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HOW AUTOMATION IMPROVES WAREHOUSING AND MATERIALS HANDLING

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ПІДВИЩЕННЯ ЕФЕКТИВНОСТІ СКЛАДУВАННЯ ЗА РАХУНОК АВТОМАТИЗАЦІЇ СКЛАДУ

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ПОВЫШЕНИЕ ЭФФЕКТИВНОСТИ СКЛАДИРОВАНИЯ ЗА СЧЕТ АВТОМАТИЗАЦИИ СКЛАДА

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Problem statement

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.

More companies are looking to materials handling automation to improve processes, streamline shipping operations, and lower supply chain operating costs. However, the change from a manual warehouse to an automated warehouse is significant and the impact of that change should never be under estimated. Even limited application of automated technologies will have a dramatic effect on the processes used in the warehouse, the management systems required to make it effective and on the people who have to adapt to accept its use. This paper describes the most common potential automation risks, and how to mitigate or prevent them.

The main part

The deployment of automation technology, whether this is a fully integrated solution or an enhancement to an otherwise manual warehouse, can bring a competitive advantage to companies, with benefits in staffing, property and / or service. For staff these include reduced costs, providing improved ergonomics and an alternative to unproductive labor. For property it can bring space efficiency, reduced facility size and reduced costs. Service benefits include improved order accuracy, product security and

condition, and lead-times. However, there are also risks, such as increased complexity, a degree of reduced flexibility and a finite capacity. In addition, poor implementation can mean that automation expertise doesn't transition into the operation, and the full benefits are not realized.

Automation has finite limitations and may not be able to respond to unexpected peaks in throughput. The limitations of a solution can be mitigated during the design phase. Given the likely scale of investment then the planning base should be at least a ten-year horizon, to include the most robust forecast of changes in business profile and growth that are available.

There can be resistance to changing working methods with a desire by staff to retain as much of the existing process as possible. Specifying new working practices can be difficult as people have to envisage how they will be working in the future, but thorough detailing of the revised processes is absolutely necessary. However, the focus should be on adapting to how the automation works and getting the most benefit out of it.

After the implementation project teams disband and the operations team is left to deliver. So what can go wrong? There are a number of key groups whose prominence and importance varies through the life of an implementation. As the balance of responsibility moves from one to the other, trust needs to be built between the parties.

Among the many options for improving supply chain performance, warehouse automation is one whose benefits, though potentially great, are in many cases only partly understood.

Thanks to recent and ongoing technological innovations, the benefits of warehouse automation are more accessible than in the past, and they can be used to drive value throughout the supply chain and to open up strategic options.

Achieving Warehouse Savings

Most retailers are well aware of the warehouse operations ("four-wall") savings enabled by automating processes such as putaway, retrieval picking, sorting, and palletizing. The automation of these processes can improve labor efficiency and quality control and save on other equipment, materials, and expenses. The four-wall economics are a function of scale and labor costs, which is why retail operations with high throughput and labor costs, such as case-pick grocery facilities, have been most likely to automate. Automation also has been easiest to justify in a growing retail space in which additional distribution-center space is needed, and the cost of new construction can be amortized over this growth.

Although achieving four-wall savings from warehouse automation might seem relatively straightforward, evaluating the potential savings is more complicated than many people realize. One reason for this is the dramatic differences in investment costs for automation, depending on the complexity and scale of a warehouse operation and the particular solution chosen. Choosing which processes and items to automate can also have immense implications for fixed costs and project risk.

To properly evaluate the benefits of such investments, executives must consider an extensive set of factors. In our experience, holistic investment-decision models for warehouse automation include several dozen inputs, which incorporate a variety of financial and operational considerations.

Beyond Four-Wall Savings

Potential four-wall savings are often top-of-mind considerations for retail executive teams, but teams should not be trapped into thinking that these savings are the only source of value from automation. Warehouse automation can also enable improvements to the broader supply-chain network and, even more dramatically, enable a range of previously unimagined strategic options.

The potential benefits of warehouse automation exist throughout the supply-chain network. Consider these examples of benefits at three key points in the network:

- Warehouse. Dramatically improved utilization of storage space reduces the need for new construction as greater warehouse capacity becomes needed, and facilitates centralization of warehouse operations and closing of buildings.

- Transportation. The ability to assemble denser pallet cubes through automation means more tightly packed trucks and lower average shipping costs per item, reducing transportation costs by up to 10 percent.

- Store Backroom. Store-specific pallets (assembled to reflect the layout of a particular store) can reduce shelf replenishment labor, with store operations savings estimated at up to $0.02 per case.

Beyond such network improvements, warehouse automation can be used to open up new strategic options and initiatives for retailers. For example, automation can enable growth by allowing a distribution center to service more stores and increase product offerings.

Reducing cycle time through warehouse automation is another strategic benefit. By speeding up the queuing and batch-planning, order-picking and packing, and transportation processes, automation can dramatically reduce order-to-delivery cycle times. This improved cycle time in turn reduces inventory, improves fill rates, minimizes lost sales that can reduce customer satisfaction and loyalty, and can even eliminate the need to maintain distribution center stock altogether.

Finally, automation can be a key lever for strategic growth and is particularly well suited to help unlock the value of retail e-commerce. Traditionally, e-commerce has presented daunting problems associated with complexity, cost per order, and customer responsiveness, and automation can mitigate some of these challenges.

Implementing an automated solution could be the best decision or the worst. The benefits include improved productivity, order accuracy, product security and space efficiency. However, there is significant risk in adopting automation because it is such a life-changing experience, which can have a negative impact on both an operation and a business. This has been demonstrated by a number of highly publicized failures, where poorly managed automation implementations have had a detrimental effect on business performance and service. By investing, typically, less than 2% of the total project cost in independent, professional support these risks will be mitigated and project success assured.

Tools of the automation:

- Robots. Robots play a major role in the materials handling systems. The company uses articulating arm robots manufactured by KUKA Robotics Corporation, a global manufacturer of industrial robots, and by Fuji Yusoki, a leading robotic palletized manufacturer.

- AS/RS Systems. AS/RS systems save labor, are 99.9-percent accurate, and do not damage product. These computer-controlled systems provide instant access to a tremendous amount of information, which warehouse and logistics managers can retrieve through web links.

- Layer forming palletizes. Layer forming palletizes are often used in high-speed applications, and in conjunction with handling bags when pattern quality is important. How do layer forming palletizes compare with robotic palletizes? A layer forming palletize 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.

Whether dealing with robots or layer forming palletizes, safety is always an issue. A layer forming machine or robot cannot access certain areas, for example. The robotic palletizing cell is extremely dangerous when not guarded properly with laser protection devices or safety fences. Lock-out/tag-out procedures are typically implemented to ensure humans are not inside a robotic palletizing cell during operations.

- Forklifts. 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).

- Conveyors. The lack of controls required, plus the fact that only a two-horsepower motor is needed for up to 20 zones (100 feet), make the conveyors cost effective.

- Transfer cars. Companies use transfer cars to consolidate multiple pickup or drop-off locations—such as palletizing lines - into one or two in-feed lines to an AS/RS. A small computer, called the Programmable Logic Controller (PLC), controls all the machinery. The PLC can be easily programmed to respond to conditions detected by sensing devices such as photoeyes and proximity sensors.

- RFID. RFID can be implemented at the pallet level, case level, or unit level. The medium to long-term trend is to have RFID tags at the unit level, so every item a consumer purchases can be tracked. This is still fairly cost prohibitive, but most industry experts agree that unit-level RFID tagging will continue to grow.

- 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.

Measuring effectiveness

Reducing cost and product processing time is the goal of an automated warehouse. But how does measure the effectiveness of its tools and technologies? It is important to use discounted cash flow techniques to analyze projects that have a life of 20 years or more. Most companies never go back to a conventional warehouse once they own and operate an automated one that works correctly.

Unfortunately some automated warehouse systems do not have the necessary quality to handle the work cycles they are burdened with. Companies tend to view these systems negatively when they create problems. Because there are serious quality differences between AS/RS systems, it is critical to buy the highest-quality system.

REFERENCES

1. Hamberg, Roelof, Verriet, Jacques «Automation in Warehouse Development». London: Springer-Verlage, 2012, 73 p. (Ukr)

2. Hompel, Michael, Schmidt, Thorsten «Warehouse Management». Intralogistik, 2007, 102 p. (Ukr)

3. Siciliano, Bruno, Khatib, Oussama (Eds.) «Springer Handbook of Robotics», UK, 2008, 536 p. (Ukr)

4. Nicholas D. Adams «Warehouse and Distribution Automation Handbook», McGraw-Hill, 1996, 560 p. (Ukr)

5. James A., Tompkins, Jerry D.Smith «The Warehouse Management Handbook», Tompkins Press, 1998, 980 p. (Ukr)

ПЕРЕЛІК ПОСИЛАНЬ

1. Хамберг, Роелоф, ті інш. «Автоматизація у розвитку складу». Лондон: Спрингер-Велад, 2012, 73 с.

2. Хомпел, Мічаєл ті інш. «Управління складом», Інтралогістик, 2007, 102 с.

3. Сіціліано, Бруно та інш. «Довідник робо техніки», Великобританія, 2008, 536 с.

4. Ніколас Д. Адамс «Довідник: Склад і впровадження автоматизації», МсГрей-Хіл, 1996, 560 с.

5. Джеймс А., Томпкинс, та інш. «Керівництво з управління складом», Томпкинс Прес, 1998, 980 с.

ABSTRACT

Polischuk V.P., Yeresov V.I., Kunitska O.M., Korchevska A.A., Korchevskuy A.O., Lanovyy O.T. How automation improves warehousing and materials handling. Visnyk National Transport University. Series «Technical sciences». Scientific and Technical Collection. – Kyiv: National Transport University, 2016. – Issue 1 (34).

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More companies are looking to materials handling automation to improve processes, streamline shipping operations, and lower supply chain operating costs. However, the change from a manual warehouse to an automated warehouse is significant and the impact of that change should never be under estimated. Even limited application of automated technologies will have a dramatic effect on the processes used in the warehouse, the management systems required to make it effective and on the people who have to adapt to accept its use. This paper describes the most common potential automation risks, and how to mitigate or prevent them.

KEYWORDS: WAREHOUSE, WAREHOUSE MANAGEMENT, WAREHOUSE AUTOMATION, LOGISTICS.

РЕФЕРАТ

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Сучасна складська діяльність включає різні напрями роботи, серед яких наскрізне складування, палетування, комплектація, маркування, ідентифікація продуктів, а також їх зберігання в самому часі і просторі ефективним способом. В результаті, автоматизація складу тепер має пряме відношення до ефективності ланцюжка поставок.

Все більше компаній шукають способи автоматизації для поліпшення процесів, оптимізації транспортних операцій і зниження експлуатаційних витрат в ланцюзі постачань. Проте, перехід від ручного складу до автоматизованого є істотним, і вплив цієї зміни не повинен бути недооцінений. Стаття описує найпоширеніші потенційні ризики автоматизації, і визначає як їх пом'якшити або запобігти їм.

КЛЮЧОВІ СЛОВА: СКЛАД, АВТОМАТИЗАЦІЯ СКЛАДУ, УПРАВЛІННЯ СКЛАДОМ, ЛОГІСТИКА.

РЕФЕРАТ

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Современная складская деятельность включает различные направления работы, среди которых сквозное складирование, паллетирование, комплектация, маркировка, идентификация продуктов, а также их хранение в самом времени и пространстве эффективным способом. В результате, автоматизация склада теперь имеет прямое отношение к эффективности цепочки поставок.

Все больше компаний ищут способы автоматизации для улучшения процессов, оптимизации транспортных операций и снижения эксплуатационных расходов в цепи поставок. Однако переход от ручного состава к автоматизированному является существенным, и влияние этого изменения не должно быть недооценено. Статья описывает распространенные потенциальные риски автоматизации, и определяет, как их смягчить, или избежать их.

КЛЮЧЕВЫЕ СЛОВА: СКЛАД, АВТОМАТИЗАЦИЯ СКЛАДА, УПРАВЛЕНИЕ СКЛАДОМ, ЛОГИСТИКА.

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