable solution (Figure 5 a). In this solution, pallet with homogenous content (at least for one layer) is delivered to the working area of robot who grabs entire layer from pallet and put it on demanded spot.

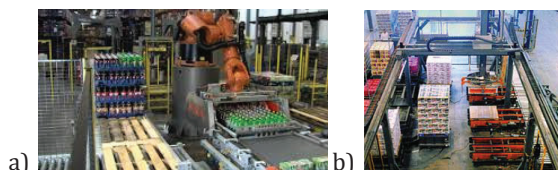


Figure 5. Layer case picking

After order picking, the pallet is returned to storage zone, or if empty, to the place of empty pallet drop. The technical solutions of engagement devices (due to higher capacity and complexity) in this version could have high price, but they can make significant productivity. This solution can be made as one version of gantry robot (Figure 5 b).

3. APPLICABLE PARAMETERS FOR ALTERNATIVE AUTOMATED CP CONCEPTIONS COMPARISON

The comparison of conceptions needed for making project decisions and choosing solutions, needs to define/chose whole of various applicable criteria - techno-technological, economical, working conditions, etc. By rule, applicable parameters for alternative CP conceptions comparison are: **Productivity**: refers to the pick rate, which can be expressed as cases per hour; **Costs**: There are many kinds of costs. In the context of this research, the most important types of costs can be divided into fixed costs and operating costs; **Cycle time**: This term refers to the time an order takes from its entrance to the system until it reaches the shipping area; **Accuracy**: Accuracy could be defined as the system's ability to avoid errors occurring while the processes are running, especially in OP procedures. It has a great effect on customer service level; **Flexibility**: Flexibility can be defined as the ability of a system to adapt to a wide range of operating conditions; **Maintenance** (costs and time delays) that is close connected with reliability of the OPS.

It is clear that these parameters can have different significance depending on the order picking task. In concrete terms, it is necessary to "wage" each of them in order to value alternative solutions.

4 RECOMMENDATIONS FOR DEVELOPMENT AND MAKING DECISION ON SELECTION OF SOLUTION OF AUTOMATED CPSs

It is interesting that despite the increasing interest in warehouse automation, clear guidance in selecting an automated OP solution is not present in literature. There are global recommendations concerned on factors that should be respected during automated design of CPSs (one is presented on Figure 6) [6]. Very interesting recommendation in this area is given in [9] - this recommendation respects two factors - Package Variability and SKU (Storage Keeping Unit) velocity in warehouse system, as it is shown in Figure 7.

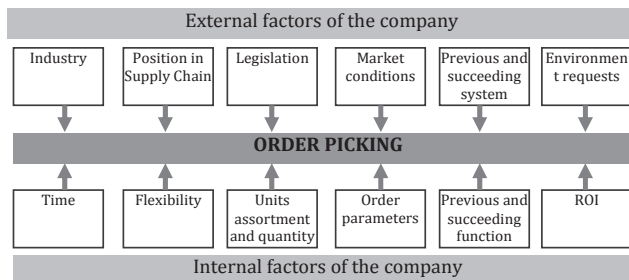


Figure 6. Respective Factors during design of automated CPS systems

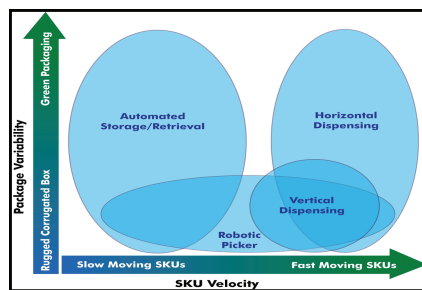


Figure 7. Respective factors during automated design of case OP systems

It's important to notice, that such selection is not sufficient and logistics experts have to investigate more details concerned on productivity, different costs, space, labor, complexity, risk, flexibility and scalability, ROI etc. Only when those analysis are performed, design of CPS could be appropriate.

5. CONCLUSION

By analyzing presented technologies, it can be concluded that there are lot of new, automated CPS solutions, more and more present, despite of some implementation problems concerned on few factors described in this paper. This trend is present in developed countries, where labor costs are high, and required service level in logistics is permanently growing - resulting with various automated CP solutions. Development in of robotics is very intensive at all as well in the application in OPS. One fact that confirm this trend in the recent time is development of automated piece unit (broken case) picking solutions which are present on the market and practice. Everything mentioned above shows that logistics experts, especially ones that deals with OP, have to permanently follow trends in this area, but also to have in mind and respect all relevant factors when dealing with application of this solutions.

ACKNOWLEDGMENT

This paper was supported by the Ministry of Education, Science and Technological Development of the Government of the Republic of Serbia through the project TR36006 for the period 2011-2017.

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