Volume 2, Issue 4

Innovation Series Quarterly

https://journal.academicapress.org/aps/index.php/isq

Research Article

OmniLift X Forklift

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Keywords:
Forklift
Pallet handling
Warehouse

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Abstract: *Time saved at a warehouse is money saved across the supply chain. Currently a forklift can only carry one pallet at a time, which is time consuming. Therefore, our team innovates OmniLift X Forklift to address the challenges of pallet handling in busy warehouses. Through side-to-side forklift operation, this innovation aims at enhancing speed and efficiency in lifting, transporting, and positioning pallets thereby reducing unnecessary movements and improving workflow. This innovation also helps handle pallets in narrow spaces by reducing the need for turning, improving warehouse space utilization and operational efficiency. In order to use the OmniLift X Forklift, the operator must drive the dual-side forklift into the warehouse's tight aisle, then the side mast extended to pick the new pallet. Finally, the forklift unloads the pallet by retracting the mast on the warehouse rack. Our innovations are designed for warehouse owners, operators, and forklift drivers who manage daily warehouse operation and the movement of materials. The commercialization potential of OmniLift X Forklift lies in warehouse companies purchasing and utilizing this innovation to facilitate on-site tasks. This innovation can also contribute to sustainability and enhance user efficiency.*

1. INTRODUCTION

. Previously, existing forklifts mainly required adjusting the position to ensure the fork fit into the pallet space precisely. The operator needs to relocate from a different direction because of limited functions in the existing forklift. Additionally, they have to go back and forth to carry one pallet per trip, which costs a lot of movement and is not efficient in warehouse operation. Indirectly, it will cost

more time, less output but more input, and a slower turnover process, especially if there were a huge number of pallets in the warehouse.

However, with this new innovation, it will help to prevent going back to square one and facilitate material handling. Besides, the pallet handling becomes more practical because it comes together with the function of dual-sided forks, which allow working to carry pallets from both sides of the forklift. This two-sided forklift has dual-sided forks and telescopic masts for increased reach for flexible usage instead of requiring a lot of adjustment. With safety features built in, the use of cameras and sensors facilitates visibility and obstacle detection. To add on that, a reinforced chassis structure is built in to carry the weight of the pallet from both sides while keeping the balance of the forklift.

1.1 Two-sided solid extendable mast

The proposed OmniLift X Forklift uses high-strength steel for its structural frame and two-sided extendable mast to improve material or pallet handling in warehouses.



Figure 1. High-strength steel for structural frame and two-sided extendable mast.

With the new OmniLift X, the proposal is on a left- and right-sided fork together with an extendable solid mast, which allows it to carry two pallets at one time. The mast extension material consists of hydraulic cylinders, steel sliding rails, and guide rollers. The usage of the sliding rail helps the mast alleviate the resistance and move the load more efficiently.

Besides, the use of hydraulic cylinders is to withstand the pressure or the load and is excellent in preventing seal wear. It is a suitable material that we chose that fits the forklift that requires a lot of extendable and retractable masts.

Apart from that, the OmniLift X also adds guide rollers to support movement of the masts. Material that we proposed for guide roller bearing steel and sliding rails is S355JR structural steel, which is suitable to carry the weight of the pallet and very suitable for a variety of weights or masses.

1.2 Reinforced chassis to support load balance

A counterweight and a safety system are also included to support stability and operational control. Together, these components are intended to assist the operator when lifting, transporting, and positioning pallets. We are proposing reinforcing plates for the chassis using high-quality strength steel to support the rigidity and high resistance of the forklift during pallet collection, for example, S355JR. The reason for this proposed material is that it works better in upper yield strength in supporting structural applications by its material properties.

The authors also proposed this to add up on the existing chassis characteristics for steel stands that have been used in standard vehicles, but this innovation is applied to forklifts (Automotive Technology, 2025). This reinforces the plates together with a structural cross member to distribute loads

evenly to both the right and left sides for the whole forklift-framed structure to prevent collapse or any unwanted hazard and circumstances (OSHA, 2008).



Figure 2. Two sided chassis operation.

1.3 Monitoring Components

*T*he design incorporates sensors, a 360° rear view camera, and a display monitor to support operator visibility and monitoring during warehouse operations. The sensors use the same technology as normal car parking sensors to detect obstacles when reversing vehicles. The sensors can alert operators when hazards are detected nearby, while the rear view camera and display monitor provide additional visual information to support safer movement.

Next, the 360° rear-view camera provides a wider view of the surrounding area, helping operators monitor nearby objects, workers, and obstacles that may not be visible when handling forklift. The camera footage is displayed on a monitor installed within the operator's cabin, allowing operators to monitor their surroundings without continuously turning their heads to check for possible hazards. Ultimately, these features aim to reduce blind spots, improve operational awareness, and minimise the risk of accidents in hectic warehouse environments.

2. LITERATURE REVIEW

Due to the growing trend of having an efficient warehouse operation, regular forklifts may need to turn and go backward when picking up loads from different sides of the pallet (Toyota Material Handling, 2018; The Price of Safety, 2025). These actions take more time and affect productivity negatively. Low visibility and problems with keeping the balance of the load may present safety hazards in narrow spaces and in high warehouses (OSHA, 2008). Therefore, the authors invented OmniLift X Forklift, which aims to upgrade the usage of our forklift and maximize the time and total pallet that one forklift is able to carry while still alleviating the hazard with a complete safety system and facilities built in.

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3. METHODOLOGY



Figure 3. Pallet delivery.

. The proposed development of the OmniLift X Forklift follows a multi-phase design and engineering approach focused on two-sided pallet handling and operation in narrow warehouse aisles. The system workflow follows a three-stage structure that centers on operator positioning and controlled mast movement.



Figure 4. Positioning stage.

Firstly, during the positioning stage, the operator moves the forklift to the side of the target pallet with the mast fully retracted. A 360° rear view camera and display monitor assist the operator in viewing the area behind the forklift, while the rear sensors detect obstacles to support a saver reversing process (PACO1, 2026). These features are specific to reversing operations and are inactive during standard forward movement.



Figure 5. Pallet collection stage.

Second, during the pallet collection stage, the operator extends the mast towards the target pallet, engages the pallet with the forks and lifts the load to the required height. The mast is then retracted to its designated transport position before the forklift moves to the destination rack. The reinforced chassis structure supports the weight of the pallet and helps maintain load balance during handling (Rahmani,2026). In addition, the counterweight helps balance the forklift against the weight of the load and improves stability during pallet handling. Before travelling, the load is lowered to the appropriate travel height to improve stability and comply with general forklift safety practices (Health and Safety Executive [HSE], 2013).



Figure 6. Pallet placement stage.

Lastly, in the pallet placement stage, the operator positions the forklift beside the destination rack and raises the forks to the required height. The mast is then extended to place the pallet onto the rack. Once the pallet is securely placed, the operator withdraws the forks and retracts the mast to its

designated position. The reinforced chassis structure provides additional structural support and helps distribute the load during pallet placement, contributing to stability when handling pallets on either side of the forklift. This completes the pallet handling cycle.

4. FINDINGS

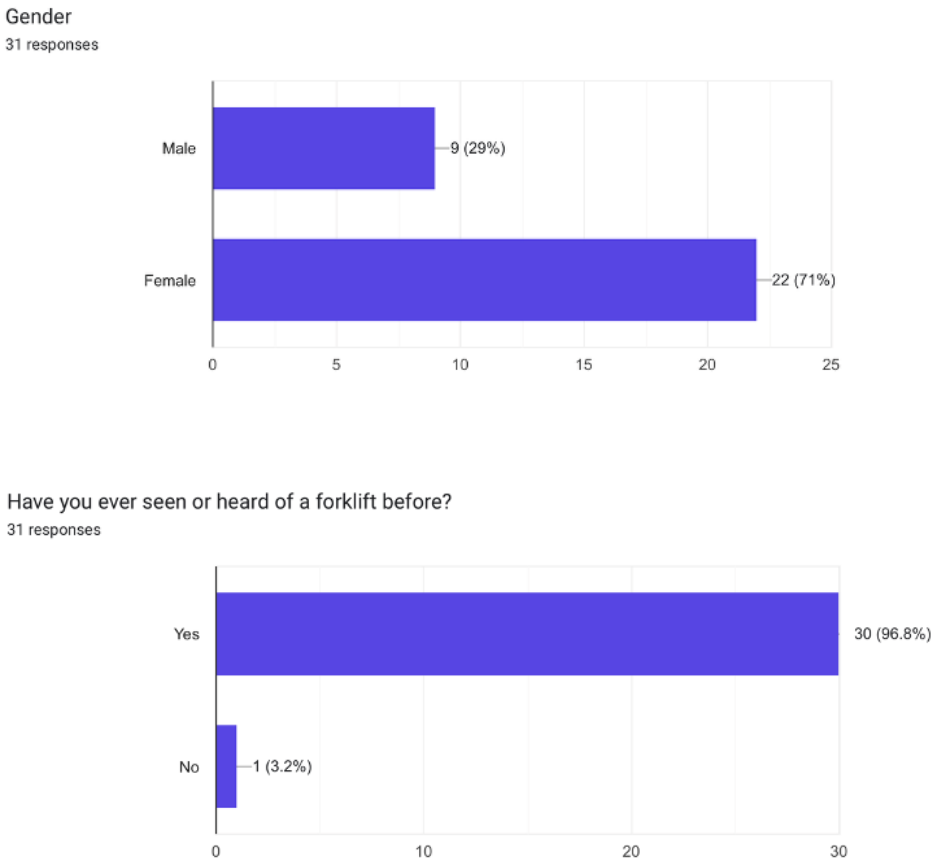


Figure 7. Respondents' feedback 1.

Based on our survey from 31 respondents, which consist of 71% female and 29% male, 30 respondents have seen or heard of forklift before, while 1 respondent has never seen or heard of forklift. These figures show that most of our respondents can comprehend and imagine how forklift works (Figure 7).

Furthermore, 61.3% and 29% of respondents answered that they 'strongly agree' and 'agree', respectively, and consider that a forklift that can pick up and place loads from the left and right side is a useful innovation. Interpretation of the number indicates positive feedback of the innovation. However, the remaining respondents of 9.7% are still unsure and disagree with the feasibility of the invention (Figure 8).

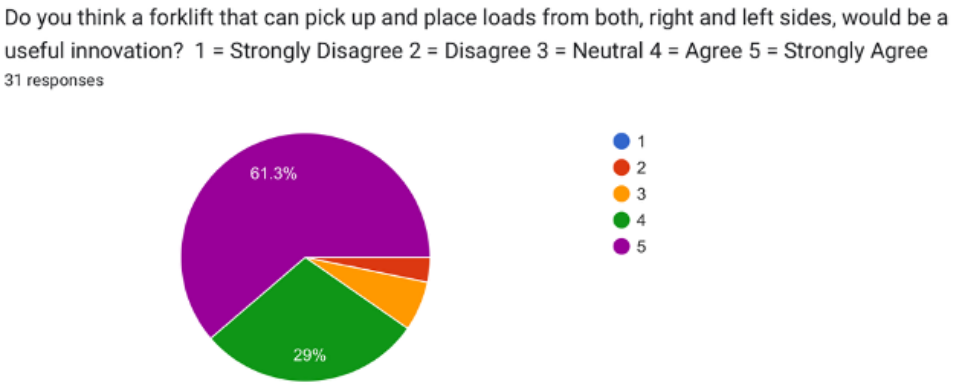


Figure 8. Respondents' feedback 2.

Next, 54.8% of respondents strongly agreed and 38.7% agreed that the dual-sided forklift could improve the efficiency of moving goods in warehouses and factories (Figure 9). This indicates that the OmniLift X Forklift could save time, minimize unnecessary movements, and enhance workflow in tight spaces.

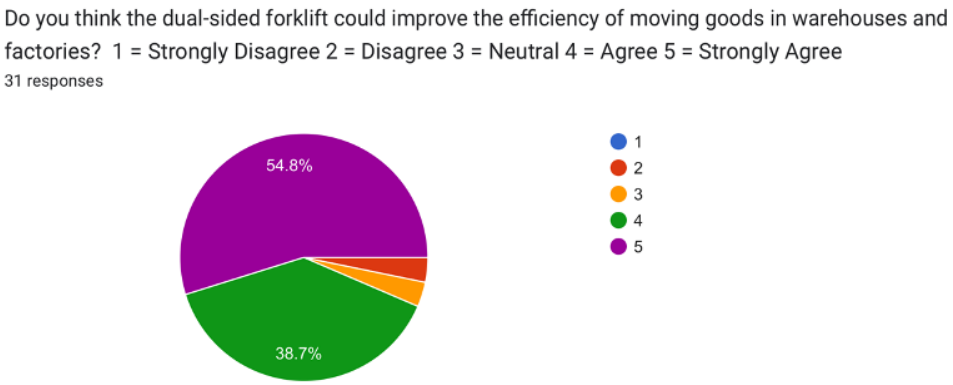


Figure 9. Respondents' feedback 3.

As for safety, 74.2% strongly agreed and 19.4% agreed that a 360-degree camera and AI sensor system is necessary to avoid accidents when using a two-sided forklift (Figure 10). The results suggest that cameras and sensors play a crucial role in enhancing the visibility of the operator and identifying potential obstacles.

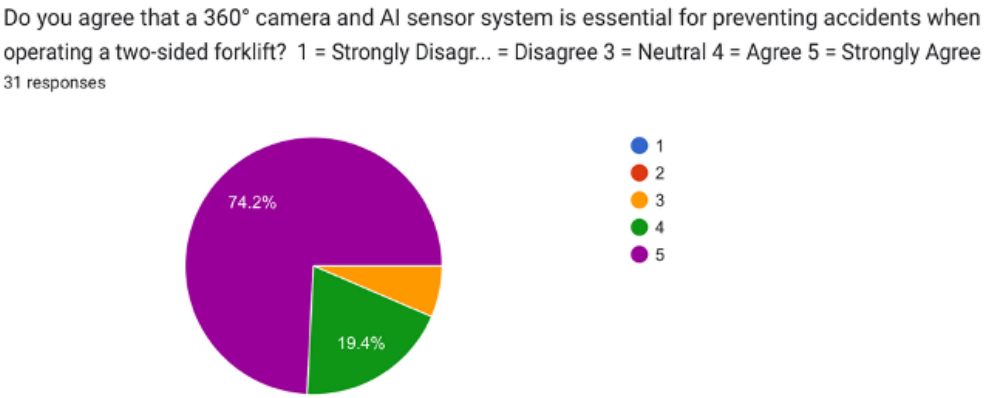


Figure 10. Respondents' feedback 4.

Additionally, 54.8% of respondents strongly agreed that this innovation should be developed, 35.5% agreed, and 9.7% were neutral. The overall findings suggest that the OmniLift X Forklift is well-received and has the potential to be improved, with a focus on ensuring safety, stability, and usability.

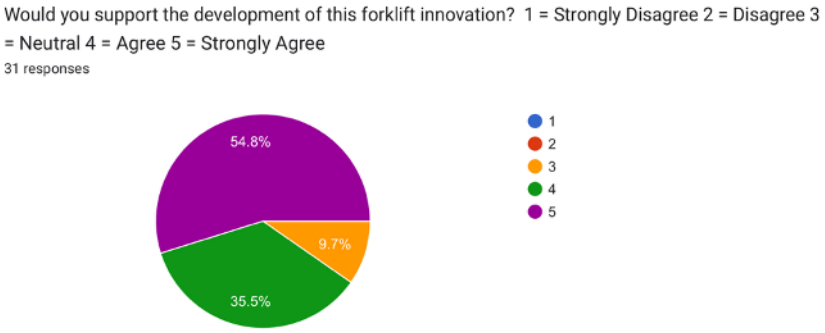


Figure 11. Respondents' feedback 5.

5. DISCUSSION

This innovation will give a positive impact on enhancing overall operational efficiency, particularly for:

5.1 Warehouse operator

It helps operators move the heavy goods faster and easier in limited or tight space while reducing manual lifting, physical strain, and the possibility of workplace accidents (Jimenez, 2023). As a result, it will optimize equipment performance, streamline daily handling tasks, and tasks, and save working time (Goga et al.,2024).

5.2 Ports

It accelerates the loading and unloading of heavy containers, while enhancing better maneuvering in narrow port corridors (Jalal et al.,2025). Therefore, it maximizes the storage spaces and reduces the operational bottlenecks to keep port logistics running smoothly. On the other hand, there are numerous benefits that OmniLift X Forklift can offer to sustainability and the environment.

5.3 Warehouse Space Optimization

The double-ended forklift truck, being equipped with two sets of forks on both sides, facilitates the process of loading and unloading of the pallets in an easy manner, more so in the case of confined warehouse areas (Bartholdi & Hackman, 2021). The versatile moving feature of the forklift allows the forks to be moved forward or backwards according to the situation. Because of its efficient design, it needs less space for movement, thus maximizing the available storage area.

5.4 Operational Efficiency and Safety

The new design of the forklift reduces time for loading and offloading because of its smooth functioning of pallets. The unnecessary maneuvers and movements of adjustable forks are eliminated to save time and increase efficiency during the process of operations, which leads to the increased daily production of the company (Richards, 2023). Moreover, the rear sensors help drivers see obstacles while moving backward, which helps avoid any collision with other people or objects around (Zhu et al., 2023).

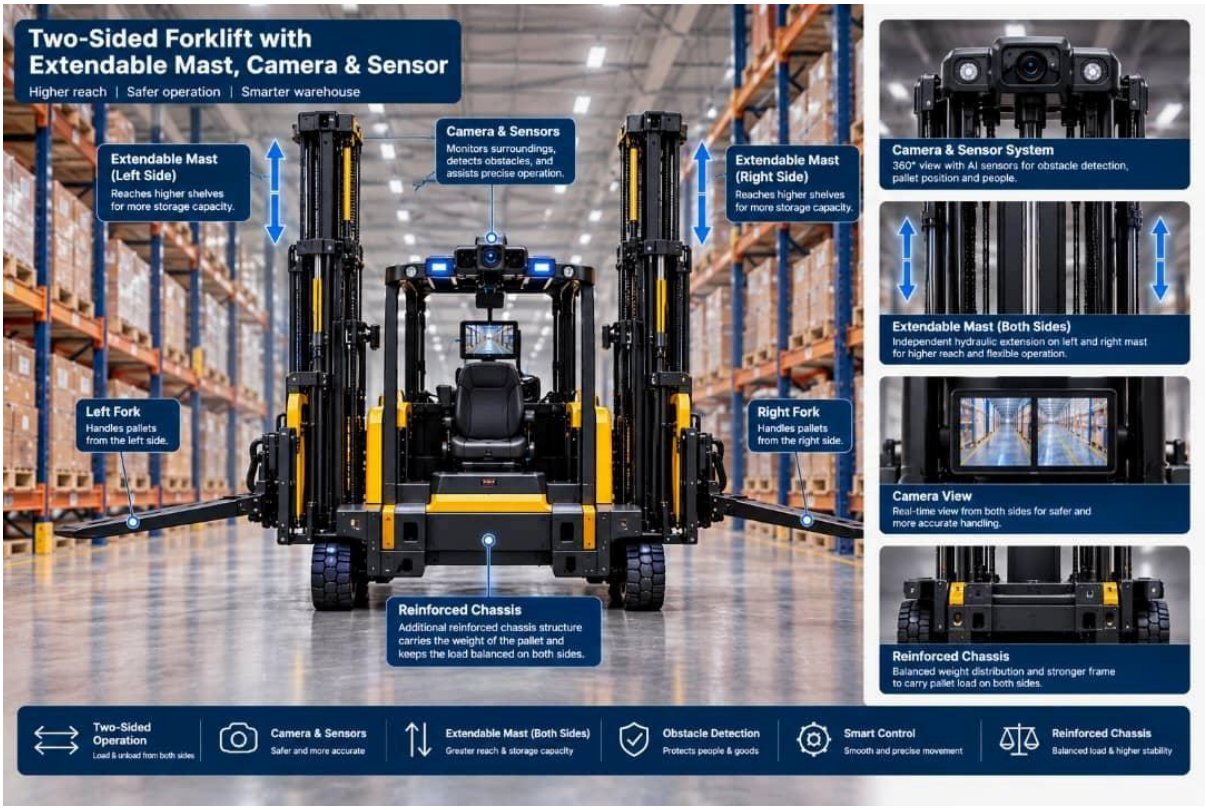


Figure 12. Two-sided forklift with extendable mast, camera and sensor.

6. CONCLUSION

The OmniLift X Forklift demonstrates an innovative solution to increase efficiency of warehouse operations with a dual-sided pallet handling mechanism and extendable mast system. This

innovation is expected to improve operational efficiency, enhance warehouse space utilization and create safer working environments by minimizing unnecessary movements through the integration of sensors and monitoring systems. The positive survey results, which 90.3% of the respondents agree or strongly agree with, indicate that the innovation is beneficial, which indicates it has the potential to meet the needs of warehouses. The development and practical testing are suggested for assessing its technical feasibility, load stability and commercial potential in the context of the modern warehouse environment.

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