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Adopting Technological Upgrades in Warehousing: Challenges and Resistance

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Abstract

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In the current state of many businesses, there are many outdated software and processes that may be limiting the potential of businesses to reach their optimal output results. This thesis aims to understand what solutions could provide more efficient processes and tries to understand why improving these processes is important to staff, customers and businesses themselves. This research sets out to understand how technologies like RFID and AGV improve efficiency in the warehouse and what is the smartest way to invest in upgrading technology.

The study involves interpreting new logistic concepts, research on secondary data, a study of some specific use cases of various sizes of companies and an interview with an expert in the field. The target of this thesis is to help the reader to understand what is needed to drive technology adoption.

The results include a better view of measuring processes, limitations and what drives cost savings and improvement of customer satisfaction. Limitations of the study are that the goals of performance, the working environments, and allocated budgets for adapting technology in businesses are subjective and it is therefore difficult to generalize the results. Further research on this topic would shed light on the potential to increase productivity and staff satisfaction that can be derived from the correct adoption of technology with the inclusion of the staff.

Keywords: Warehousing, Technology advancement, Improving Logistics, Resistance to technology

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Glossary

CSLAP	Correlated Storage Location Assignment Problem
IoT	Internet of Things
MHE	Material Handling Equipment
ML	Machine Learning
PPE	Personal Protection Equipment
RPA	Robotic Process Automation, a form of business process automation, usually including software
WMS	Warehouse Management System

1 Introduction

The thesis utilises exploratory methods to research whether the adaption to the most efficient technologies is either a factor of resistance, a question of resources or the result of not knowing the indicators (properly measuring productivity) which prompts a demand. The thesis will have review advantages and disadvantages of upgrading logistics processes with the latest technology for their business. Review Warehouse processes and productivity measures that drive the demand to implement new technology.

The question remains, what are the best ways forward to automate. Trying to review whether there is in fact a further resistance (due to costs, disruptions and need for upgrades) even if the staff is skilled. Finally the study will look into how to implement new technologies, the benefits and key takeaways from the findings of this research.

1.1 Research Purpose and Goals

The study aims to perform exploratory research and examine whether there is a resistance of adapting to automated and more advanced technology and understanding what the state is regarding upgrading technology. The study deals with warehousing environments as well as small businesses logistical practices that ideally perceive such technology adaption out of their reach or that may otherwise be heavily invested in the companies' processes.

Though it is commonly known that skills and resources are the reason for businesses to reach a ceiling, the documents study will find if there are in fact methods that can be utilised affordably as well as finding gaps in individuals ability to work with systems and creating processes which enable business staff to implement more efficient and profitable solutions.

There are many positive reasons for an adaption to a new technology that makes businesses more efficient, and thus more profitable. There are also

pitfalls that occur without the use of proper diligence the following research questions will be used to address the aim of the study.

1.2 Research Questions

The following research questions are reviewed after narrowing the focus to the resistance of technology from the employer's and employee's perspective, as well as specific automation questions.

The immediate questions that are relevant to the topic are below and the further developed questions under those:

- Are competent staff and resources the only limitation for resistance when it comes to technological upgrades?
- What sort of investment is required to upgrade different elements of warehouse solutions?
- What is the nature of "Resistance to change"?
- Is there a benefit to upgrading and what are the causes for the need?
- What are the indicators for technological upgrades?

More specifically to these immediate questions are further understanding our key research questions:

- Are there any tools or models to improve processes?
- How difficult is it to install an automated element in the warehouse? An interview with Lauri Ristolainen answers this particular question but in addition, warehouse tools will be reviewed.
- For what reasons is there a resistance to AI and automated processes? What is the mindset behind the resistance to upgrading technology, investing into new software / and integration and the hurdles associated and the overall costs and effort?

- How much do productivity improvements help the bottomline and what are the benefits of the improvements for the labour force?

1.3 Study Structure

The thesis is divided in six primary parts. Starting with the thesis introduction, which addresses the initial part of the review and gives general data regarding the importance of digitalising and automating various parts of your business.

The next section deals with the research methodology. This part of the thesis provides and describes the reasoning, approach, instruments, and procedures used to collect, gather, and investigate the exploration information to meet the review's goals. The part will likewise determine the exploration limits and moral contemplations for the thesis.

The third part deals with the review of the literature. This section presents potential claims and discoveries relevant to the exploration topic region, sources include books, diaries, articles, and websites.

The fourth section considers traditional warehouse operations that run with manual processes and compares them with automated and software driven modern alternatives. Both primary and secondary sources are used for this section.

The fifth part deals with measuring methods. The sixth section considers tools and case examples.

The sixth section covers benchmarking. The seventh considers implementation of new technological solutions and their challenges.

The final part is the overview of the analysis following with the conclusion and key takeaways.

2 Research Methodology

The research method used in this study is qualitative research methods. The purpose of the study is to investigate and explore areas of warehouse processes and see how automation could be incorporated so the use of collecting and analysing different information will allow for reviewing stages of a warehouses development in the areas of technological upgrades. Qualitative research will help to produce professional outlooks and provide evidence of how the manner of upgrading technology should be conducted also evidence for what may be the cause for the resistance. This study will give a view of the bigger picture with a focus on how to measure, what areas can be upgraded and an overlook on the topic of Change Management. Reviewing expert strategies and understanding drawbacks can be vital to assisting small businesses to become more efficient so they can focus on other areas of production and improve finances by leveraging resources.

2.1 Research Purpose

The aim of the thesis is to equip the reader with the motivation and tools to be able to plan for upgrading processes and tools to allow for competitiveness. In the current business environment there is endless potential when it comes to technological solutions that would enable businesses to run optimally. There has been cases of demand for customer satisfaction to be improved, training for employees is crucial but what benefits come from proactive training and what are the limitations found in new software. While technology itself is powerful, the information processed by this technology is even more powerful and valuable.

In many cases most businesses want to run as efficiently as possible so it's likely the factors affecting upgrades are time, money, energy, competency and opportunity cost of spending the time upgrading. Reviewing indicators for upgrading and understanding warehousing basics before understanding the

demands to upgrade. Within the literature review the exploration of these areas is covered.

2.2 Data Collection Method

As part of my investigation into understanding the resistance to the adaptation of technology and automation, the plan is to gather primary data (through an interview) and secondary data, both of which will be qualitative research data. Using primary data and secondary data, analyzed through reviews of books, journals, and articles published in market research and other forms of publishing.

2.3 Why review when to upgrade technology and if there is a resistance?

At the end of the technology adaptation route there is an easier, faster more efficient and more resilient way of commencing daily operations which allows more time for staff to spend time creating further productive warehouses that are for more fruitful for the business.

There may be established indicators for when technological upgrades should be initiated and at the same time reviewing practices that can be upgraded is beneficial to understand solutions available.

3 Resistance to change

What is the resistance from employer and employee in automating processes? Literature of this nature can be found in Lauer's Change Management.

Why do employees resist new technology and change?

Resistance is a heavy factor of consideration in the thesis so understanding more of how it occurs is important and finding a way around resistance may be the first step forward to a new way of thinking when approaching automating the office and warehouse.

Lauer (2021: 122) observes communication is a major factor for overcoming resistance.

As Lauer (2021: 50) stated in Change Management, there are four different forms of resistance: opposition, discomposure, evasion and listlessness. Opposition is often verbal resistance which includes counter-arguments, to accusations and even to threats. Discomposure is generally non verbal resistance which include rumours, initiators usually only sense something is wrong but not informed. Evasion only indirectly relates to the object and is includes forms of ridiculing. Lastly listlessness is the least directly visible resistance it combines non-verbal with passivity, this resistance can lead to burn-outs and internal dismissal.

Understanding the nature of resistance in human psychology will have a dramatic impact on how we can view how employees and employers view implementing automated solutions.

Kotter (2011: 68) observed that the most general lesson to more successful cases is change process goes through 3 stages of motivational phases: Startup, Process and Target Motivation.

Based on Kotter's (2011) observations across "more than 100 companies" there is a need to understand the steps involved as well as a plan that is rolled out over a longer period of time.

In Practical Guidelines to Managing Change in People and Process: Making Sense of Change Management by Patrick M. Dawson it was Dawson's contention that there is a not a universal way of managing change and there are no simple recipes for success.

- Change strategies need to be adaptable and have an understanding of where it takes place
- Change takes time, improvisation, planning and adaption
- Individuals experience change differently
- Employees should be trained new techniques and procedures
- Employee communication should be consistent.

(Dawson 2008: 12)

3.1 Focus areas: Picking and Traceability

Uncovering the basics of Warehousing will be found through Warehouse Management by Richards (2014). Basic warehouse processes include: pre receipt, receiving, put-away, storage, picking, replenishment, value-adding services and despatch. (Richards, 2014: 168). Due to the vast nature of warehousing a focus of picking will be found later in this study. Reviewing the advantages and disadvantages of picking tools from manual use tools to the latest technologies as well as what these tools cost and require to maintain.

Clear communication needs to be made to all employees. Reducing costs can be achieved when processes work effeciently. (Richards 2014: 58)

There are major benefits to investing in new technologies and automating the warehouse. One of the largest benefits is the increase of accuracy which is one of the largest factors when running a warehouse. To jump in further to reasons why accuracy needs to be improved, the potential errors come into scope:

There are a variety of costs for mispicks. By reviewing mispick elements it will highlight which processes are in demand to be upgraded. Below list some of the incorrect picking elements:

Variety of costs for mispicks
recovering the item
labour cost of in-handling
costs related to picking the replacement item, re-packing, re-delivery and retraining staff
administration costs
customer not paying the invoice
potential loss of sale
possible stock write-off

Table 1 – Cost of mispicks (Richards 2014: 160)

These above elements are ones that would not only make it beneficial to the employee but to the employer to improve as far as time and energy saving, if there is so much benefit from modern solutions we need to review what indicators drive the change to more autonomy.

The need for study of Change Management and Warehouse management is apparent, in the next chapter there is a review of Warehouse Management and measuring productivity follows that.

4 Warehouse Processes

The introduction of warehouse management is important. Warehouse management will be the area of focus around technological upgrades and the resistance we may be seeing.

Due to the large nature of the topic of warehouse management the thesis will cover specific areas which involve: Order Picking, Warehouse Processes, Warehouse Management Systems, Warehouse Costs and Measuring performance.

Faber (2013: 4) agreed that the objective of warehouse management is to efficiently and effectively coordinate all warehouse processes and activities. Furthermore it's purpose is planning and control Planning is proactive and control

is reactive. Together plans and controls regulate outputs. Warehouses draw plans to make efficient use of resources.

In our research we will take fundamentals of warehousing to further understand how standard tasks can be improved upon with technology.

Warehouse operation is working as efficiently as it can without the use of technology and if there is a broken process a business should avoid automating this and to ensure you are at the stage you should consider the use of technology. The need for measuring productivity which attributes to indicators of the need for change. Also covered are the types of solutions that can be implemented as well as the process leading up to the implementation. (Richards 2014: 294).

The nature of warehouse tasks is robust and for that reason a focus on primary tasks which have the ability to be improved with upgraded technology is necessary to reduce costs. Products are in low profit contribution that are priority need a re-examing of logistics costs to see if there is anyway to improve profits. (Christopher 2010: 47).

The daily warehouse tasks that do contribute tremendously to warehouse processes include: picking, managing orders and locating products. Looking at tools that may remove 'non-value-adding' activities will improve processes and remove activities that do not benefit the customer. (Christopher 2010: 113).

One of the top priorities to avoid lost sales order cycle times. To meeting customer expectations, setting clear objectives and understanding customer requirements may have a business reassess service standards to which are set by the customer themselves. Competitive Benchmarking studies are to be conducted to understand objectives necessary. (Christopher 2010: 50)

A growing recognition of reducing time on tasks in supply chain can enhance customer service and reduce costs. (Christopher 2010: 63). The above processes can be improved by researching: Picking by Voice, RFID, Warehouse

Management Systems, and Automated Guided Vehicles. A focus on processes which improve efficiency whilst reducing costs and labour fatigue are paramount to this research.

4.1 Warehouse Management: Order Picking and the Adoption of AGV's

Order picking is a very standard business task but depending on how many daily orders you receive will drive a demand for change to decrease errors, improve pick rate speeds which will ultimately provide better customer satisfaction.

Islam suggests that thousands of picking lists are processed everyday in distribution centers. Each list has a variety of items and a varying quantity. Distance of picking can be reduced by categorising items effectively as well as using correlated data from purchase history. (Islam, 2023: 295)

It is important to keep descriptions of processes and have staff who understand their responsibilities. Improvement comes from simplifying processes and procedures. You can reduce costs by having processes aligned and working optimally, improving efficiency. (Richards: 2014: 161).

The below Tables will give an indicator of the Benefits and Drawbacks that come with each approach on picking and this will highlight the benefits and provide the motivation to want to upgrade solutions.

	Applications and Pick Rate	Benefits	Drawbacks
Paper Picking	<ul style="list-style-type: none"> • Most Operations • Low cost • <100 lines per hour • Little systems support 	<ul style="list-style-type: none"> • Low costs • Flexible • Quick implementation 	<ul style="list-style-type: none"> • Low pick rate • Not hands free • Low accuracy • Duplicated tasks

		<ul style="list-style-type: none"> • Isolate urgent orders • Picker decides path • Low maintenance 	<ul style="list-style-type: none"> • Not real time • Training takes time • Manual updates • Requires returning to desk for further instruction
Pick by label	<ul style="list-style-type: none"> • Most Operations • Low cost • <100 lines per hour • Little systems support 	<ul style="list-style-type: none"> • Low costs • Flexible • Quick implementation • Reasonably accurate • Low maintenance 	<ul style="list-style-type: none"> • Low pick rate • Not hands free • Duplicated tasks • Need to print labels • Not real time • Training takes time • Can damage the product • Requires return to desk

Table 2: Pick system advantages and disadvantages. (Richards: 2014: 161)

Though Pick by label has a low cost there are still a variety of drawbacks including damaging the product. Paper pickings drawbacks are quite substantial especially if the order demands more information then the picker would have to return to desk for more instruction not to mention it's not hands free, not real time and includes duplicated tasks. Summaratively of comparing these two methods a solution where you do not damage the product, you have higher accuracy and everything is in real time would be a solution to sort out.

	Applications and Pick Rate	Benefits	Drawbacks
Voice Picking	<ul style="list-style-type: none"> • Most Operations 	<ul style="list-style-type: none"> • Paperless • Flexible 	<ul style="list-style-type: none"> • Cost of hardware

	<ul style="list-style-type: none"> • Ideal for temperature controlled environments • 100-250 lines per hour • Heavy awkward items 	<ul style="list-style-type: none"> • Fewer processes • Improved accuracy • Quick training • Hands free/ eyes free • Improved training • Damage reduction • Real time stock 	<ul style="list-style-type: none"> • Difficulty in noisy environments • Requires system interface • Requires maintenance • Problem with multi SKU • Unsure of longterm health issues
Voice picking plus finger scanning	<ul style="list-style-type: none"> • Most Operations • Ideal for temperature controlled environments • 125-250 lines per hour 	<ul style="list-style-type: none"> • Paperless • High accuracy • Good productivity • Hands free/ eyes free • Less strain • Damage reduction • Can multi SKU 	<ul style="list-style-type: none"> • Cost of hardware and software • Requires barcode • Requires system interface • Requires international standards

Table 3: Pick system advantages and disadvantages. (Richards: 2014: 163)

Voice picking and Voice picking plus finger scanning are quite similar which include the benefits of them both being paperless, flexible, fewer processes, damage reduction and hands free. The plus finger scanning option has the ability to work with Multi SKU and can pick an additional 25 lines per hour minimum more.

	Applications and Pick Rate	Benefits	Drawbacks

Pick to light	<ul style="list-style-type: none"> • High volumes per individual item • Mail orders and ecommerce • 250-450 lines per hour 	<ul style="list-style-type: none"> • High accuracy • High productivity • High pick rate • Easy to train • Damage reduction • Real time stock • Hands free • Simultaneous picking 	<ul style="list-style-type: none"> • Cost of hardware • Requires system interface • Requires maintenance • System failure • Cost of maintenance • Low flexibility
Put to light	<ul style="list-style-type: none"> • Retail Store Operations • Cluster picking 	<ul style="list-style-type: none"> • High accuracy • High productivity • High pick rate • Easy to train • Damage reduction • Real time stock 	<ul style="list-style-type: none"> • Cost of hardware and software • System failure • Limited terms of product types • Cost of maintenance • Two stage operation
RFID	<ul style="list-style-type: none"> • High value goods • Items requiring traceability • 200-300 lines per day 	<ul style="list-style-type: none"> • Very High Accuracy • Real time stock update 	<ul style="list-style-type: none"> • Cost of hardware • Read distance very short • Requires international standards • Requires system interface • Cost of maintenance

Table 4: Pick system advantages and disadvantages. (Richards: 2014: 164)

The above figures show that RFID has less drawbacks than Pick to light with a major benefit of high production and traceability but is still not without it's

demands, as there is a need for a system interface, high cost of hardware, international standards and high cost of maintenance.

Equipment type	Accuracy	Approximate Cost
Radio frequency hand held terminal	<ul style="list-style-type: none"> • 99.3-99.5% 	<ul style="list-style-type: none"> • \$108,000
Radio frequency visual hand held unit	<ul style="list-style-type: none"> • 99.4-99.6% 	<ul style="list-style-type: none"> • \$120,000
Pick to light	<ul style="list-style-type: none"> • 99.5-99.7% 	<ul style="list-style-type: none"> • \$300,000 - \$425,000
Voice technology	<ul style="list-style-type: none"> • 99.7-99.7% 	<ul style="list-style-type: none"> • \$188,000 - \$280,000

Table 5: Cost and accuracy comparison with various pick technologies (Richards: 2014: 164)

The above figures are a great example of the advantages of using the new technologies. The breakdown in Table 4 shows the accuracies and the financial investment required which is particularly interesting when deciding from to upgrade paper picking to either the more affordable Radio frequency handheld or the Voice technology. From these diagrams we can see cost and accuracy are two major factors when considering upgrades.

There are pressures to reduce costs but also pressure to improve productivity and increase accuracy which causes a great dilemma for warehouse managers. If there were to be a resistance before making an investment into Technology Richards suggests for there to be a 3-5 year return on investment. (Richards 2014: 165.)

An example case of resistance to automation is at a UK-based fulfillment center. A UK-based fulfillment centre, has decided against large-scale

investment in automation to avoid a large amount of units sitting redundant for a large portion of the year. (Richards 2014: 166.)

Simulation software may just be key to overcoming resisting the fear of delving into an automated solution, by simulating pick types you can find which one is best for operations. Richards also recommends a thorough review of pick operations and review of future of operations. Furthermore Richards recommends to never automate a broken process. Ensuring a warehouse is working as efficiently as possible without technology, at this stage technology should enhance your operation. (Richards 2014: 167.)

Staff being on board is a major need and this will be reviewed in this document under Change Management.

Production in logistics has a difficult task of having to constantly deliver quality, increase efficiency in sorting, distribution, order picking processes. A dynamic approach is to use Automated Guided Vehicles (AGV's). (Böckenkamp, Weichert, Rudall & Prasse 2016: 397)

A tool use as a part of the picking process these days includes the use of Automated guided vehicles. AGV's handle the movement of goods to various areas within an organisations operation. Organising and optimising goods is known as intralogistics. AGV's are unable to negotiate around obstructions as it's the organisations responsibility to make sure these paths are not blocked. The objective of optimising AGV's is to keep paths that are working optimally and eliminate negative ones. Well planned intralogistics allows for quick adaptation of changes in stock levels. Simply AGV's optimise logistics processes whilst meeting growth demands. (Ullrich 2015: 18)

Mentioned in a Toyota Forklifts AGV Video (2019), Tim Meyer the Director of Automated Vehicles for Toyota mentions that they "The pallet truck AGV brings the next level of efficiency.. this vehicle can reduce 80% of the total costs"

The management of the flow of multiple AGV's is happening within the software at Toyota. This is also seen via the 2018 Megatrans Exhibition interview with driverless Forklifts, Neil Beveridge explains: "you can run 24/7 without any brakes, improve efficiency of the factory and saves on labour costs... The AGV is linked to master system... It also decreases product damage... the truck lasts a lot longer than a manual one would" (Toyota Forklift 2019).

An example of efficient picking is at RMFS. Wang states that Calculating different route strategies could save up to 20% of travel distance at Robotic Mobile Fulfillment Systems. This allows for more efficient picking. (Wang, 2022: 1).

Working in warehouse environments have been prone to stress due to demand of fulfilling orders, if these machines can help fulfill orders, safely after learning how these machines cooperate with staff, the acceptance should be smooth as less labour intensive work is necessary as well as less stress being compiled from delays.

4.2 Warehouse Management Systems (WMS)

Productivity is created through the use of a Warehouse Management System (WMS) this solution communicates with other warehouse systems. According to Waltz in Aron's article: Do you need a warehouse management system? The only business that doesn't benefit from WMS is a small business that can't justify the expense. If a business does choose to invest a WMS can offer complete inventory control.

A warehouse management system allows to track goods. Specifically the quantity of goods, the specific details about each product, supplier information, especially helpful when picking products finding specific product codes and where items are available.

Modern WMS Solutions will allow you to scan pallets with how many products are on the pallet, lot number and importantly expiration dates.

Before appointing a location for a pallet that goes out you first palletise the goods and wrap them. With this WMS you can give a specific order for these goods and an area where to find them this later links in with AGV's ability to find the goods ready for delivery.

Depending on the WMS Solutions ability you can scan lots and update quantity amounts on the fly, which may be important especially if linking availabilities in online stores.

Waste theft and shrinkage can also be handled through WMS. (Richards 2014: 189).

Introducing new technologies into your operation not only improves your competitiveness within challenging market it can also be instrumental in meeting ever-increasing customer demands.

Potential benefits of having a WMS in place
real-time stock traceability
improved productivity
accurate stock
reduction in mispicks
replenish automatically
reductions in returns
reporting accuracy increases
improved responsiveness

remote data visibility
improved customer service
minimized paperwork

Table 6: Potential WMS Benefits (Richards 2014, 290).

The above table lists almost every element necessary for an efficient and productive Warehouse. If a WMS was not working to its best ability the WMS would be an area of focus specifically to traceability, stock, reporting and improved customer service. This leads on to the next chapter discussing costs for consideration.

Producing an ROI report:

Involve finance to discuss the potential return on investment together with a ROI calculation you need to be certain of the following:

- Needing a solution that improves stock accuracy which will reduce errors, real-time information will allow to communicate live updates
- Increased productivity and financial savings, improved labour and equipment utilisation
- Traceability
- Warehouse control, Picking and dispatch accuracy is also an area of focus

(Richards 2014: 194).

4.3 Warehouse Management: Warehouse Costs

In and chapter 3 of Logistics and Supply Chain Management: Christopher, M argues that: 50 percent of a company's assets are tied up in inventories and the use of good operations minimise the need for inventory. (Christopher 2010: 60).

True cost of Inventory
<ul style="list-style-type: none"> • Loss of profit • Storage and handling • Obsolescence • Damage • Insurance • Management expenses

Table 7: True cost of Inventory (Christopher 2010: 70)

There are many costs that may not be first recognised above depicts costs that occur and also drive a demand from improved processes to widen the EBIT.

To understand the resistance of investing in other upgrades we need to understand where some of the expenses are going. According to Warehouse Management the following are Warehousing costs:

Space Costs	rent and leasing insurance government taxes utility and communication expenses fixtures and fittings depreciation racking depreciation refrigeration plant depreciation
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	maintenance cleaning and security waste disposal
Direct labour costs (fixed):	wages including on-costs personnel insurance safety wear personal protection equipment (PPE) welfare training
Indirect labour costs (fixed):	wages including on-costs insurance safety wear (PPE) welfare training
Labour costs (variable):	overtime, bonuses
Equipment costs (fixed):	depreciation/lease costs/rental costs
Equipment costs (variable):	running expenses packaging overhead salaries company vehicles office equipment and furniture rental costs IT costs (hardware and software)
Overhead costs (sales and marketing in 3PLs):	salaries and on-costs accommodation company cars and running costs marketing spend

Table 8: Shows variety of Warehouse Costs (Richards 2014: 278)

The above proves there is a need for improvement of efficiency. Cash flow can be affected by order completion rate as invoices cannot be issued until the goods are despatched. (Christopher 2010: 60). Ultimately when goods are delivered to the customer faster then the invoice payments can be made faster.

Return on Investment (ROI)

There is a major play on the perception of resistance and there being an actual point of demand in which resources are utilised and the demand for upgrading technology is reached. Richards also provides an exact formula to calculate ROI of upgrades:

The calculation of ROI percentage is as follows: $(\text{Gain from investment (or savings)} - \text{cost of investment}) \div \text{cost of investment} \times 100$ (Richards 2014: 280).

Warehouse managers can allocate costs effectively to things like third party fees by understanding warehouse operation costs. (Richards 2014: 292).

When making any upgrade in a business there can be significant costs, for arguments sake let's say this business has an established organisation with enough resources and acquired skills, there would then only need to be a shift of time and energy spent within staff. For many established businesses they are looking for a way to save costs through this new technology.

According to IBM Global AI Index 42% of businesses need to reduce costs and improve efficiency. (IBM Global AI Adoption Index 2022).

A major upgrade in a warehouse would be to it's WMS the below are how you can break down the costs: Licence, the monthly/yearly or outright costs, Professional services: training and support, Development costs integration to third-party systems Support, Hardware costs then you should sum the costs from year 1 to 5. (Richards 2014: 194).

5 Measuring Productivity

Measuring productivity will give a realistic view point of how long activities actually take to undergo whether it be by advanced technology or manually

handling. Reviewing optimal levels to which current resources of labour and MHE (Material handling equipment) that is at hand. As previously mentioned Richards says once all things you have are being utilised only then should you consider additional technology. Knowing what areas need improvements allow for upgrades and with customer service in a competitively demanding environment it won't be long before a business needs to improve it's service areas.

5.1 Why do we need to measure?

Ultimately in business there is a need to achieve customer satisfaction and avoiding taking losses and the reduction of productivity. We measure to make sure that there is a culture of continuous improvement, discover issues before they become major problems, train staff properly and reward staff properly. (Richards 2014: 269)

Furthermore if we do not without measuring we are at risk of some major problems: inventory requires extra stock for just in case moments, departments have to handle complaints, extra deliveries and collections need to be arranged, duplicate activities in the warehouse, more returns and write-off's, additional training, loss of products and customers. (Richards 2014: 269).

5.2 What do we need to Measure?

According to Richards in short we need to be measuring reliability, flexibility, cost and asset utilisation. The end goal is to meet with Retailer KPI's as well to give the correct customer satisfaction. Fill rates, accuracy and on time delivery is how you provide reliable service. An order's cycle time is the best measure of flexibility (covering the customers order process). Cost management is costs as a percentage of sales and productivity against labour hourly costs and lastly Asset utilisation is efficient use of warehouse space, staff, Material Handling Equipment (MHE) and storage equipment. (Richards 2014: 294)

Competitive prices come from operations which do not cost excessive amounts to operate. High performance companies operate in the following fashion: Customers are served fast and efficiently, no distractions to operation, flexible operations mean if one area is affected that another is not.

(Richards 2014: 295)

To improve productivity you need to measure how tasks are done in the Warehouse below is an example of so.

Name:						
Shift: No 1						
Area:						
Day: Monday 1 st Dec 2023						
Task Desc	Start Time	Finish Time	Volume	Lines per order	Equipment	Measure
Pick order 123456	8:45	9:03	"x" cases	4	PPT	"x" cases per hour
Pick order 123498	9:05	9:30	"x" cases	5	PPT	"x" cases per hour
Stretch Wrap Pallets	9:31	10:07	"x" Pallets		S/W Machine	"x" pallets
Load Trailer	10:08	10:38	"x" Pallets		PPT	"x" pallets

Table 9: Manual record of work (Richards 2014: 298)

To have an accurate measure, measuring should occur at different stages by different people.

When measuring activities you also need to take into account the following:

Time for preparation. This could include collecting, preparing paperwork and pallets. Human factors such as fatigue and abilities should also be considered.

Mechanical and operational factors also need to be considered. Also to consider is a good amount of time could be spent on the areas you may not usually factor in. (Richards 2014: 298).

5.3 Balance Scorecard

There is a need to balance the level of customer service with the cost it takes to provide that service. A business needs to monitor the delivery of the perfect order and what it costs to make that happen. It's ultimately customer expectations versus company resources.

A realistic approach needs to occur when providing customer satisfaction as there are some factors that will affect the perfect 100% score meaning this can at times just be an idealistic target and not achievable. For example having sufficient inventory on that particular day (Richards 2014: 312).

This realistic perspective also provides the demand for tracking balance. Warehouse managers have a number of inputs to and resources under control including labour and Material Handling Equipment. (Richards 2014: 295).

5.4 Benchmarking

Globally used Benchmarking is a popular management tool to improve performance by identifying and applying best practices. Externally measure processes, practices with competitor and the best companies with operations of similar activities. (Bogetoft, 2012:1)

The concept of KPI (Key Performance Indicators) are used a lot in Benchmarking. Benchmarking uses a variety of ratio equations to give a compared value. One example of a ratio used within Benchmarking is comparative advantage model where you divide the benefit by the cost. (Bogetoft, 2012:144)

With the Mondelez benchmarking tool from page 311 of Warehouse Management an operator could take compare this table with competitor

business with similar space and layout and compare output values for comparable solutions.

6 Technological Upgrades

After reviewing a variety of different picking methods this chapter will review more specific features of RFID and picking by voice. This chapter also explores disadvantages as well as reaching customer service benefits through improving areas and why organizations are making the efforts to do so.

6.1 Improving Efficiencies

Future of supply chain is traceability, transparency and safety. Richards early mentions only once your resources are being used completely only then should you invest in technological upgrades. Traceability is always necessary in Warehouse Management as well as data accuracy and as well as accurate transport of goods.

We have seen the drawbacks and benefits of upgrading to RFID from paper picking in chapter two is just one of many examples.

There are many benefits to upgrading technology, ultimately important is customer satisfaction to drive repeat sales and ensure businesses future success, IBM explains why organisations have turned to automated software and tools.

Why are organizations turning to automation software or tools? (IBM Adoption Index 2022: 17)

46% Greater efficiencies in IT

46% Drive business operations

45% Finance savings

- 39% Employees can focus on more important work
- 30% Anticipating technical mishaps
- 27% Improving employee skills

According to IT professionals fields are considering using automation for more efficiency and better processes, many countries justify the upgrades just because of the financial savings. (IBM Global AI Adoption Index 2022: 17)

Through Robotic Process Automation (RPA):

One of the ways of improving efficiencies with technology is through RPA robotic process automation. In *The Digital Transformation of Logistics* M. Sullivan mentions:

DHL is one of the largest logistics providers across the world they have seen massive returns through time savings of the RPA bots which has saved 5000 hours of manual work and 30000 hours saved globally with pilot programs rolled out. (Sullivan 2019: 71).

Automating Picking

You may be within your resources in smaller operation but as business grows to say 3000 units per day it is worth considering automating. This will increase accuracy, speed and productivity which is important for the warehouse manager. (Richards 2014: 105).

Richards states the following improvement from automating picking:

Automation advantages
Reduced space requirement
Aisle systems (High and narrow)
Higher density storage
Lower energy requirements
Improved control
Labour and energy savings
Minimum supervision
24/7 operating hours
Product security
Safety
Storage
Integration
Coordination of product flows

Table 10: Automation advantages (Richards 2014: 105)

The next section discusses tools that can improve logistics and warehousing efficiency.

6.2 Upgrading Technology

As mentioned we upgrade technology to improve customer service which can be defined as the consistency provision of time and place which means products don't have value until the customers have them in their hands. Service means on time delivery and aftersales support. Once 'value in use' occurs the business will have a competitive advantage. (Christopher 2010:22).

6.2.1 RFID

RFID is a major warehousing upgrade at the moment which allows a scanner to detect what a product is using a small antenna inside of a cost effective disposable label. Passive RFID readers can automatically detect when a package leaves it's designated area for a live update in stock, monitoring happens in real time so you know when to upgrade supplies. (RFID Smart Zone — Smarter Inventory Management, 2019, SLS RFID Solutions: Youtube).

When it comes to product handling in the daily processes of warehouse picking and the use of RFID it is concluded from Karagianaki that there is less need for frequent identification of products in a highly automated warehouse where a large number of tasks are manually handled and employees need to make sure the product is correct before moving forward. (Karagiannaki, 2011: 13). This means with the use of RFID a work can make decisions with confidence handling which will improve a processes momentum without the concern of sending the wrong product which will ultimately cost the business financially and in customer satisfaction.

6.2.2 Picking by Voice

Voice technology is an upgrade warehouses have been undergoing globally, especially for picking. Many companies have bypassed barcode scanning and went to voice.

Voice came out over 20 years ago for cold storage where gloves made it difficult to use scanners or paper. Voice improves, accuracy, productivity and the reduction of paper, errors, damage, it also provides real-time updates leading to accurate replenishment, updates on shortages. Two major take aways is that there is a quick ROI and easy integration to systems and reduced training times. (Richards 2014: 140).

6.2.3 Upgrading Sorters

Large warehouses have utilised conveyor belts and sorting machines for the handling of units throughout production and have found significant savings in upgrading their sorting technology. Though an initial investment may cost \$5 million with the right foresight you will see a great return within a few years and have a more functional asset. A great example of return on Investment in a large scale upgrade was mentioned in *World-Class Warehousing and Material Handling* by Frazelle with a sorter investment which cost \$5 million and yielded \$3.4 million in annual savings additionally interesting was the fast payback period of 1.47 years. (Frazelle 2016: Chapter 6)

6.2.4 SaaS

There are affordable warehouse management softwares available but are the SaaS available which offer ways of automating the warehouse?

Companies that have identified a need for a WMS but do not have the capital to spend on a stand-alone system are turning to alternatives.

Software as a service (SaaS) is an internet-based software hosted on secure servers by a third-party. The owner of the online software appoints accounts to different users for a fee.

The advantages are as follows: lower cost of entry, reduced start-up costs, instant upgrades, user-driven innovation. (Richards 2014, 199)

6.3 Disadvantages of Upgrading Technology and Automation

Automation takes a great deal of preparation and time as well as implementation. Automation has its place; however, there are a number of disadvantages. Firstly to mention is when you invest the money for the upgrades it may have been invested elsewhere, then once you have invested you may need to invest further into building, equipment and IT. One of the

biggest problems is the operations once automated are solely reliant of the employed technology. Additionally random units need to be sorted separately, there is a need for more checking and higher cost of disposing of units.

(Richards 2014: 116).

RFID Challenges

The first challenge is people hesitate to make the initial purchase of the hardware (readers and tags) or the software it takes to run the solution. It's important to study what the return on investment would be with the RFID Solution. RFID is a confusing technology. (RFID Trends and Challenges – Tech Made Simple 2022)

6.4 Improved Efficiencies – Expert Concept of Future Warehouse

The concept of a warehouse of the future incorporates the following elements: RFID readers through the products incoming, storage and sale process. (Warehouse Management, 384).

The future use of RFID readers where a pallet tag has a unique EPC code. The WMS can retrieve goods via voice where repetitive movement is replaced with AGV which follows the WMS' set path to retrieve the goods. When wrong quantity is picked corrective action takes place at the pick location where the problem can be resolved with minimal disruption. Which means high levels of accuracy, no wrong locations, reduction in pick times, less stress, higher pick rates, saves energy and many more benefits. (Richards 2014: 384.)

Focus on future supply chains will focus on using less resources but are more flexible and can serve local markets. (Christopher 2010: 267).

Modern technological solutions such as RFID, WMS and Voice picking will provide more efficiency and more control, less costs which will allow businesses

to be able to deliver a competitive advantage of value in the hand of the consumer faster.

7 Implementation

7.1 Implementation: Building teams who build change / Change Management

There may not always be a resistance there may just be inaction caused from an overwhelming amount of subtasks that may demand varying skillsets that not just one individual has with this in mind we need a way to form a team and understand goals of the individuals who are working on the overall project.

Change Management (Lauer 2021: 180) reviewed a case study within the Toll Group case seeing a need for decentralisation. Corporate Finance Institute (2023) argues that centralization is where activities including planning and decision-making are given to a specific leader.

When developing their should be a shared load of work rather than one person to which rolls out all changes. Additionally the most capable people should always be appointed to projects, not those who are currently available.

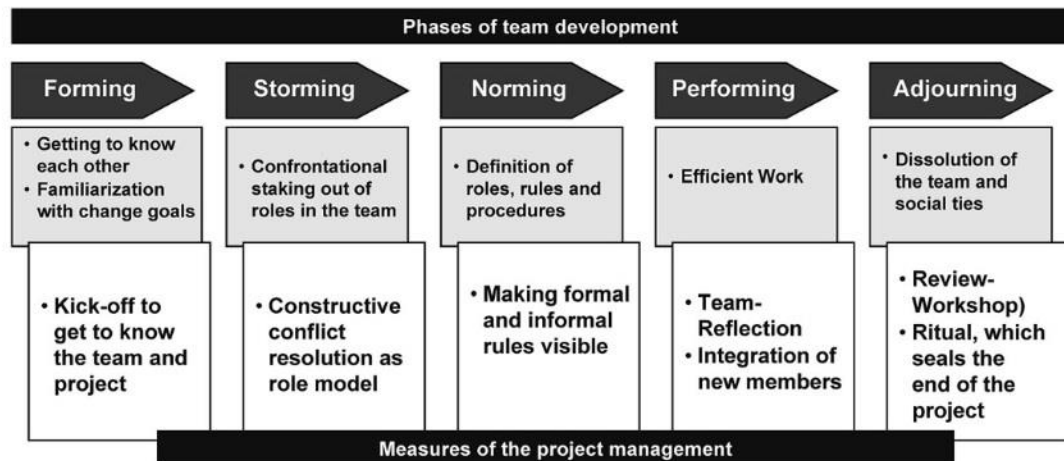


Fig. 12.3 Phases of project team development (Own illustration, contents based on Bohinc (2012), p. 33 f. and p. 62 ff.)

Figure 1 – Team development phases (Lauer 2021: 200).

The right amount of motivation and acceptance is needed for a team project. It's observed that not always the most capable individuals are appointed in a project but those are available after other have been appointed. A candidate description should be created to sought the best possible candidates for the project. Making sure individuals are accepting to the project and have a fair timeline is important to avoid resistance of desired upgrades. (Lauer, 2021: 200).

7.2 Implementation: AGV Solutions

Having a self moving machine operating in a busy warehouse should merit some safety concern for staff. Sullivan mentions: using advanced sensor and collision avoidance systems AGV's avoid collision with other objects. The more connected the factory, the better the integrated GPS within the AGV will be able to recognise, in real time, nearby moving objects and their surrounding environment. (Sullivan, 2021: 199).

Connectivity is key for AGV safety and collision avoidance but furthermore for flexibility and navigation capabilities.

Valio Cheese factory has an example case of an AGV that has been implemented. Terhi Rasanen (Marketing and Communications Manager, Rocla) states: "They are intelligent, they are moving around in areas where there are manual forklifts and people, and they get along with everybody, that's the great thing about them." (Rocla 2016). Jarno Pajunen states that: "of course, forklift drivers they are professionals, but they have bad days, and these guys they don't have bad days". (Rocla 2016).

7.3 State of Digitalisation in Logistics

The logistics industry is the infrastructure including seaport, airports and warehousing. Automation can lead to reduction in operational costs within labour and increase safety whilst cutting operating costs by 25-55%. Depending on the goals of seaports it may be likely that up to 55% reduction of expenses may outweigh the decrease of maximum 15 percent productivity which is a double incentive to adopt to new technology and tools. (Sullivan 2019: 365).

Logistics trails behind the digital curve due to fragmentation and poor transparency. This leads to the need to update operations and innovate around business transformation and change management. (Sullivan 2021: 275).

This can further be seen in Toll Group's example case from the same source: In September 2019, Vikram Cardozo presented during a team conference in Torquay, Australia: Toll's new customer promise which was based on customer demand. Customers demand the best from them so they wanted to show their passion for logistics, dedication to operational excellence, and drive for innovation. (Sullivan 2021: 289).

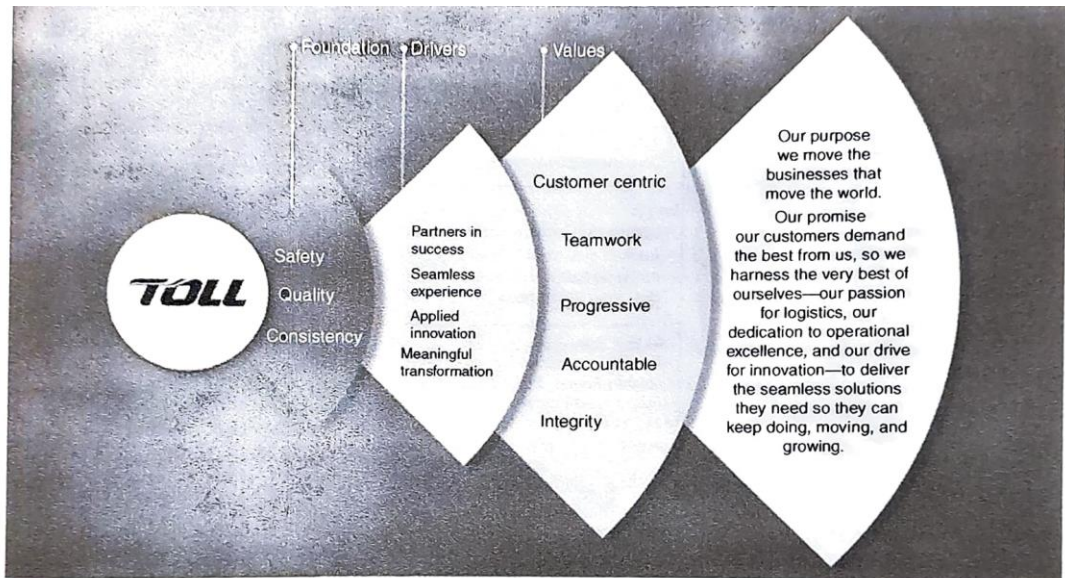


Figure 20.3 Toll purpose and promise. *Source:* Slides Toll Leadership Conference 2019 – Making it Count Our values and behaviors – presented by Vikram Cardozo. © 2019, Toll Holdings Limited.

Figure 2: Depicts Tolls Purpose and Promise (Sullivan M 2021: 289).

The above image depicts Toll's Values and Behaviours in 2019. Sullivan mentions based on an extensive series of interviews with customers, employees, and other stakeholders, and with the help of an external agency, Toll revised both brand and values as well as foundational elements brand drivers, and its values... Toll's employees to move forward and be successful:

Firstly moving forward there is a focus on: large infrastructure projects, new systems, and safety and compliance, together with strong central control whenever results were disappointing. The second point is the emphasis on cost and EBIT had diminished Toll's customer focus. The last point is the operational excellence and cash management had undermined day to day operations which included a lack of appreciation for expertise in areas like customer service. (Sullivan, M 2021: 289).

The above 3 points are examples of where the need for competence of IoT trained employees come in to raise to upper management regarding the lack of

customer satisfaction around: The need for decentralisation, areas systems could improve to improve customer satisfaction. (Sullivan, M 2021: 289).

290 | Organizational Culture Change

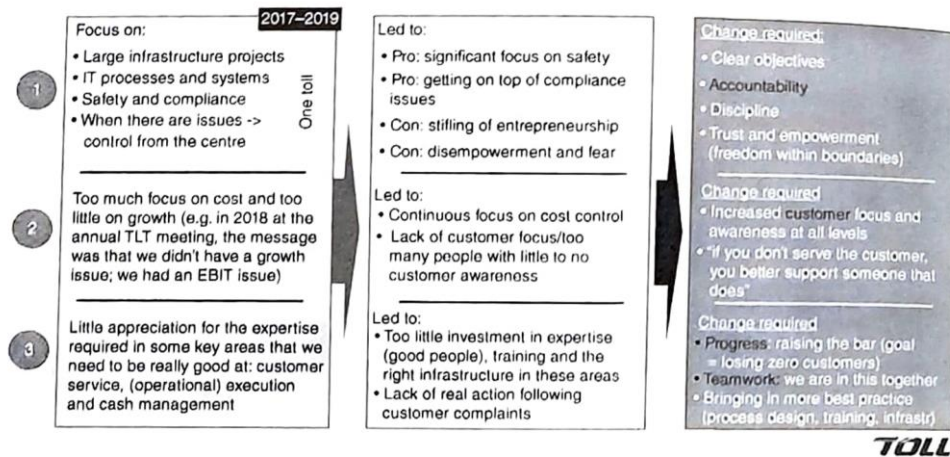
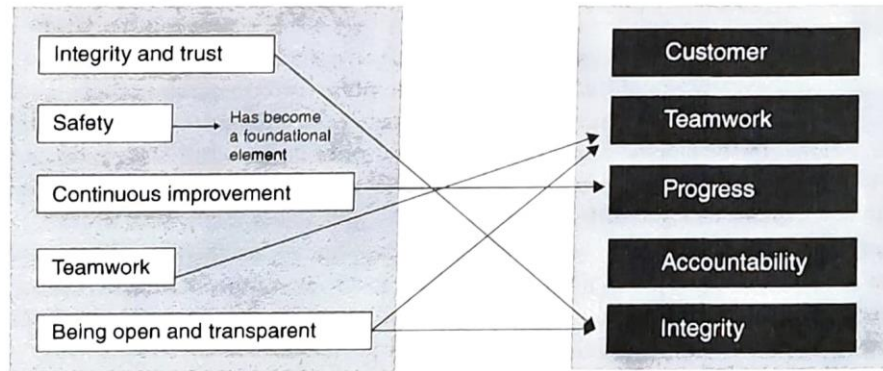


Figure 20.4 Business reasons for Toll's organizational culture change. *Source:* Training materials new performance management system, Toll Group (2020). © Toll Holdings Limited.

Figure 3: Business reasons for Toll's organisational change. (Sullivan 2021: 290).

The above figure mentions that for this particularly large logistic enterprise some of the most important change required is process design, training and infrastructure.



Becoming highly customer focused is essential for our future success

TOLL

Figure 20.5 Differences and similarities in old and new values.

Figure 4: Differences and similarities to old and new values. (Sullivan 2021: 290).

There is a need for retraining internally. Upper management needs to be aware of who is the most skilled for what projects. The overall drive to change technology comes back to customer satisfaction and the need for faster processes.

According to Heather Stagl resistance to change can be seen like a symptom of a virus as you can see a reaction but don't see the source of the problem. It is not always visible. A minor inconvenience is in fact a major disruption or the fact an employee may be too embarrassed to ask for help. Not always seeing the negative signals a boss sends. Not always seeing that slowing things down is a way to control the situation. (Heather Stagl 2015).

Understanding the need for progress comes with a need for training, within that training there is a large need for an individual to be able to be vulnerable about their concerns regarding the change, leadership also needs to be courageous in approaching the new updates with being the first to understand the new ways of operation as the confidence will trickled down the organisation.

Cultural factors around ways of working has a need to be explored. An inclusive business with good relationships, a strong team ethic and understanding leadership with a willing demeanor when it comes to training is far more likely to have fruitful results sooner than one that is toxic with no training or help.

Not only does the proper training allow an employee to complete their work they will make the business more productive and more profitable.

As listed in IBM Adoption index, many businesses are reskilling staff which is needed to keep up with the complexities of coding and allowing softwares to communicate with one another.

AI is still in need of skills for it's adoption. One in three businesses reskilling employees to work with AI and automation software and tools. More evident in larger companies you can see an increase in time saved. Professionals in Information Technology across many countries are suggesting for the adoption to automation software and tools. (IBM Global AI Adoption Index 2022).

Benchmarking is the best way to measure your previous business wins to your current progress. Within the process of reviewing other companies scorecards you are likely to see the use of better machinery in the areas of higher productivity. Benchmarking scorecards are an indicator of how operations and upgrades can improve efficiency. Happier customers is the biggest benefit of upgrading technology, IBM Adoption Index 2022 explains the benefits:

What benefits are organizations gaining from using AI to automate IT, business or network processes?

54%	Cost savings and efficiencies
53%	Improvements in IT or network performance
48%	Better experiences for our customers
46%	Employees are freed to focus on higher value
41%	Delivering and scaling new services more quickly
39%	Mitigating labor and skills shortages
33%	Reduction in outages
28%	Reduction in data center emissions

Figure 5: Benefits from adopting AI (IBM Adoption Index 2022: 19)

Additionally is what people are looking to gain from adopting new technologies.

Types of automation software or tools are organizations are using	
80%	Integration of applications
78%	Network performance management
76%	Business process management (BPM)
73%	AI for IT operations (AIOps)
73%	Application performance management (APM)
74%	Application resource management (ARM)

72%	Process and task mining
72%	Observability
65%	RPA

Table 11: – Benefits to gain from adopting AI (IBM Adoption Index 2022: 19)

7.4 Understanding Resistance as a concept and the Resistance to Upgrading Technology

A large factor to understand is when change occurs there is a demand for communication and when things are communicated there is always a chance for misinterpretations to occur. Communication is not only a success factor it can be a failure as well. Communication is always open to interpretation Lauer states: “in the case of misinterpretation can lead to misunderstandings and consequently to conflicts.” (Lauer 2021: 119).

Resistance is a heavy factor of consideration in this research. Understanding more of how it occurs is important and finding a way around resistance may be the first step forward to a new way of thinking when approaching automating the office and warehouse.

Resistance arises from failed communication processes. (Lauer 2021: 122).

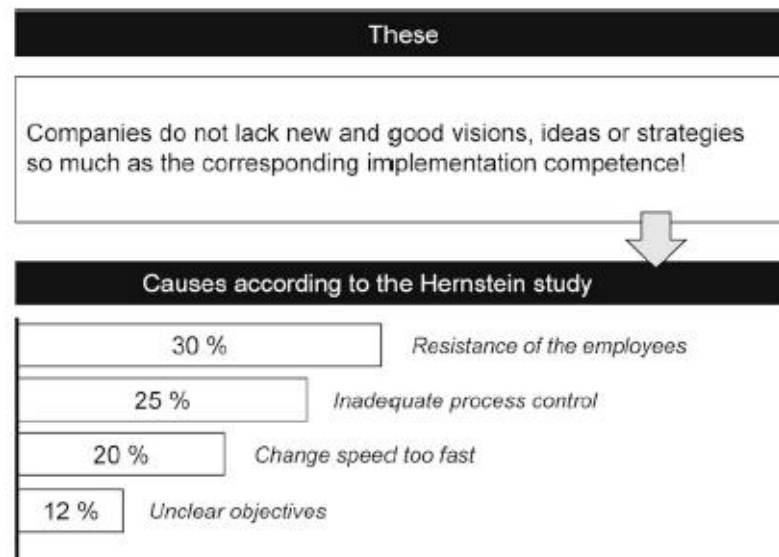


Fig. 4.1 Causes of failed change (Source: Hernstein study, cited from Schott and Wick 2005, p. 196)

Figure 6: Causes of Failed Change (Lauer 2021: 46)

It is not only employees but middle management that are critical to a changes success (Lauer, 2021).

Involving employees and communicating effectively is key to avoid resistance to and business project.

7.5 Cobotics Interview and Questions

Interview response is to be interpreted qualitatively to help form a perspective regarding implementation of a modern efficiency driver.

Cobotics is cooperative robotics which allows computers to work alongside humans. Cobotics is also another way to improve efficiency in the warehouse or primarily used in manufacturing taking away tedious tasks from employees.

After being introduced to Cobotics previously by Lauri Ristolainen who is an Engineer at Metropolia's Robotics Laboratory, the idea to interview some questions around the installation and need areas of Cobotics was asked.

In an attempt to understand installation times and need areas the following questions were asked:

- Where could cobots be involved?
- How long does it take to set up a Cobot?
- How safe is cobotics?
- Where could cobots be used?

After conducting an interview with Lauri Ristolainen from Metropolia's Robotics Laboratory at Metropolia Myyrmaki Campus in 2022, I intend to explain the benefits of cobotics and the benefits of this upgraded technology.

In overview of finding from the interview with Lauri Ristolainen states that:

- When asked about the safety of Cobotics, Ristolainen states: "Cobots can work at the same desk as humans." (Lauri Ristolainen 2022)
- "More employees is subsequent of the growth of a company to which cobots make more productive e.g. staff should not fear cobotics but embrace the security cobots bring." (Lauri Ristolainen 2022)
- An interesting perspective from Ristolainen once asked about the debate of robots taking jobs "Robots take away unergonomic tasks." (Lauri Ristolainen 2022)
- In asking Lauri where cobots could be involved right now: "Mechanical workshops already have drilling and milling machines but humans are feeding the machines the material, this is where cobots could be added." (Lauri Ristolainen 2022)

- “The drilling machine could communicate with the cobot to open the door for example.” (Lauri Ristolainen 2022)
- Who else uses cobots? “Samsung use cobots for packing phone holders into the boxes.” (Lauri Ristolainen 2022)
- How long would it take to set up a cobot? Lauri mentioned from his experience “Taking the cobot out of the package, once you understand the programming. It can take no longer than 2 or 3 days to change movements of the cobot. It can take 2 to 3 weeks to make a cobot interact with third party software and machinery.” (Lauri Ristolainen 2022)

This interview provides a new perspective on how quickly an automated process can be initiated but also provides insight on the need for research around ongoing maintenance and development.

7.6 Implementation Challenges

We have found that there may not only be a resistance to change but a resistance to development, interestingly there are many factors that allow for the best project completion (Including implementing new technologies). For instance an employee may have fictitious or emotional conflicts or even conflicting goals. Furthermore to handle the resistance that may occur in development: The project manager should set realistic interim targets from the beginning. (Lauer 2021: 195).

These targets may just be necessity when breaking down the tasks at hand.

Modern Warehouse Management Systems are difficult to integrate but if done correctly there will be cost reductions, better product quality and customer satisfaction is found. WMS should have training material available and these systems should link effectively with others. (The Digital Transformation, Sullivan M, 2019: 135-136).

Initial costs and confusing technology can scare away potential buyers. (RFID Trends and Challenges 2022).

7.6.1 Factors for Consideration before Implementing a WMS System

As one of the largest upgrades in the warehouse we can use a WMS upgrade as an example as to the variety of factors necessary. Richards provides factors for consideration when upgrading:

- Ability to integrate with other systems (Accounts, ERP, MRP and Transport management systems) Necessary for order entry, inventory control, invoicing, the system needs to communicate with automation systems, conveyors and MHE as well as the latest picking systems
- Modular system where it's prebuilt and you pay for functionalities and add-on later
- E-commerce integration
- Reporting capabilities
- Ease of use
- Tasks crucial to business (Expiry date fields etc)
- Automated receipt, directed put-away, optimum pick sequences, replenishment, despatch management, slotting and warehouse mapping.
- Meets current and future needs but excessive functionality adds to time wastage, training cost and poor return on (Richards 2014: 195)

8 Analysis – Key Takeaways

This chapter will cover key areas of importance including: Measuring Productivity, Warehouse upgrades and Calculating ROI. There are a variety of key takeaways to be listed summaritively here: The importance of measuring: measuring will allow to contribute to planning for change. Understanding all your current and future goals matched with compatibility and a 2-3 year ROI within a plan that can be rolled out with effective communication with all affected parties involved in the upgrade.

8.1 Measuring Productivity

As we found earlier measuring makes sure that there is a culture of continuous improvement, discover issues before they become major problems, train staff properly and reward staff properly.

Richards used great examples of the tools being used to drive the demand for upgrades in measuring productivity, benchmarking and keeping a balanced score against competitor businesses.

FIGURE 8.1 Advantages of quality information (used with permission of Tompkins Associates)

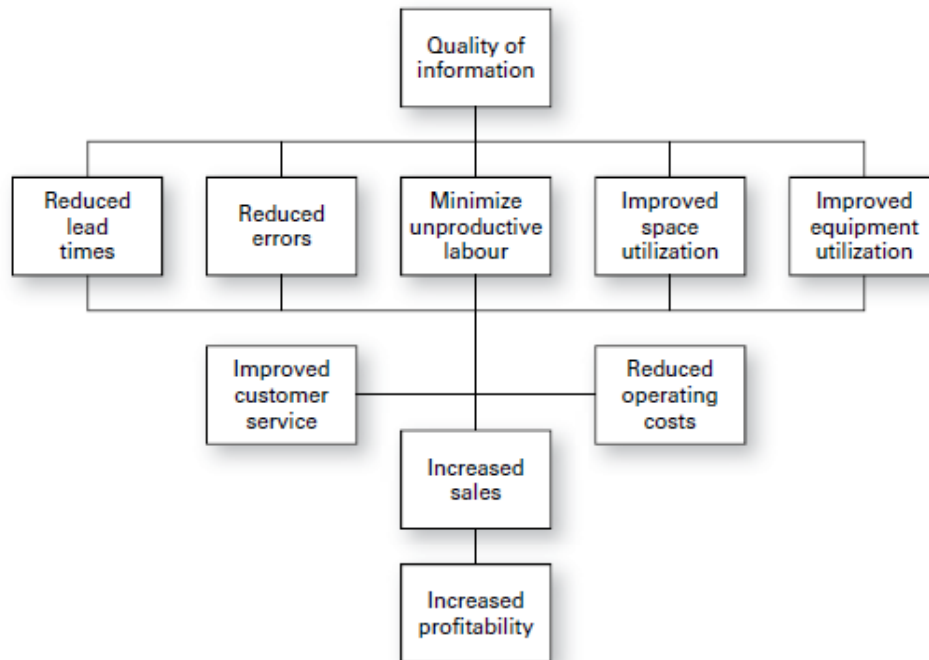


Figure 7: Benefits of quality of information (Richards 2014: 190)

8.2 Warehouse Technological Upgrades

After the reviewal of the literature we found a strong need for following indicators that propel the need for upgrades, as well as the proper due dilligence in reviewing factors before implementing new technologies. Areas of focus for upgrades were WMS, Voice Picking and AGV.

WMS: When upgrading the warehouse management system it is important to involve finance and make sure of specific factors that are required for current and future needs.

Benchmarking is the best way to measure your previous business wins to your current progress. Within the process of reviewing other companies scorecards you are likely to see the use of better machinery in the areas of higher productivity. Benchmarking scorecards are an indicator of how operations and upgrades can improve efficiency.

Voice Picking is very fast to train staff, you have a way of performing tasks as fast as you can speak and there is less damage.

Improving sorting machinery: Though there is a heavy investment cost, with the right foresight you can make you return in the first few years and have more productive solution that receives more profits.

Happier customers is the biggest benefit of upgrading technology, IBM Adoption Index 2022 explains the benefits:

What benefits are organizations gaining from using AI to automate IT, business or network processes?

54%	Cost savings and efficiencies
53%	Improvements in IT or network performance
48%	Better experiences for our customers
46%	Employees are freed to focus on higher value
41%	Delivering and scaling new services more quickly
39%	Mitigating labor and skills shortages
33%	Reduction in outages
28%	Reduction in data center emissions

Figure 8: Benefits from adopting AI (IBM Adoption Index, 2022: 19)

Additionally is what people are looking to gain from adopting new technologies.

What types of automation software or tools are organizations very or somewhat interested in using?

80%	Integration of apps and data
78%	Network performance management
76%	Business process management (BPM)
73%	AI for IT operations (AIOps)
73%	Application performance management (APM)
74%	Application resource management (ARM)
65%	RPA

8.3 Calculating ROI and Indicators to Upgrade

If a businesses values are to best serve customers than a part of customer service is the time in which a functional result is given and a part of that is the businesses processes, once processes have been brought forward to softwares than further progress of linking API systems to communicate amongst each other, than further more staff that recognise this and challenge what is currently in play while having the competence to avoid business disruptions being able to avoid implementation challenges while also cooperating with upper management to be able to work on the production for new tools that serve alongside the daily routine.

One of the considerations when adopting IoT is the acceptance of RPA which is Robotic Process Automation, this will allow employees to focus on more stimulating growth related tasks rather than repetitive tasks, not only this but accuracy and work hours can be saved. Sullivan concluded 55 automatic bots were developed and Konica Minolta could save around 19,000 hours in 2018 and expected to save 33,000 hours in the following year. (Sullivan 2021: 65).

8.4 Challenges and Benefits of Upgrading Technology in the Warehouse

There is no universal approach for change and how to best manage change, additionally there's no simple recipes for competitive success, the strategies should be sensitive and adaptable (Lauer 2021: 230).

Warehouse work is an exhaustive practice, having the correct tools (WMS and MHE) in place not only makes workers jobs easier it's end result is happier customers and a more profitable business.

Challenges in supply chain include traceability, accuracy (understock) and efficiency (Full utilisation of resources and increasing throughput)
Understanding the point in which you should invest and anticipating a ROI within 1 – 2 years.

Disadvantages of automating: Automation has its place; however, there are a number of disadvantages. These include:

- High investment costs: building, equipment, information technology, consideration of where else the investment could be utilised
- Everything reliant on technology
- Manual handling for random units and more checking
- High cost to remove units
- Lack of flexibility.

Understanding an approximate cost is important as you will then be able to compare this to it's potential savings and additionally productivity from the improvement of the new equipments estimated accuracies.

Equipment type	Accuracy	Approximate Cost
Radio frequency hand held terminal	<ul style="list-style-type: none"> • 99.3-99.5% 	<ul style="list-style-type: none"> • \$108,000
Radio frequency visual hand held unit	<ul style="list-style-type: none"> • 99.4-99.6% 	<ul style="list-style-type: none"> • \$120,000
Pick to light	<ul style="list-style-type: none"> • 99.5-99.7% 	<ul style="list-style-type: none"> • \$300,000 - \$425,000
Voice technology	<ul style="list-style-type: none"> • 99.7-99.7% 	<ul style="list-style-type: none"> • \$188,000 - \$280,000

Table 4: Cost and accuracy comparison with various pick technologies (Richards: 2014: 164)

With the Mondelez benchmarking tool from page 311 of Warehouse Management an operator could take compare this table with competitor business with similar space and layout and compare output values for comparable solutions.

8.5 Recommendations

Within this study there is an array of valuable insights, tools and suggestions of how to approach upgrading technology.

Utilising improved tools and technologies like effective WMS that comes well documented and is well integrated. Additionally RFID will allow for less manual handling which may be happening every hour within a warehouse operation. RFID will also improve traceability, improving productivity, improving customer order cycle time and ultimately the sooner invoices can be paid.

With a heavy focus on the end consumer having a readily available product will provide a competitive advantage before getting to this point measuring results and benchmarking will help get to this point.

Benchmarking is the best way to measure your previous business wins to your current progress. Within the process of reviewing other companies scorecards you are likely to see the use of better machinery in the areas of higher productivity. Benchmarking scorecards are an indicator of how operations and upgrades can improve efficiency. Happier customers is the biggest benefit of upgrading technology.

It was mentioned by Richards it is important to approach the finance department to arrange the ROI after understanding current and future needs as well as an assortment of compatibility factors before initiating an upgrade.

It's important to note further research should be conducted in other areas of warehousing processes to explore specific sectors of specific cases so that efficiency can be improved. Specific use cases will provide more information on areas that could adopt efficient technology. E.g. Small picking operation could utilise RFID, Voice Picking and Paper picking with 20 picking lists and ultimately calculate if these methods would alleviate labour costs due to the improved order cycle times.

Further study into Mondelez Benchmarking tool and sharing of balanced scorecards with successful businesses operating similar solutions of interest will provide potential valuable insights to increase business technological performance.

Whenever you upgrade you should incorporate future growth plans and the considerations that follow, for example you open a new warehouse with a need for more products where systems are integrated what software's are to be invested, what are their limitations and overall costs. Going with a modular software solution will avoid too many unforeseeable costs for instance. The right WMS will increase control, accuracy as will RFID and this can be presented to the board as well as the ROI report.

9 Conclusion

This study set out to find ways that a business could utilise methods to find indicators that bring forward a need for more updated technology and autonomous solutions. Also exploring ways to avoid pitfalls that occur without the proper due diligence.

Companies culture and values in regards to customer satisfaction will reflect a level of service being driven to the customer, without certain tools of measure in place, there will not be a way of measuring to comparable businesses who may have undergone technological upgrades which will later make it more difficult for understanding future needs and will lead to being susceptible to competitive prices, order times and customer satisfaction.

Sullivan observes that Logistics is trailing behind due to poor transparency when it comes to the digital adaption. Underutilised assets, inefficient processes and outdated interfaces. Competencies are needed to build transformation and change management (Sullivan 2021: 122).

The use of good operations minimise the need for high inventories which allows for more space for strategic stock. (Christopher M 2010: 60)

Understanding every employee is different and they will experience change differently. Involving employees in the initial stages of planning, providing training with consistent communication is key when upgrading new technologies.

Very important to mention once more: only when all resources have been utilised at hand is when you should consider upgrading. The perceived "resistance" is not a resistance but a call for communication of what drives customer satisfaction and how implementing new solutions solidifies job security whilst freeing up time for other job tasks.

In warehousing there is a need for daily processes to be measured. There is a need to utilise all resources, understanding all factors (importantly the ones that may be overlooked). Understanding processes is important, more important is measuring the results of those processes. Before you upgrade the information you have measured will assist to provide a measurable ROI to justify undergoing the involved challenges (disruptions, costs, downtime and order delays).

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