



WHITEPAPER

The Optimal Time for Investing in AMRs

Why now is the right time.

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Contents

01.

Introduction

02.

The Benefits of AMRs

03.

Is Waiting Worth It?

04.

The Cost of Waiting

05.

Now, Later, or Never?

06.

Conclusion



01. Introduction

The benefits of automation in a warehouse are clear and proven. Deciding when to make the transition is the hard part.

Warehouses and manufacturers have been using automation for a long time now. The practice of automating tasks that a person does not want to do or cannot do isn't new. However, the forms of automation and their applications change and grow as new technologies develop. Many traditional forms of automation require infrastructure changes, which can be costly and lead to considerable downtime in operations. While Automated Guided Vehicles (AGVs) have tried to address these issues, Autonomous Mobile Robots (AMRs) are perfecting what AGVs set out to do.

Interact Analysis predicts a strong growth in

AGV and AMR deployment over the coming years from almost 60,000 deployed in 2020 to 860,000 being deployed in 2025 (2.1 million in total by that time). Or, put in other terms, from over 9,000 customer sites in 2020 to 53,000 in 2025, with AMRs expected to increase market share with each year.^[1]

While the growth is staggering, it still represents less than 30% of the total market by 2025. The room for further growth is huge and it begs the question, "Why isn't a larger portion of the market getting involved sooner?"

Here, we are going to look at the benefits of AMRs in a warehouse, reasons that warehouses are hesitant to invest, and why warehouses stand to save more by adopting this new technology early.

02. The Benefits of AMRs

Productivity

A quick glance at any case study that has adopted AMRs in its operations shows a clear boost in productivity. Most show anywhere from a 100%–200% [2x–3x] increase in picking production. ITOCHU Logistics China boasts a 2.13x increase in picking efficiency after adding AMRs to its distribution center.

Reduced Labor Costs

Labor costs are on the rise around the globe. The demand for workers is getting more and more competitive as consumer demand and e-commerce continue to grow. Automation reduces labor costs and relieves businesses the grievances of labor shortages, particularly during peak seasons.

Flexibility

AMRs are the most flexible form of automation available. They are adaptable to any environment, don't need any infrastructure changes, and can be scaled up or down depending on the user's needs.

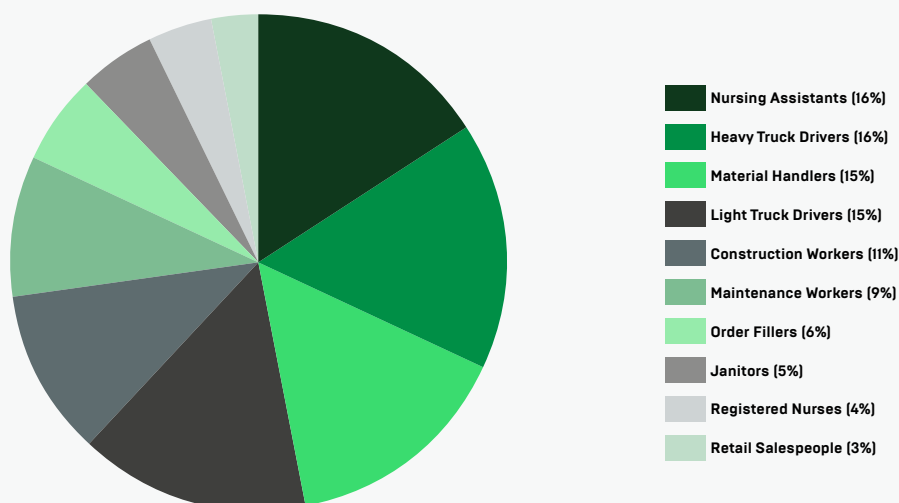
Increased Accuracy & Inventory Visibility

A major source of lost revenue is due to human error. Usually in the form of picking the wrong item or being unaware of a surplus or lack of inventory. AMRs reduce the error rate and collect real-time inventory data. This allows warehouse managers to save on operations both in time and expenses, by being able to make more informed decisions about when to add more inventory. SF Supply Chain China saw a pronounced improvement in its error rate after introducing 20 AMRs to its warehouse.

Safety

According to the US Bureau of Labor Statistics in 2019, hand laborers, material movers, stockers, and order fillers accounted for 21% of workplace injuries and illnesses among the top ten occupations with the most job-related injuries and illnesses (see fig. 1). The most common cause of injury among these professions is material handling. Furthermore, hand laborers and material movers had the highest number of days away from work.^[2]

Figure 1: Top 10 Occupations with the Most Job-Related Injuries & Illnesses in 2019



*Data for 2020 was not available at the time of publishing.



03. Is Waiting Worth It?

While AMRs aren't as expensive as other forms of automation, they still aren't what many would consider "cheap." Warehouses that have relied on manual operations may be hesitant to make the switch for several reasons, but according to McKinsey & Company's Industrial Robotics: Insights into the Sector's Future Growth Dynamics, "By far the most widely cited challenge is the cost of robots." In their survey, "All players identified the cost of robots as one of the primary challenges to adoption."^[3]

Analysts expect the cost of robots to drop by 20% to 60% by 2025.

For the past few years, truly autonomous AMRs that rely on sight and sensors have been priced at around \$30K per robot. Depending on your source, analysts anticipate the cost to drop by 20%–65% by 2025 [Boston Consulting Group, BCG, expects a 20% drop by 2025 while ARK Invest anticipates a 65% drop].^[4] The uncertainty doesn't make things easy for the consumer, but analysts can agree that they will get cheaper over time.

On the face of it, it's no surprise that warehouses want to hold out for cheaper AMRs in the future. But when you break down the numbers, it simply costs more to wait than to adopt the technology now and reap the benefits for years to come.

04. The Cost of Waiting

In this section, we're going to look at labor and wage trends for the warehousing industry in the United States, then apply three different scenarios for a small warehouse to examine the potential costs over a 10 year period. All labor and wage data were collected from the US Bureau of Labor Statistics, and all averages are mean averages unless otherwise stated.

Labor

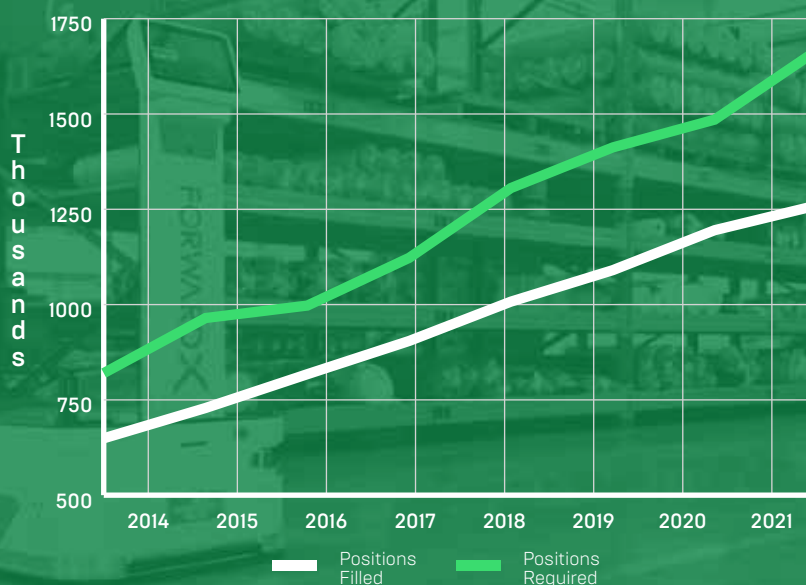
Between 2014 and 2020, the number of warehousing and storage employees has been on the rise at a relatively constant rate. There has been an 8%–12% increase in the workforce each year [see fig. 2].

This shows the industry is growing, but on its own doesn't tell us by how much. For that we need to also look at the unfulfilled positions, or job openings, to see how many jobs are

needed in the industry to keep up with consumer demand. If we look at the labor shortage, we can see, while it isn't as consistent, it is also on the rise, and the gap is widening. This is true for many jobs in the supply chain as well, such as manufacturing, retail trade, construction, wholesale trade, etc.

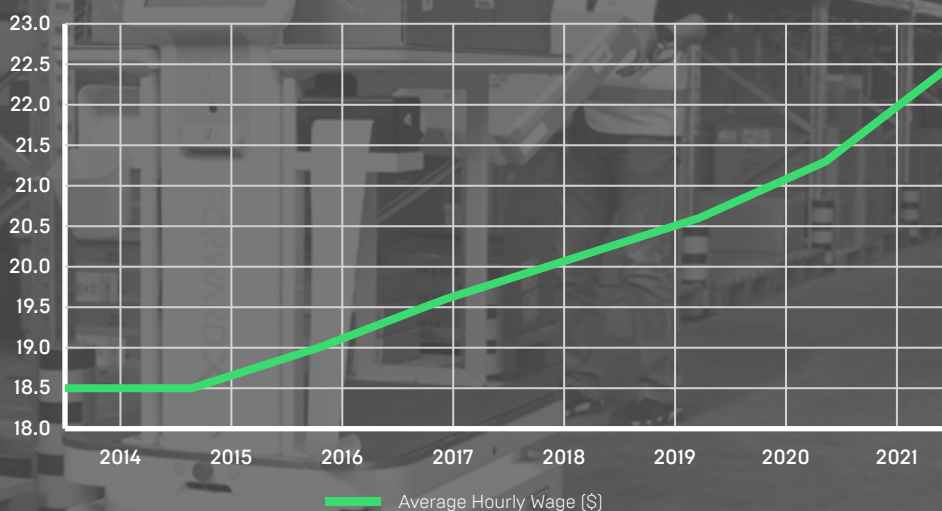
This means that warehouses, and other industries closely linked to warehousing, are facing a growing problem. The number of workers needed to keep operations running at their maximum level of output is outpacing the available workforce. A certain scaremongering rhetoric has many believe that automation is or will be taking jobs away from people. However, we are in fact observing the opposite: consumer demand is causing an increase in both automation and employment. The level of automation just has not yet reached what's needed to correct the labor gap.

Figure 2: The U.S. Labor Gap, Showing Positions Required and Positions Filled From 2014 to 2021



*Data beyond July 2021 was not available at the time of publishing.

Figure 3: The Average Hourly Wage in the US between 2014 to 2021



*Data beyond July 2021 was not available at the time of publishing.

This gap leads to increasing competition among employers to offer higher wages and benefits. The demand for employees, among other variables, has led to a yearly average wage increase ranging from \$0.50 to over \$1.00 per hour for all warehousing and storage employees since 2015 (see fig. 3).

In fact, many examples of this can be seen in recent events. One such example which provides a clear view of the changing landscape for pay and benefits can be seen in Amazon's September 21st announcement where it stated it will begin to fully fund college tuition for more than 750,000 operations workers as part of its Career Choice program. All-in-all, the e-commerce behemoth plans to invest more than \$1.2B to expand its education and skills training programs to its employees in the U.S. Taking this into account, how can other organizations keep up?

As the demand for increasingly expensive workers rises, the cost of running a manual warehouse at full capacity is becoming far too costly. Integrating AMRs into the workforce addresses the labor gap and provides a cost-effective solution for warehouses to meet demand.

Case Study: SF Supply Chain China

SF Supply Chain China is a top 3PL provider and has a distribution center that handles about 1,000 SKUs and serves 400+ stores. Prior to implementing AMRs, the warehouse used manual picking methods with paper pick lists and manual carts. Employees covered large distances every day, resulting in low productivity and high error rates that led to significant financial loss.

To address its issues, SF Supply Chain China chose a ForwardX Solution that consisted of ForwardX Flex 300-S AMRs with custom built racking and f(x) Fleet Manager. The results were astounding. The facility started with 5 AMRs and increased the order to 20 shortly after implementation. Now, error rates are down 90%, productivity has increased 3-fold, and labor costs have been slashed by 43%.

05. Now, Later, or Never?

The following three examples use an average of a 10% yearly increase in hired labor (the median increase since 2014). They also use the lowest average wage increase since 2015 of \$0.50 an hour each year. They do not account for the labor gap that is also on the rise and may lead to even larger wage increases over the following years due to increased hiring competition. They also do not account for overtime pay (using only a 40-hour work week, which is lower than the national average) or other benefits. Therefore, the overall projected labor costs presented are likely lower than what the actual costs would be over a 10-year period.

Manual is Expensive

After 10 years, a traditional manual warehouse employing 10 order pickers today will need to spend over \$8.3M to keep up with growing demand (see fig. 4). This assumes that employers will be able to find and retain the workers they need. This also uses fractions of people in the calculations, resulting in a slightly lower cost due to the assumption that all workers are working at their full capacity, therefore 12.10 workers would need a 13th worker in 2023 and so on.

The following two examples use AMRs to bring labor down by roughly 50%. The calculation for the number of AMRs needed assumes a ratio of 2.5 robots per person. 10 people in a manual warehouse have the same output as 5 people with 12.5 robots (rounded to 13 robots). Both examples also add in a 7% maintenance cost per year after the initial purchase of each robot throughout its lifecycle. AMR life cycles are typically 5 to 7 years, so these examples add replacement robots every 5 years.

Save Big with AMRs Today

This example uses a fixed cost of \$30K per robot over the course of 10 years. It does not account for any decrease in AMR costs over time to show a worst-case scenario of investing today.

In the unlikely event that AMR costs do not decrease, a warehouse will still save about \$2.64M over the course of 10 years (see fig. 5). If we assume robot prices will decrease to some degree over the next 5 years, then the total cost would go down by a significant amount in this example, resulting in a savings of something closer to \$3M (or more if they drop by 65% as ARK Invest predicts).

Figure 4: Scenario 1 – The Projected Cost of Fully Manual Operations from 2021 to 2030

Year	Workers	Weekly Hours	Weeks	Hourly Wage	Yearly Total
2021	10.00	40	52	\$22.50	\$468,000.00
2022	11.00	40	52	\$23.00	\$526,240.00
2023	12.10	40	52	\$23.50	\$591,448.00
2024	13.31	40	52	\$24.00	\$664,435.20
2025	14.64	40	52	\$24.50	\$746,105.36
2026	16.11	40	52	\$25.00	\$837,465.20
2027	17.72	40	52	\$25.50	\$939,635.95
2028	19.49	40	52	\$26.00	\$1,053,866.21
2029	21.44	40	52	\$26.50	\$1,181,546.15
2030	23.58	40	52	\$27.00	\$1,324,223.42
				Total Cost	\$8,332,965.50

Figure 5: Scenario 2 - The Projected Cost between 2021 and 2030 if You Invest in AMRs now

Year	Workers	Yearly Labor	AMRs	AMR Costs	Maintenance	Yearly Total
2021	5.00	\$234,000.00	13	\$390,000.00		\$624,000.00
2022	6.00	\$287,040.00	0	\$ -	\$27,300.00	\$314,340.00
2023	6.00	\$293,280.00	2	\$60,000.00	\$27,300.00	\$380,580.00
2024	7.00	\$349,440.00	0	\$ -	\$31,500.00	\$380,940.00
2025	7.00	\$356,720.00	2	\$60,000.00	\$31,500.00	\$448,220.00
2026	8.00	\$416,000.00	13	\$390,000.00	\$8,400.00	\$814,400.00
2027	8.00	\$424,320.00	2	\$60,000.00	\$35,700.00	\$520,020.00
2028	9.00	\$486,720.00	4	\$120,000.00	\$39,900.00	\$646,620.00
2029	10.00	\$551,200.00	3	\$90,000.00	\$44,100.00	\$685,300.00
2030	12.00	\$673,920.00	5	\$150,000.00	\$56,700.00	\$880,620.00
					Total Cost	\$5,695,040.00

It's Not Worth the Wait

The final example assumes that AMRs will, in fact, drop by the optimistic 65% in costs by 2025. This gives us a best-case scenario for warehouses waiting for cheaper robots to invest. It then uses a fixed cost as in the previous example, but at \$11K over the course of 6 years.

If a warehouse waits for AMRs to become cheaper and invests in 2025 at about \$11K per robot, they will save about \$2.63M over the course of 10 years to that of a manual ware-

house [see fig. 6]. That is still \$10K less in savings than a worst-case scenario of adopting AMRs today. This difference goes up to \$1M if the costs do not go down at all or about \$750K if these projected AMR cost reductions were reflected in the previous example. The actual result will most likely be somewhere between the two assuming AMRs will become cheaper over time at some rate. Not only does this warehouse not save as much, but it is also 4 years behind in experience than any given warehouse that invested today.

Figure 6: Scenario 3 - The Projected Cost between 2021 and 2030 if You Wait 5 Years to Invest in AMRs

Year	Workers	Yearly Labor	AMRs	AMR Costs	Maintenance	Yearly Total
2021	10.00	\$468,000.00	0	\$00.00	\$00.00	\$468,000.00
2022	11.00	\$526,240.00	0	\$00.00	\$00.00	\$526,240.00
2023	12.10	\$591,448.00	0	\$00.00	\$00.00	\$591,448.00
2024	13.31	\$664,435.20	0	\$00.00	\$00.00	\$664,435.20
2025	7.00	\$356,720.00	17	\$187,000.00	\$00.00	\$543,720.00
2026	8.00	\$416,000.00	0	\$ -	\$13,090.00	\$429,090.00
2027	8.00	\$424,320.00	2	\$22,000.00	\$13,090.00	\$459,410.00
2028	9.00	\$486,720.00	2	\$22,000.00	\$14,630.00	\$523,350.00
2029	10.00	\$551,200.00	3	\$33,000.00	\$16,170.00	\$600,370.00
2030	12.00	\$673,920.00	20	\$220,000.00	\$5,390.00	\$899,310.00
					Total Cost	\$5,705,373.20

06. Conclusion

A warehouse waiting for a cost reduction in AMRs is a warehouse that will lose out on overall savings and revenue while falling behind its counterpart that invests today. AMRs stand to save in ways that aren't even reflected in the given examples, as they are hard to accurately quantify and would vary significantly. By increasing flexibility, they decrease the need for overtime pay during peak seasons or part-time hires. By increasing accuracy and inventory visibility, they

decrease lost revenue. By increasing employee safety, they decrease days away from work due to injury or illness. They also save in other costs not reflected in employees' wages such as training costs, healthcare, etc.

Don't fall behind and don't miss out on the immense savings that AMRs offer. The rewards are evident with case study after case study to prove it. The optimal time for investing in AMRs is today.

References:

All case studies mentioned were in partnership with ForwardX Robotics. All data used for the included graphs was gathered from the US Bureau of Labor Statistics. Market projections come from research done by Interact Analysis.

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ForwardX Robotics

About ForwardX

ForwardX Robotics is a global technology leader in the fields of AI and Robotics. Through its flexible automation platform comprising of intelligent mobile robots and AI-enabled software, ForwardX delivers material handling solutions for warehousing and manufacturing facilities that offer better performance at better value. The company is comprised of over 300 members hailing from top universities and leading enterprises around the world. As shown by the 200+ patents pending and its award-winning research work, such as 2 1st-Place Prizes at TRECVID and the 1st-Place Prize at IEEE's VOT-RT, ForwardX's team boasts some of the world's top computer vision scientists and robotics experts.

With offices in China, Japan, and the US, along with partnerships around the globe, ForwardX is expanding and applying its proven solutions to warehouses and manufacturers worldwide.

Want to learn more about ForwardX and how we can help you flexibly automate your material handling operations? For more information, visit:

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