16-osios jaunųjų mokslininkų konferencijos „Mokslas – Lietuvos ateitis“ teminės konferencijos
TRANSPORTO INŽINERIJA IR VADYBA,
vykusios 2013 m. gegužės 8 d. Vilniuje, straipsnių rinkinys

Proceedings of the 16th Conference for Junior Researchers ‘Science – Future of Lithuania’
TRANSPORT ENGINEERING AND MANAGEMENT, 8 May 2013, Vilnius, Lithuania

Сборник статей 16-й конференции молодых ученых «Наука – будущее Литвы»
ИНЖЕНЕРИЯ ТРАНСПОРТА И ОРГАНИЗАЦИЯ ПЕРЕВОЗОК, 8 мая 2013 г., Вильнюс, Литва

GENERAL OVERVIEW, PROBLEMS AND FUTURE DEVELOPMENT OF AUTOMATED WAREHOUSE OPERATIONS

Viktoriia Ivannikova[1], Kateryna Golovenko[2]
[1, 2]National Aviation University, Kyiv, Ukraine
E-mail: [1]vicg@bigmir.net

Abstract. The general overview of the automated warehouse operations, the equipment intended in these operations, occurring difficulties when applying these technologies and the trend of future development based on the comparison with the results of years of using the systems, are presented in the article.

Keywords: Automated warehouse, automated storage and retrieval system (ASRS or AS/RS), handling operations, time reducing, increasing efficiency.

1. Overview

The traditional functions of a warehouse are well known. Unlike its predecessors, however, the modern warehouse is an assemblage of highly evolved automation technologies, making it a core part of the supply chain.

Today's warehouse activities include crossdocking, palletizing, kitting, tagging, and identifying products, as well as storing them in the most time- and space-efficient manner possible. As a result, warehouse automation now has a direct bearing on supply chain efficiency [1].

Previously manually handled operations took a lot of time, working personnel, they were not so effective as nowadays. Thus we can outline main advantages of the automatization of warehouses, They are the following:

- Increasing efficiency of using of warehouse area and thus warehouse turnover;
- Decrease the time of handling operations;
- Automated system of searching of the best place for storage;
- Improved control supervision;
- Reducing the dependency on human factor.

“The warehouse is the last frontier for reducing long-term distribution and logistics costs”, says Dan Labell, president, Westfalia Technologies, a warehousing systems planner and implementer headquartered in York, Pa, thus it can be the good reason for the airlines and the airports’ management to invest funds into the development and update warehouses (especially with big turnover) to keep their operation level high.

There are several defined purposes on which you will orient during designing your automated warehouse equipment. Depending on it the selection of equipment and the combinations will be grounded. The most famous of them are:

a) Low activity/low storage requirements: This scenario represents the simple, smaller warehouse operation. Rarely are automation or sophisticated storage and picking mediums or devices justified for these smaller operations. In most instances, floor storage, stacked pallets, simple pallet racks and/or conventional shelving are utilized within the facility, along with manual handling.

b) Low activity/high storage requirements: This way typically calls for high bay, multi-level, high-density storage and a random location

ISSN 2029-7157 / eISSN 2029-7149
ISBN 978-609-457-490-0 / eISBN 978-609-457-489-4

strategy. Order picking can be manual or semi-manual.

c) High activity/low storage requirements: This combination generally suggests a very condensed forward picking area supported by simple overstock storage. The high pick activity level often justifies automating the order picking system and the use of automated material handling systems.

Around the mid-20th century, warehousing underwent something of a metamorphosis, thanks to the rise of mass production and machine-operated factories. More products called for more storage facilities, and more efficient, effective means of storing and retrieving products and it caused the great demand for warehouses. Approximately at that time the evolution of the biggest part of tools in a warehouse started its automatization. Automated storage and retrieval system, Radio Frequency Identification appeared, conveyors, forklifts, robots transformed. All of these mentioned and several other tools are the ones that are consist to be the tools of automated warehouse operations. Let's consider some of these parts and observe their main operations:.

1) An automated storage and retrieval system (ASRS or AS/RS) consists of a variety of computer-controlled methods for automatically placing and retrieving loads from specific storage locations [2]. Automated storage and retrieval systems (AS/RS) are typically used in applications where: there is a very high volume of loads being moved into and out of storage; storage density is important because of space constraints; no value adding content is present in this process; accuracy is critical because of potential expensive damages to the load. AS/RS can be used with standard loads as well as nonstandard loads. AS/RS systems save labor, are 99.9-percent accurate, and do not damage product

On the Figure 1 below we can overview the general parts of an automated warehouse

2) Layer forming palletizers. Layer forming palletizers are often used in high-speed applications, and in conjunction with handling bags when pattern quality is important. How do layer forming palletizers compare with robotic palletizers? A layer forming palletizer can square each layer before it is stripped onto the pallet (this applies to bags only). A robot cannot. A robot is far more flexible, however, because it can handle multiple production lines at once. Robots can also quickly pick up multiple cases/bags at one time, but will not match the speed of the very high-speed lines often found in the beverage industry, for example [1].

3) Forklifts. Forklifts are a critical element of warehouses and distribution centers. It's imperative that these structures be designed to accommodate their efficient and safe movement [3]. Automated warehouse systems typically use forklifts to load trucks, but sometimes use counterbalanced trucks to move product received from the outside, or if the manufacturing facility is not coupled to the warehouse. These trucks are usually equipped with RF equipment so the truck operator can communicate information back to the Warehouse Management System (WMS).

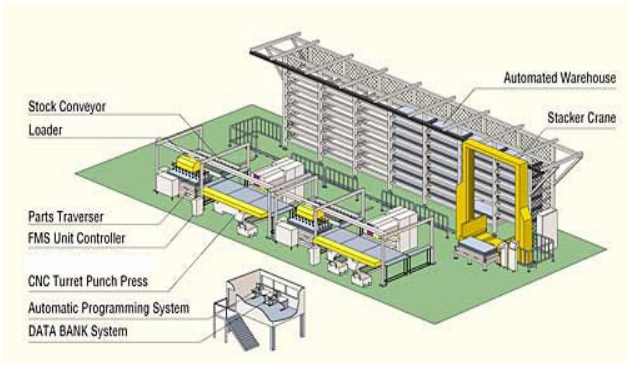

Fig. 1. General Layout of an Automated Warehouse

4) Conveyors. These are the type of warehouse equipment, widely used during warehouse "inside handling". Some of them require no electric controls to accomplish zero-pressure accumulation. Depending on the type of the cargo to be transported and the technology of cargo movement in different warehouses different kinds of conveyors are used. In these technologies almost all kinds of conveyors are used. Also the type of the equipment depends on different factors: physical and chemical characteristics of the transporting cargo, the length and the geometry of the track of the conveyor, the efficiency and so on. The most popular are roller conveyors and belt ones.

5) RFID. Radio-frequency identification is the use of a wireless non-contact system that uses radio-frequency electromagnetic fields to transfer data from a tag attached to an object, for the purposes of automatic identification and tracking. Some tags require no battery and are powered and read at short ranges via magnetic fields (electromagnetic induction). Others use a local power source and emit radio waves (electromagnetic radiation at radio frequencies).

RFID readers can be easily integrated into any AS/RS to identify pallets and the product on a pallet. This data can be used later as the product moves through the rest of the supply chain.

"RFID is another way to identify a product without having visual reference to it", Labell notes.

6) Pallets. Plastic pallets continue to grow in popularity. As they become more automation friendly, they are easier to move on conveyers. Though more expensive to purchase than wooden pallets, when used in a captive system, plastic pallets hold up more effectively and cut costs in the long run. Plastic pallets are also used often in food applications where cleanliness is an important issue[1].

7) Automatic guided vehicle systems are fully automatic transport systems using unmanned vehicles. AGVs safely transport all kinds of products without human intervention within production, logistic, warehouse and distribution environments: the clear way to reduce costs and to increase efficiency and profitability.

Egemin's AGV systems consist of reliable off-the-shelf components. However, we always tailor our AGVs to meet your requirements. Automatic guided vehicles lift, rotate and shift your goods, fetch loads from racks, store products in deep lanes, transport product across long distances, deliver them onto conveyors, etc. [5].

2. Effectiveness

The purpose of the warehouse automatization is decreasing product handling time and reducing costs. But first of all management should get the proper equipment for their warehouse turnover and specifications to get proper quality of performing work cycles. Besides, it is necessary to analyze the flow of products and investments, because with the increasing of cargo transportations throughout the world some warehouses need expansion or reconstruction for fitting new requirements.

Just like the variety of conveyors, AS/RS systems have serious quality differences, so the choice of equipment should be grounded on the past accidents, present product types and future cargo flow forecast.

For the increasing the effectiveness there are several steps included in a strategy of creating an automated warehouse. The most important of them are: defining the goals, documentation of the process, finding needed data, analyzing, creating a master plan, its realization and collecting results after its processing start.

Every step is important in its own way. Defining the goals and objectives will set up the general strategy for the future facility and as a rule they have a general character (They can also be defined more specifically, such as maximizing cube utilization, providing maximum flexibility in the final layout to accommodate future expansion or changes in business, or maximizing efficiency and productivity with a minimal amount of resources). Documentation is important for the selecting and hiring the staff and monitoring the general information about personnel via interviews etc. Collecting any and all possible information specific to the new facility. Since it is best to work from inside of the facility out when considering new construction, it's unpleasant to let any building constraints restrict design. When considering existing space for the new facility, make sure the information includes accurate drawings showing each part defined sizes and locations, dock and personnel doors and locations, ceiling height restrictions and ceiling girder/joist construction(also it's advised to collect all relevant product information pertaining to the number of stock keeping units (SKUs) to be stored and picked within the facility, along with their dimensional measurements, weights, order history and velocity data). Analyzing is connected with the points described above as it undermeans the processing of the gathered and defining of the ways of purchasing of the goals(the general questions are; How well does the product flow into, within, and out of the facility? What are the staffing requirements? How effectively will the warehouse management system work with the automated material handling system? etc.).The project lan should identify all steps of the creating of warehouse or distribution centre layout for purchasing of the needed goals, it should contain detailed descriptions from the start of construction till the dead-line of the project. Implementation is the phase during what the layout is transformed from concept to reality. Collecting results and overview allows to compare the operating tasks with the originally set goals, discuss future development, implement some needed changes. This step is critical for future project planning.

3. Problems occurred during operation

After any warehouse has applied the automated technologies, it will never come back to conventional principles of handling. Though automated warehouses are the perspective and can handle any amount of cargo (in case if they are properly equipped and used) still there

occur accidents and troubles while their operating. As a rule, the cause is the not satisfying type of equipment that cannot handle the flow of products for what it is not specified. Typically, once an automation project has been given the green light, the ongoing responsibility is passed onto the operation team, who are then assigned the budget to negotiate with a myriad of suppliers. This is usually where the problems start, as equipment vendors are well-versed at highlighting the huge merits of their respective systems. Critically, this is the stage of the project that needs serious due diligence, but rarely gets it. It's now that an experienced, almost cynical eye is needed to evaluate the true benefit of each prospective solution and how it will bring tangible benefit to the business's supply chain function – not just tomorrow but in ten years' time. Decisions on automation systems can take just a few months, but often remain as part of an organisation's logistics infrastructure for over a decade.

Secondly, unexpected changes to a business's market, customer base, product range or demand spikes through the year can render a new automation system impotent.(c. Andy Keith, founder of supply chain consultancy Total Logistics).

4. Future development

Warehouse Teamsters always said that they could never automate what we do. Now they have. Everything is separated, different sector workers do not intersect with another sector. Everything is in a strict order.

In fact, the trend is toward greater centralization of distribution warehouses as layers of distribution will be eliminated and the pull for the goods will be directly from the central warehouse to the consumer of the finished goods. This trend will require centralized warehouses to perform more small picks, i.e., more single case and individual part picks. In fact, the second greatest area of growth in warehouses automation over the next decade will be in order picking. The automated order picking systems of the future will not be labour Intensive but will have greater responsiveness, will be more flexible and will be more modular than systems today. In support of this higher throughput order picking environment, conveyor systems will play an even more significant role in warehousing than in the past.

The greatest area of growth will be in Real Time Warehouse Control Systems (RTWCS). The reduced costs of warehouse control systems will place these systems well within reach of warehouses who in the past could not afford warehouse automation. The reduced costs and increased performance of warehouse control systems will result in automated warehouse control systems with traditional material handling equipment being a superior alternative to AS/RS [4].

5. Conclusion

Automated warehouse operations are the tools to build the better system of product handling due to different types of equipment used in cargo handling. The main aim – efficiency of handling, i.e. handling time decreasing and improving the ways of handling.

The problems occurred during usage should be predicted and avoid due to permanent control and analysis of product flow and workforce experience.

The actuality of automatization allows rely on it and forecast the future trends for warehouses grounding on the present results of using and growing amount of cargo transportation performing all over the world.

References

1. Malone, R. 2005. Inside the Automated Warehouse. Inbound Logistics. Available from Internet: <http://www.inboundlogistics.com/cms/article/inside-the-automated-warehouse/>
2. Material Handling Industry of America. 2012. Available from Internet: <http://www.mhi.org/glossary?q=&sort=title-sort%20asc%2Ccompany-sort%20asc&page=1&fq=title-first-letter:a-c>
3. Phelan, Jr.; John, T. Which Storage Rack System Is Right for Your company. 2009. TriFactor Home page <http://www.trifactor.com/Material-Handling-White-Papers/Which-Rack-Storage-System-is-Right-for-Your-Company>
4. *Indian Institute of materials Management.* Automated Warehouse Perspective and Trends.
5. Automated Guided Vehicles AGVs. *Egemine Automation*. Available from Internet: <http://www.egemin-automation.com/en/automation/material-handling-automation_ha-solutions/agv-systems>