

Mobilising the workforce

An investigation into the impacts of **Mobile powered workstations** can have upon a firm and the return on investment, within manufacture, warehousing and retail.

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Abstract

This paper will look into the ways in which companies can utilise an MPW to impact upon their operations, to improve productivity and save capital. Furthermore, it will assess the return on investment (ROI). Showing potential customers an accurate mechanism for assessment of scenarios, by which they can apply to their own operations. This is mainly proven through reducing the time taken for Necessary but non-value added (NNVA) tasks such as walking between jobs. (Raghuram and Arjunan, 2021).

This is explored through diagrams and a fictional case study. The case study will incorporate diagrams to visualise the change in work flow showing an improvement in the process and how this will impact a company financially over a year. The paper will then go on describe the many different mobile printing scenarios that occur in industry and how the MPS can be utilised in such situations. Following this, the paper will address the current mobile printing solutions and compare them to the use of an MPW, informing users of the benefits and drawbacks of each.

As well as this, the paper shall give real world examples of how the products has been used. These will be presented through customer testimonials and reseller feedback. The use scenarios in industry will be addressed, followed by potential future use scenarios.

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Frequently used terms

MPW - Mobile powered workstation

[A trolley with, storage and battery capabilities enabling multiple use cases.]

NNVA - Necessary (but) no value added (tasks)

[Tasks such as walking and correcting mistakes, which are necessary but do not add value to a business]

ROI - Return on investment

[The calculation of how long an investment takes to pay itself back.]

WMS - Warehouse management systems.

[Software to improve efficiency within a warehouse.]

1.0 - Introduction

The intention of the paper is to inform potential users what the Mobile powered workstation can be utilised for. To visualise how the MPW can be used to cut costs by reducing waste and increasing productivity, thus increasing revenue.

Cost cutting in the traditional ways has been achieved by most companies. Therefore new methods of investment are needed to be taken to maximise the potential of a workforce. This is becoming increasingly more relevant as the cost of labour is constantly rising. Managers are stuck in the dilemma of needing to cut costs but not being able to justify the investment of new technology to do so.

An MPW has many benefits to a multitude of applied scenarios. Across all of these scenarios the main attraction of the product, is that it can reduce costly errors and labour. The fact it can transport a desktop, printer, scanner and many more high powered devices along with carrying heavy stock, makes it a powerful multi-tasking tool. The other key benefit is being able to transform static printers, computers and scanners into a mobile system at a low price point compared to other mobile printing solutions, as well as protecting said devices, making it more a more durable solution, with a large screen also.

The next section shall address the ways in which the MPW can improve upon productivity and propose an ROI calculation example.

2.0 - Productivity and ROI

2.1 - Productivity improvements

It is widely understood that if a company reduces the number of Necessary but no value adding tasks (NNVA) their workforce are doing, ie reduce the length of walking between jobs, then that company will be saving time. As everyone in business knows: time is money. Therefore if tasks can be merged by multi-tasking or made faster, a company can correlate that directly to cutting costs, leading to leaner manufacture, (Raghuram and Arjunan, 2021). In the case of the MPW the way labour is saved is by making a stationary PC, printer and scanner mobile. The steps reduced in walking between the two can be timed, thus if wages are factored in to how much time is saved a day, then a statistic can be found showing labour costs saved. Additionally bottlenecks are avoided for queues with designated stationary printers and workstations, further reducing NNVA.

What is not factored in is the time saved from improving accuracy by reducing the probability of errors. Scanning, printing and sticking all at once reduces the chance of a mistake being made by a worker. This helps a company achieve "Right first time" culture, avoiding defects and invoice errors (Baudin, 2007). This prevents costly recalls. Productivity is further reduced by the fact that the large screen used on the mounted monitors allows more information to be assessed as well as multi-tasking to be achievable in multiple windows, whilst being mobile.

If mistakes percentage can be estimated at a certain level, then cost of said mistakes are averaged, then another calculation can be made, showing the capital saved by preventing these mistakes. Both of these can then be used together to show the immediate ROI of the solution.

2.2 - Proposed calculations

To forecast the capital saved in labour costs a simple calculation can be made. Whereby the time saved in reducing the NNVA's, is deducted from the time it would usually take, without the use of the MPW. This can then be multiplied by the average wages of a worker in this scenario.

Secondly, to calculate the capital saved in reducing errors, would be to predict the percentage reduction in errors caused by having on site scanning, logging and printing. Multiply this by the average cost of an error for said company then by the time period.

A marriage of these calculations will give you an

accurate measurement for how much capital is saved in a time period. Divide the total investment by the calculated capital saved then by time period. From this a figure can be calculated for the capital saved in a period. Divide this final result by the initial investment and this will calculate the ROI.

2.3 - ROI case study

To demonstrate the way in which an MPW can impact upon a business, a fake case study has been constructed. This should allow readers to compare the case study to their own operations. This has been influenced by academic literature, particularly "Design framework for a lean warehouse." (Raghuram and Arjunan, 2021).

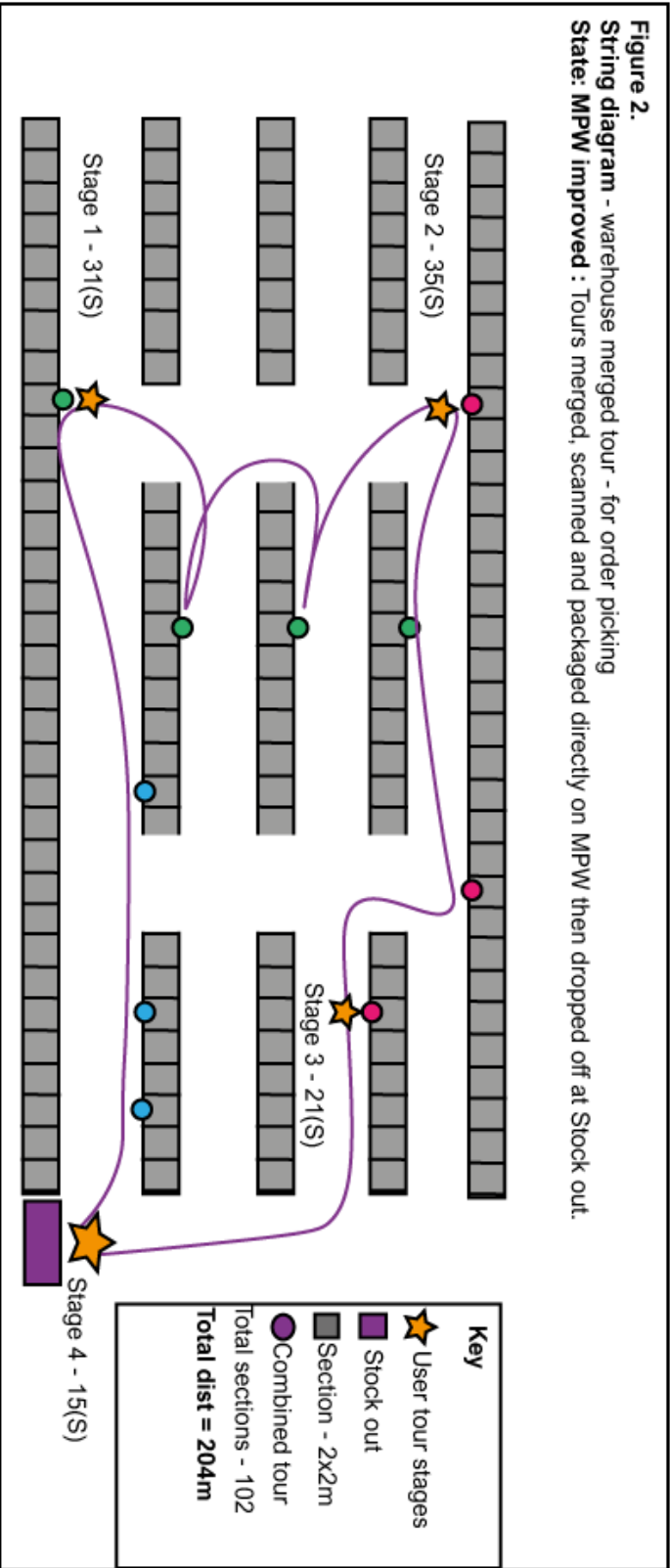
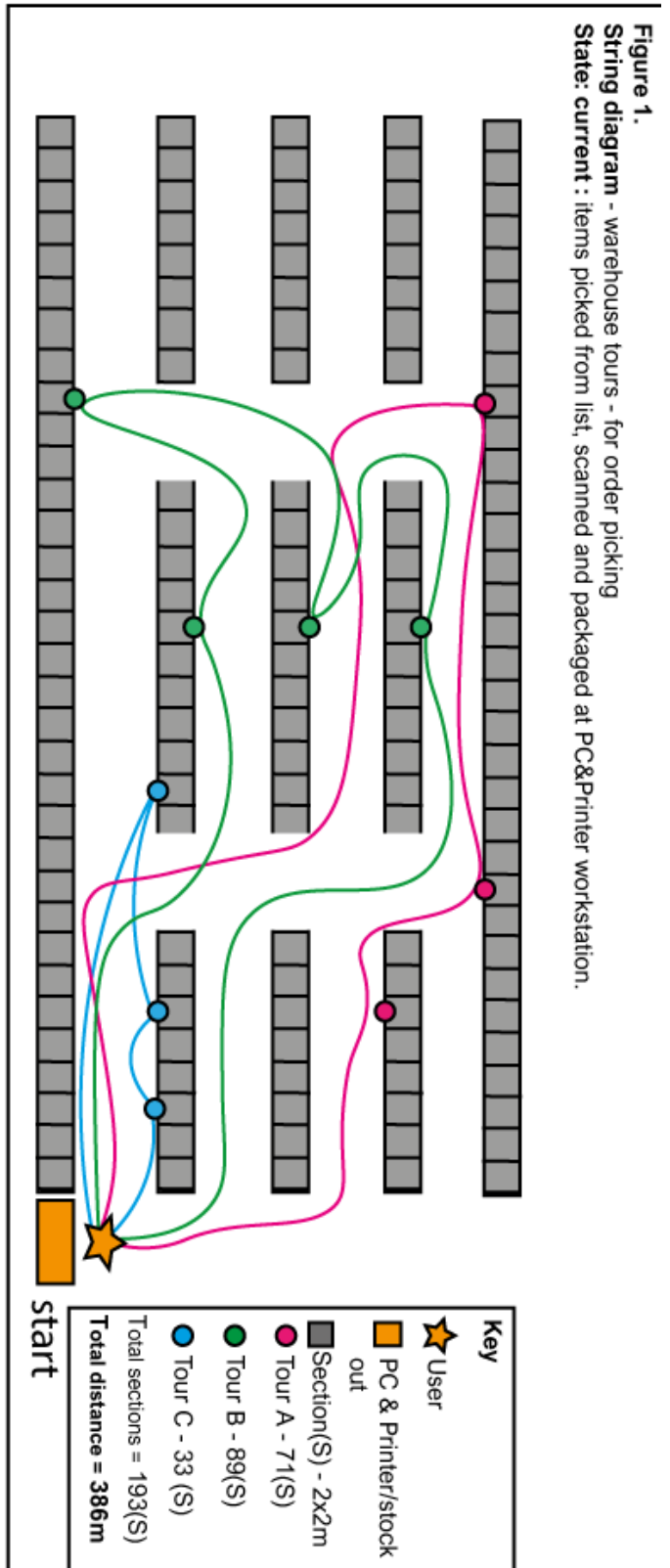
The figures 5 and 6 depict a warehouse labourer, using traditional methods of picking for orders, the second shows the worker equipped with the MPW. The main obvious strength is the fact that the user is empowered to carry out tasks on the move as well as being able to carry much more. The ability to multi-task and to reduce walking time is the focus of this case study, as these can be proved with a high degree of accuracy. Other factors are beneficial, but have many variables to be factored in, therefore they need to be approached with caution when calculating the ROI.

The case study is an example of a depot picking scenario, where the user will complete three different order tours and how this is streamlined with a MPW. The flow charts and string diagrams compare the two different use cases. The order positions are identical, however the method of completing the order changes. The three separate orders are merged into one larger tour. Not having to return to a processing area greatly reduces the mileage required of a worker. The justification behind a picking tour being used as an example is because in customer research this was found to be one of our main use cases in the past. This is validated in the Testimonial section.

2.4 - Mobile scanning/printing

Mobile scanning and printing solutions reduce errors and NNVA in the same manner. However this option has different characteristics to the MPW. Currently the technology is both expensive and fragile, so the ROI would take longer if the time saved is the same, particularly if the use life is shorter. The MPW also has additional features of having a large monitor, better for productivity than small touch screen and can store bigger printer/label sheets. Therefore, even less time is wasted in NNVA for restocking.

3.0 Figures supporting ROI calculation



3.0 Figures supporting ROI calculation

Figure 3.
Work flow diagram - warehouse tours - for order picking
State: current : items picked from list, scanned and packaged at PC&Printer workstation.

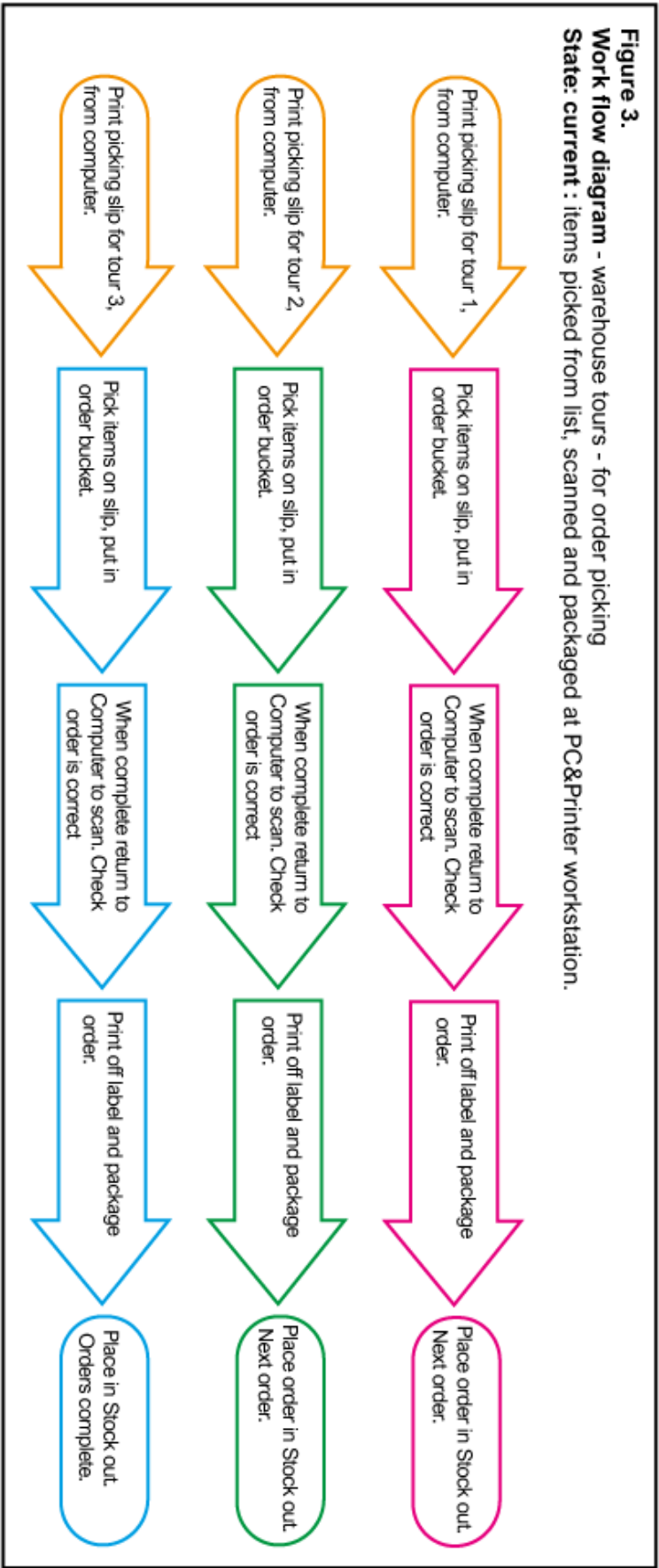


Figure 4.
Work flow diagram - warehouse merged tour - for order picking
State: MPW improved : tours and tasks merged, scanned and packaged directly, dropped off at stock out.

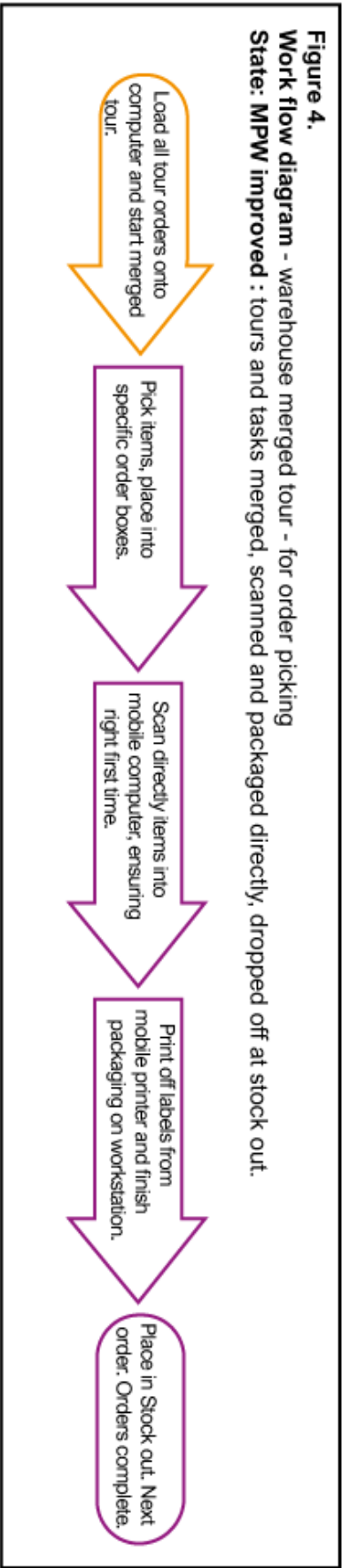
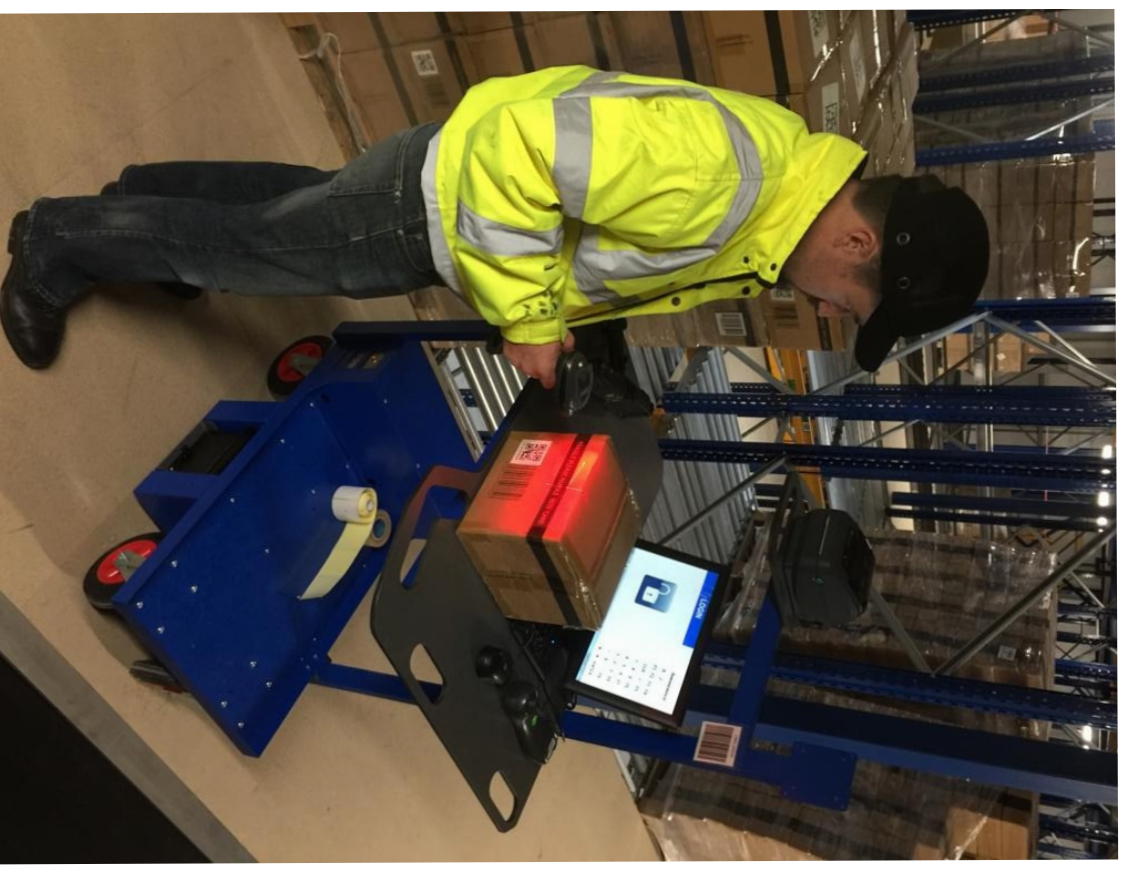


Figure 5. Image of worker on picking tour with scanner. Requiring multiple journeys to stationary PC



Figure 6. Image of worker on picking tour with MPW. Able to carry out multiple tasks as well as immediate label application.



4.0 - Calculation of ROI

From the figures above it is depicted clearly, that the user would reduce their walking distance by 182m over 3 orders. Average gait speed of working man is "143.4 cm/second" (Bohannon and Andrews, 2011). In this fictitious case study, we are proposing a worker completes 90 orders a day. To find the time saved over the three orders, purely from reducing the distance of walking the calculation below is made.

4.1- Calculation - savings per shift

Time saved From walking

$$182\text{m}/ 1.434\text{ms} = \underline{127 \text{ seconds. per 3 orders}} \\ = \underline{43 \text{ seconds per order}}$$

Seconds walking saved per day = $90 \times 43 = 3870$
Hours = $3870/3600 = 1.1$ hrs per day
Min.wage of warehouse worker (total jobs,2022) = £10hr

Capital saved in (NNVA) walking reduction
= $1.1 \times 10 = \underline{\text{£11 per shift.}}$

The calculation above proves; that for a picking situation an operator can save £11 in labour a shift, this means that in a 5 day working week, a single worker can save 5.5 hours worth of NNVA a week. The number of weeks a worker can operate a year after holidays is 46.4.

4.2 - Calculation - Savings a year of NNVA

Hours saved a year = $5.5 \times 46.4 = 255.2$
Labour cost saved per annum = 11×255.2
NNVA savings from walking reduction = £2,807.

4.3 - Result meaning

This calculation is showing the monetary value saved, as labour cost from reducing the amount of walking for a worker. This is an easy to repeat case, therefore it can be applied to most situations. However, there are many other factors that the MPW improves upon, so this should be viewed as a minimum of the amount of savings that the product incurs.

4.4 - Accuracy/error reduction

The other way the diagrams demonstrate the improvements, to the workload is the fact that the work flow is condensed, figures 3 and 4 show this. Instead of having 3 separate work flows they are merged. Making it more streamlined and simple for a worker to complete their tours. The scanning can be done immediately after picking, this ensures

no mistakes are made as it can be checked immediately. This clearly reduces time as there is no need to walk and amend the error, contributing to a "right first time" culture, building greater accuracy within the company. (Baudin, 2007). Merging the packaging to be on the go, also reduces the time of picking tours as it is not wasted moving between different receptacles. This also ensures that there is no dirt contaminations from surfaces as the items do not interact with anything other than the box. These next calculations are done to the theoretical nature of the fictitious case study.

4.5 - Accuracy Calculation

If the accuracy of a worker is 98%, meaning one in 50 there is a mistake. [Cost of mistakes vary. If the worker realises, then amends the mistake, this will only cost the company time in labour. However if the mistake is not realised, therefore sent out, it will cost more as it will need to be returned. As this factor has a lot of variables, we will make an average for this.] The error costs the company is £10, in labour and shipping costs. If the trolley creates an atmosphere of right first time and no mistakes then it can be estimated that the error rate will be near to 100%.

4.6 - Calculation - accuracy savings

Difference in accuracy = $100-98 = 2\%$
Number of mistakes a shift = $90 \times 2\% = 1.8$
cost per shift = $\text{£}10 \times 1.8 = \text{£}18$
cost per year = $\text{£}18 \times 5 \times 46.4 = \underline{\text{£4176}}$

4.7 - Calculation - Total savings of case study

= NNVA + accuracy
= $2807 + 4176 = \underline{\text{£6983 per annum}}$
RRP of MPW = £3619.69 base. (Falcona sales)
ROI = $3620/6983 = 0.518 = \underline{6\text{months } 1 \text{ day.}}$

4.8 - Other Considerations

There are many other factors where the MPW helps to increase productivity, however they require more in depth research and testing. Such as the exact time saved by merging the tours, putting the stock straight into packagings etc. These can only be estimated as they depend on the situation of each company. There will also be some unforeseen elements that might mitigate some of the time saved. For example the time taken to plan the route. The calculations are made on a fictitious case study, however are based upon the real world use of the product.

5.0 - Customer testimonials

5.1 - Interviews

Falcona.ltd has supplied MPW for over 20 years, through this time relationships have been established with customers. Customers come in the form of resellers and direct customers.

Wholesale warehouse companies like The Barcode Warehouse, Tantech and Colva IT. Are some of the resellers for the MPWs.

Through these established relationships, permission for interviews was given. Then conducted and transcribed to provide insights into the MPW from the perspective of our resellers and their clients.

The Sections depict topics we asked the resellers about and in indirect quotation they are displayed to give their perspective.

Role of interviewee

Asked their role in the company

“ Sales team leader.”

“Client director.”

Customers

When asked who they sell to

“ Medium to large warehouses who make use of picking tours for a medium price investment.”

“Smyths toys, who have a presence across the UK, Germany, Belgium and Switzerland. They’ve got about 5 Mega-warehouses, we supplied the workstation to them.”

Customer Uses

When asked what their customers used the product for currently.

“ Mainly used for rapid picking[tours], to speed up and improve efficiency, as items are processed immediately.”

“We offer it as an aid to a WMS system as it helps make that investment go further in workers more efficient, in my opinion.”

“It was used for Picking and also as a mobile space, in which labourers can carry out tasks, basically a mobile desk. And it needed to be operational 24/7, hence the requirement for the swappable batteries that you supply. It was seasonal depending on the year.”

Customer Draws

When asked what draws a customer to this product

“Customers in large warehouses who lack a substantial solution for picking tours, are who we usually recommend this product to. Allowing a

work station and scanning solution in one mobile unit, instead of walking between printers.”

“The customer required a solution similar to yours, with a 220 v supply. A major draw was the adaptability offered by Falcona. We were able to adapt the cart specifically to their needs.”

Customer Pain points

When asked what pain points their customers have.

“The main frustrations of my customers lie with the batteries life length after 12 months they tend to degrade... This is mainly due to the lack of training they’ve had on looking after them.”

“Too heavy for their weaker workers. The Cart is very robust, built like a tank, but for future orders a lighter model is required.”

Improvements

“ A sticker to inform the user [of how to take care of the batteries, on the trolleys work surface] would be pretty great, also a manual for managers to refer to would be ideal.”

“ A different design that makes the trolley lighter and perhaps with lighter batteries too.”

“Lithium batteries as an option, instead of lead Acid.”

“ Movable screens and USB ports.”

Future customer uses

“We tried to push the trolley into retail stores, as we believe its a better solution than mobile scanners and printers for relabelling. As these are more durable and so many of our customers find the scanners break after being dropped a few times. However the design and aesthetic need to be changed for a retail environment for marketing and having less of a footprint.”

5.2 - Summary of testimonials

The reseller testimonials have been insightful into customer needs and pain points as well as the use cases. Falcona are developing new MPWs for manufacture and all of the feedback received is being factored into the design.

The strengths of the products are validated by these testimonials. They have also informed this paper to be accurate and to assess the customer needs. The next page assess the use cases our trolley is and can be used in.

6.0 - Customer use cases

6.1 - Introduction

The strength of the Mobile powered workstation lies in its versatility to cover many different use scenarios, this page will address the multitude of use scenarios for the MPW. These are based upon customer use cases and literature for warehouse and retail environments.

6.2 - Shipping and Picking

The main advantage of the MPW in the shipping and picking section of warehousing is the ability to prevent bottlenecks. Due to workers queueing around designated areas of work. For example, the printing/scanning area, then the packing area. However, this is eliminated as all are combined for workers to carry out whilst on tours. Companies invest heavily to improve picking efficiency through the use of warehouse management systems (WMS), making use of sophisticated algorithms to enhance picking tours (Faber, de Koster and van de Velde, 2002). The mobilisation of the previously central computer and printers eliminates wasted time walking between tours and said computer. "Unnecessary movement is a waste that will lead to a loss in productivity (Azadivar and Wang, 2000)." Therefore the use of and MPW alongside and WMS will enhance the system, further justifying the high investment cost implemented initially. This is achieved as both reduce wasted time, leading to extremely lean operations. To further lean operations the MPW prevents misidentification, as the labels are applied immediately to desired boxes. ' "First Time Right" is the solution to avoid defects' (Baudin, 2007), (Raghuram and Arjunan, 2021). Having to reprocess orders, due to misidentification is a heavy time and labour cost and can vastly reduce efficiency. The MPW prevents such situations from occurring.

6.3 - Stock in and allocation

The MPW benefits are identical in the nature of how they resolve bottlenecks. The benefit of having a large screen to view the input data is also an advantage as this is intuitive to use, the nature of the large screen means more data can be seen at once, making errors easy to be seen. As well as multiple window capabilities allowing multi-tasking, further increasing efficiency than that of small screen devices.

6.4 - Cross Docking

The MPW is particularly effective in cross-docking

scenarios and similar practices. The nature of the task being to redistribute incoming goods to where they are needed. This is used in retail stores and in Just In Time (J.I.T) manufacturing and warehousing, ensuring lean operations. This is due to the large screen and immediate processing capabilities, that other solutions do not offer. The benefits of mobile scanning and printing devices are matched but with a workstation and larger screen. As this is a complicated and pivotal part of the operation. Reducing time wasted in bottlenecks and ensuring "First time right" (Baudin, 2007), supports these lean operations.

6.5 - Manufacture and Quality control

Due to the fact that the product in question is a workstation it is often used to carry out manufacturing tasks, the fact it has a PC and labelling capability makes it ideal for Quality control (QC). As rework labels and reports in faults can be made. Additionally the large screen and multi-tasking capabilities the PC system aboard offers the ability to process these errors. This shows that the MPW can be used to process quarantined items all in one station, increasing efficiency as no wasted time walking between different sites to process this. Furthermore, the flexibility capabilities this offers to manufacturers is invaluable as it allows production to be scalable (Raghuram and Arjunan, 2021), as the stations can be used for different functions within a production line.

6.6 - Retail

The MPW has not yet seen a retail environment, however our resale customers believe it has strong potential in this market if designed to the right specifications. Currently relabelling retail items is a huge task as labels are frequently changed in a year as prices are constantly fluctuating. This has been aided by mobile printing and computing devices. However their price point is high and capabilities compared to the MPW are lower. MPWs can allow for stock to be carried simultaneously to relabelling as well as offering larger rolls of labels, to reduce journeys back to a stock room (NNVA). The MPW can also have marketing on the sides of the product for promotions. Further advantages lie in the flexibility of the product, as it may be used as a queue buster kiosk in times of high traffic and then as a reprocessing desk for expired/damaged stock and then for customer returns. This solution is in the testing phase currently.

7.0 - Mobile printing technology

7.1 - Introduction

Mobile hand-held computers and printers allow users to carry out numerous tasks as mentioned in the many use cases above for mobile printing. The MPW, as mentioned above is also able to empower an employee in a similar fashion. With a few additional benefits and drawbacks depending on the situation.

7.2 - Flexibility

“Flexibility ensures scalability” (Raghuram and Arjunan, 2021). Scalability is vital to all businesses as orders and labour will be in higher demand at different time periods.

The flexibility of both solutions is firstly down to the fact that many different printing, on site tasks can be carried out; picking, relabelling etc. The difference is that an MPW offers many different functions as it is a workstation as well as a mobile printing and scanning solution. This makes it a much more worthwhile investment as it can be used for many different functions and business operations that the mobile printing solutions currently are incapable of offering. This is due to the fact that the desktop can be utilised to do more managerial functions and the workstation can also be used as a work surface for numerable tasks. The large screens allow multi-window capabilities that small screens cannot achieve. The second area in which the flexibility of the MPW is greater; is the adaptability to whatever technology a company is currently, or is wanting to use in the future (also a cost point). The chassis, mountings and power section are compatible with any devices requiring a power source, therefore the user is not trapped into using specific technology, allowing them to utilise a range of choices for what technology they want to use.

7.3 - Durability

With high cost of investments durability is a major factor when deciding what technology to use. The main concern with mobile printers, ascertained from our interviews is the likelihood of them being dropped by accident. Many of the devices have good IPX ratings for durability but across a long time period of damage they will degrade. Storage/protective solutions for devices come at an additional high cost.

This is where the MPW is a stronger solution, as it in itself is a mounting and thus secures the cheaper printer and devices upon it. This ensures they will not be dropped. Also the items not

secured by the table are cheap to replace, but also lightweight so unlikely to break like the heavier mobile scanners, for example a hand-held barcode scanner.

7.4 - Productivity

The productivity of a worker is correlated directly to the amount of time spent on NNVAs vs. Value added tasks. (Raghuram and Arjunan, 2021). The main strength of mobile printing devices are the fact that they reduce the amount of walking required. As they provide a labelling, scanning and printing system to a worker on the move. Rather than having to waste time walking back and forth to a computer and printing of new labels, this is done immediately. (Fairington Dr, 2009).

This also comes with the benefit of reducing errors as the workload is simplified due to labels being applied immediately after printing, making them less likely to be mixed up with the wrong orders. This saves countless hours in labour.

All the productivity benefits mentioned above are also benefits of an MPW as it too provides on point printing. However the MPW can hold much larger quantities of label rolls, size of label rolls, paper and also battery power. Mobile printers can carry a roll with the maximum length of 14.6m, contrasting to the 150m maximum of an MPW mounted printer (Barcode warehouse, 2022). This means that even less time is wasted than the mobile printing solutions currently on the market. As well as the printing manual tasks can be completed on the workstation on the move, like packaging. The fact that the dedicated system has a large monitor screen also means that workers can carry out much more complex computing tasks much faster.

7.5 - Cost

The price of a mobile printing device system to be implemented in a company is known to be very high, this is due to many factors: The devices themselves, new software, charging and storage, cost of items breaking and going missing. As mentioned in the flexibility section, the MPW can adapt to whatever technology a business is currently using and mobilise it. This makes it a much lower initial investment to achieve the same result. Additionally, if the company wants to invest in new printing or computer systems they have the flexibility to do so with the MPW. Larger stationary devices are still far cheaper than current mobile printing devices.

8.0 Infographics

From the previous case study some further calculations can be made to create visual representations of the data.

8.1 - Walking reduction %

Distance = $(204/386) \times 100 = 52.8\%$

Distance walked is reduced



8.2 - Productivity boost

From calculation 4.1:

For a 9-5 shift with an hour break = 7 hrs working.

$1.1 / 7 \times 100 = 15.7\%$ more time per shift to carry out tasks. Thus 15.7% productivity boost.

Productivity Boost

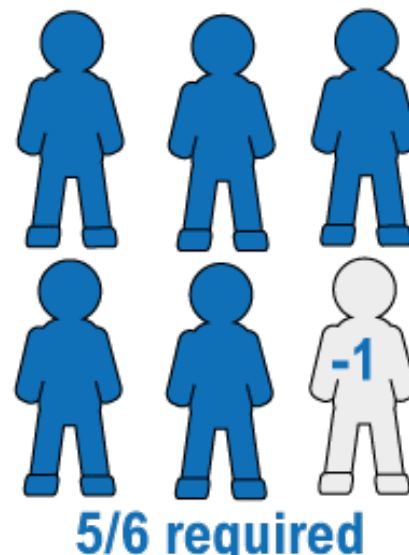


8.3 - Labour reduction

$100/15.7 = 6.3$

So for every 6 workers equipped with a MPW, one less is needed to complete the same job.

Labour Reduction



8.4 - Total cost of savings

Calculation of total cost savings in section 4.7 = 6983 per annum.

Capital Saved



8.5 - ROI

Calculation of ROI in section 4.7 = 6 months 1 Day



8.6 - Maximum length of label rolls of mobile wearable printers vs mounted device on MPW

150m / 14.6 m = 10.2 times the size.

Highest Mobile Printing Capacity



MPW mounted label printers



Mobile label printers

9.0 - Conclusion of paper

This paper has evaluated the use of Mobile powered workstations in different sectors and scenarios within said sectors. A strong case for how they can impact upon the activities of labourers has been made. Evidencing particularly upon reducing foot fall and streamlining their work flow. This has been theorised to empower a worker to achieve more within shift, thus increasing productivity and reducing labour costs. As a manager this should allow for a leaner workforce, thus increasing efficiency and creating more revenue for less of a cost.

The ROI calculation proved a rough calculation for a return of £6983 a year from reducing labour lost via NNVA's and reducing errors by 2% as a result of on point labelling and packaging and simplification of work flow.

The Use cases and comparison of the powered workstations against standard mobile printing has also been explored. Showing the benefits of both and drawbacks, ultimately concluding that MPW's are the more cost effective option as their lifespan and storage capabilities offer more benefits for a lower cost.

Customer reviews have validated these points above and shown real world opinions of these products. As well as offering insights into the other sectors that they would be useful in.

Overall the paper has to a large extent achieved the goal of informing a company as to the benefits a Mobile powered workstation can have upon a workforce, how it may be used and a systematic method by which and ROI may be calculated.

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