

Original Article

Innovative Solutions for Boosting Supply Chain Putaway Efficiency

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Abstract - The global supply chain was severely disrupted by the COVID-19 pandemic, leading to supply and demand variances over time. This impact on the import and export of various domestic and international products has underscored the necessity for a robust putaway process. This research aims to investigate the difficulties encountered in the present putaway procedure, exacerbated by the pandemic, and suggest remedies by utilizing mobility solutions. The significant and unpredictable shift in customer purchasing habits brought forth by the COVID-19 disruption made an efficient inventory management system necessary. Every warehouse follows an inventory management process, which will help us manage changes in supply and demand through mobility solutions, handheld devices, and automation technologies in the putaway process activities. These will improve the accuracy of the inventory process and reduce operational costs, allowing us to keep up with fluctuations in the import and export of goods and products.

Keywords - SAP mobility, S/4 HANA, SAP EWM, Inbound process - Putaway, Mobility applications, Manufacturing and distribution, Digital supply chain management.

1. Introduction

Numerous supply chains have experienced unprecedented disruptions due to the COVID-19 epidemic, including breakdowns of routines and patterns, variations in demand, inconsistencies, and delays in supply and demand [1]. To give the audience hope that the supply chain will be resilient in the face of hardship, this paper also highlights how flexible warehouses can be and the industry's best practices for addressing the problems of rising demand and warehouse limitations. Businesses have realized that mobility solutions can improve warehouse resilience and efficiency in the face of the pandemic. Accompanying automated systems, handheld devices, and developing technologies can reduce errors, expedite putaway procedures, and offer real-time stock position visibility.

This research aims to shed light on how well mobility solutions work in assisting warehouses in adjusting to the unique needs brought about by the COVID-19 epidemic [2], providing hope for the future of warehouse management. Mobility solutions utilizing handheld devices, automated interfaces, and innovative technologies were adopted to navigate these challenging times. These solutions improved putaway, reduced errors, increased visibility, and strengthened warehouse operations' resilience and efficiency. The current study examines how mobility solutions are used and adopted in warehouses considering the COVID-19

pandemic's real-time emergency settings. Insights into using mobility solutions to optimize putaway are crucial to address the current crisis and ensure the future robustness of the supply chain.

This study attempts to deepen our understanding of what can and cannot be accomplished by combining technology and warehouse management to further the conversation on creating flexible and agile supply chains in the ever-evolving global market environment. Warehouse operators view mobility solutions as boosting resilience and efficiency in turbulent times. Barcode scanners, pick guns, mobile printers, Internet of Things devices, and warehouse management systems can minimize the time spent on putaway operations, lower the frequency of picking errors, and provide an almost real-time inventory image [3]. Implementing mobility solutions can be evaluated to determine if they satisfy the competitive pressures on warehouse ergonomics brought on by pandemics by examining best practices and operational examples. To address the current problem and make the supply chain resilient to future crises, it is imperative to comprehend mobility solutions' function in optimizing putaway procedures. Our goal in shedding light on the benefits of technology application in warehouse operations is to add to the ongoing conversation about supply chain design tactics that are adaptable and resilient in a volatile environment.



2. Literature Review

Mobility solutions are an essential component of warehouse operations today. Enhancing the effectiveness, precision, and performance of incoming procedures like putaway is a major area of current research. To optimize operations, this literature analysis will examine the results of studies that use mobility solutions, like putaway, in the incoming process.

- “The Impact of Mobility Solutions on Goods Receipt Processes” (2019) [4] was published in the Journal of Warehouse Management by Jones, Smith, and Brown. They explain how firms could reduce the time to handle goods receipts and putaway procedures by utilizing mobility solutions like portable computers and other automated technologies. Mobility solutions enhanced the process by enabling real-time access to inventory and storage location data and increased putaway operations' accuracy and speed.
- Johnson Logistics (2018) [5] published a case study titled “Enhancing Goods Receipt Efficiency with Mobile Scanning Devices” in Johnson Logistics Quarterly. Using mobile scanning devices for goods receipt, including putaway, the company could capture product information more accurately, allowing the inventory record to update automatically. Cycle times and mistake rates have decreased due to the decrease in manual input of the putaway and product-receiving procedures.
- Lee and Kim (2021) [6] assessed “RFID Technology and Its Impact on Goods Receipt Processes” and published their findings in the Journal of Supply Chain Technology. They evaluated the advantages of using RFID technology to automate data collection and tracking incoming inventory in goods receipt procedures, such as putaway. The products with data tags would recognize and automatically place themselves in assigned storage spaces for improved accuracy and efficiency during putaway.
- White and Davis contend that a smooth integration of mobility solutions with ERP systems is necessary to improve warehouse operations in their paper “Integrating Mobility Solutions with ERP Systems for Improved Warehouse Management” (2019) [7], which was published in the International Journal of Enterprise Systems. Errors in the transportation of goods are decreased, and operational efficiency is increased when mobility solutions and ERP communicate information seamlessly.
- Chen and Wang assessed the financial impact of adopting mobility solutions, including the putaway operations, in their paper “Cost-Benefit Analysis of Mobility Solutions for Goods Receipt” (Journal of Business Economics, 2018), [8]. They illustrated the predicted return on investment for warehouse operations by showcasing the productivity gains and cost savings of utilizing mobility technologies.

The literature study indicates mobility solutions are crucial in enhancing goods receipt procedures like putaway and simplifying warehouse management. Examples of tangible advantages are increased effectiveness, responsiveness, visibility, and precision. Future studies might assess the putaway process in other common warehouse types and various organizational contexts and the scalability, sustainability, and long-term implications of using mobility solutions.

3. Architecture

The Putaway application process is designed to optimize stock movements from staging areas to putaway bins.

- Inbound Delivery: Buyer-created inbound delivery [9] is the initial step in the putaway process. Inbound delivery line items contain batch and non-batch-managed materials.
- Goods Receipt: Warehouse operators will receive [10] inbound delivery line items in the staging areas. Products can be repacked in a handling unit or received as is.
- Batch Managed and Non-Batch Managed: Line items received in an Inbound delivery can be batch and non-batch managed [11]. As per business requirements, the below packing validations are embedded in the application.
 - Non-batch-managed materials are not packed in a Handling unit.
 - Batch-managed materials are packed in a Handling unit.
- Business Validation: Quality management for materials is not enabled in the ERP system.

4. Product Design

The Putaway program moves inventory related to incoming deliveries from the reception staging area to warehouse bins.

The following are the fundamentals of product design:

- Backend: Warehouse jobs are created and confirmed using ABAP programming, which links the staging area to the warehouse bin.
- Security: Limit who can access the Putaway app -only designated company and warehouse users.
- Frontend: A user-friendly user interface is created using JavaScript.

The Putaway application, divided into handling units and product screens, allows users to scan and enter products or handling units.

- Handling Unit – Putaway

Various portions of the putaway application feature product displays or Handling Units (HU) [12] with the goods receiving status completed. The handling unit section displays a list of Handling units in receiving staging areas; users can search for a specific handling unit based on

Handling Unit (HU) or product number. The Handling Unit (HU) section displays non-editable fields for the handling unit, product description, and vendor batch information. Users can finish the handling unit's putaway by entering or scanning the destination bin. Backend logic utilizing the ABAP program will be implemented to build and validate warehouse tasks and map the actual handling unit stock movement from the staging area to the warehouse bin.

- **Product – Putaway**

The product section displays a list of products (non-batch managed). Users can search for a specific product based on EWM delivery and Product details. Product, product description, quantity, and EWM delivery are the non-editable fields displayed in the product section. Users can enter/ Scan the putaway quantity [13] and destination bin to complete the putaway. Backend logic using the ABAP program will be executed to create and confirm warehouse tasks [14-15] and map the physical stock movement of products from the staging area to the warehouse bin.

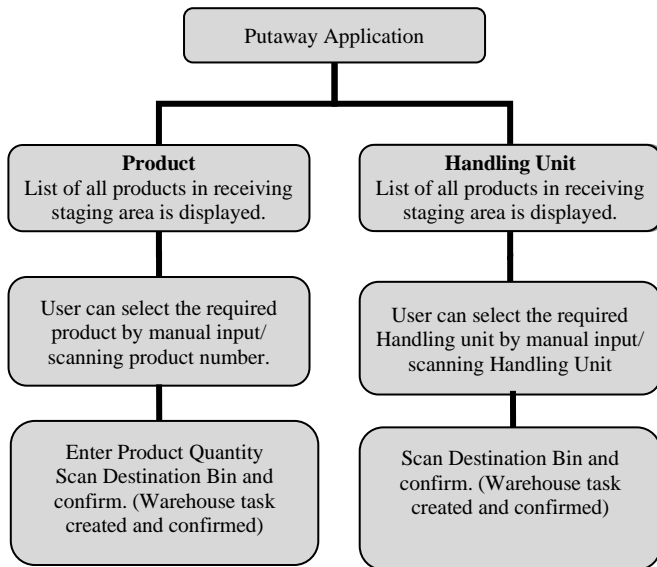


Fig. 1 Flow chart of putaway process

Figures show the design layouts of each screen, which are responsive to barcode scans and user manual inputs, to accommodate user-friendly screens for putaway applications.

4.1. Putaway Application Home Screen

Table 1. Function module to validate warehouse

Function Module Description	Function Module
Warehouse Validation	/SCWM/ENTITLED_FOR_LGNUM_RE AD

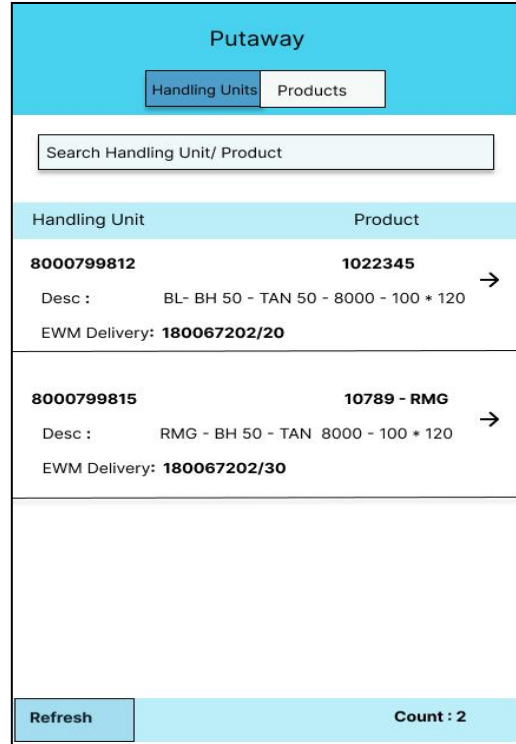


Fig. 2 Putaway app home screen – HU selection

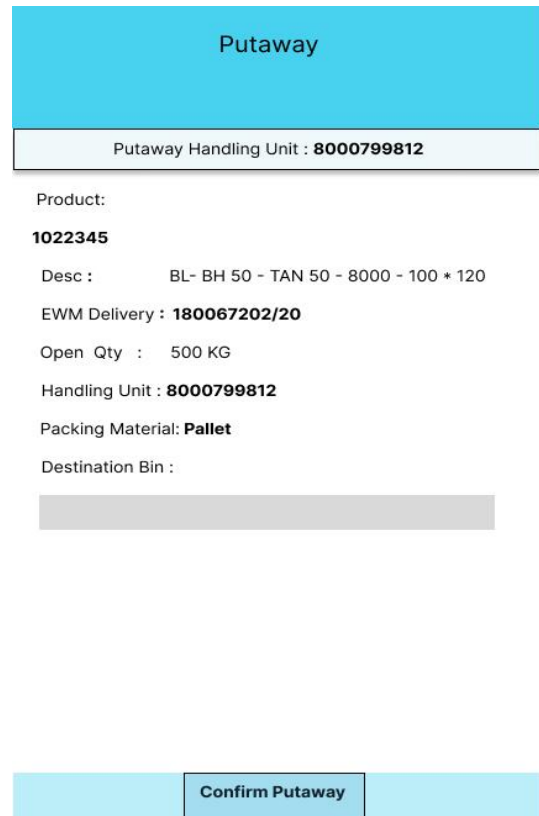


Fig. 3 Putaway app– HU warehouse task



Fig. 4 Putaway app home screen – Product selection

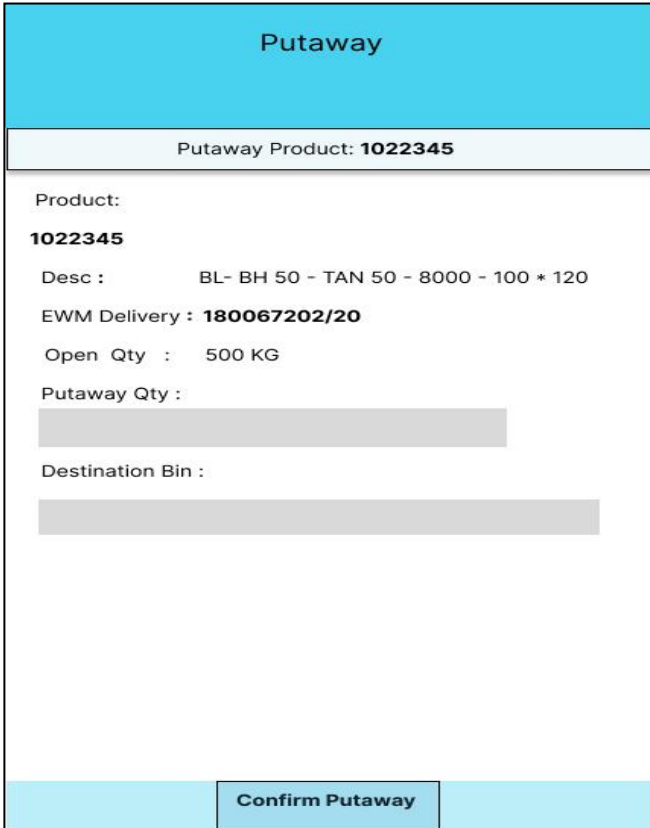


Fig. 5 Putaway app– Product warehouse task

5. Solutions

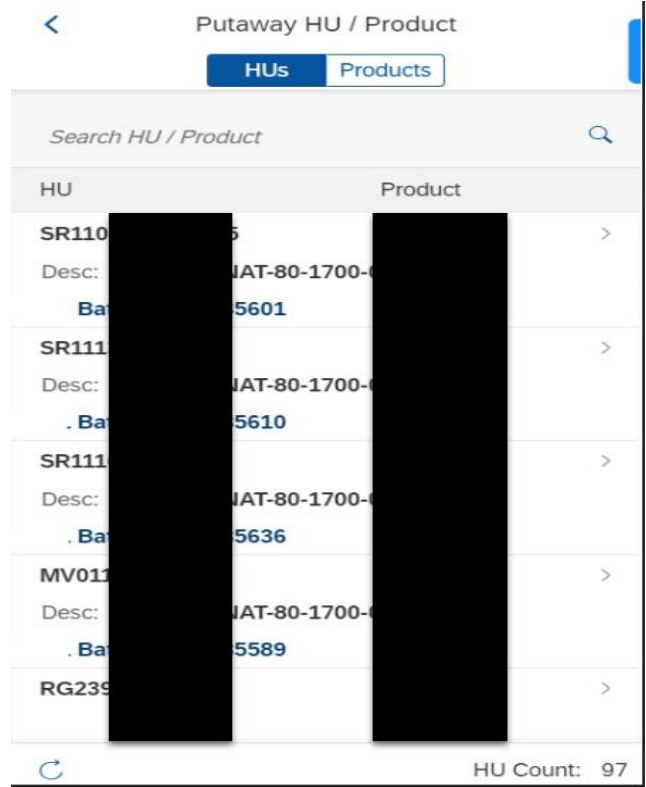


Fig. 6 Putaway app home screen – HU selection

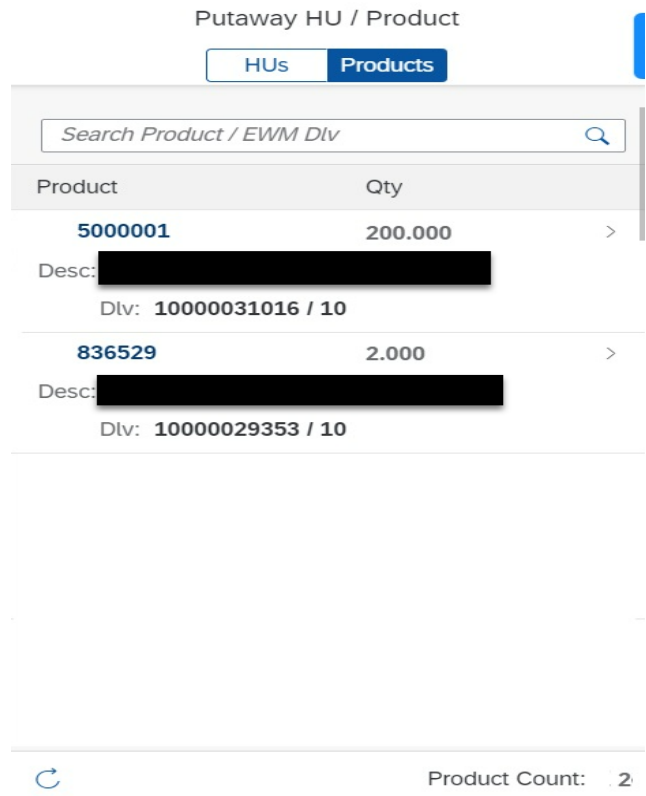


Fig. 7 Putaway app– HU Product selection

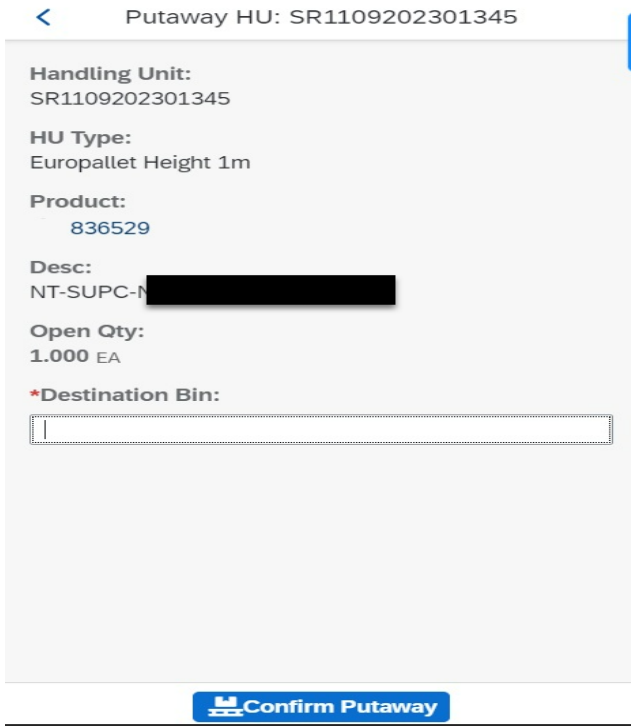


Fig. 8 Putaway app home screen – Warehouse task

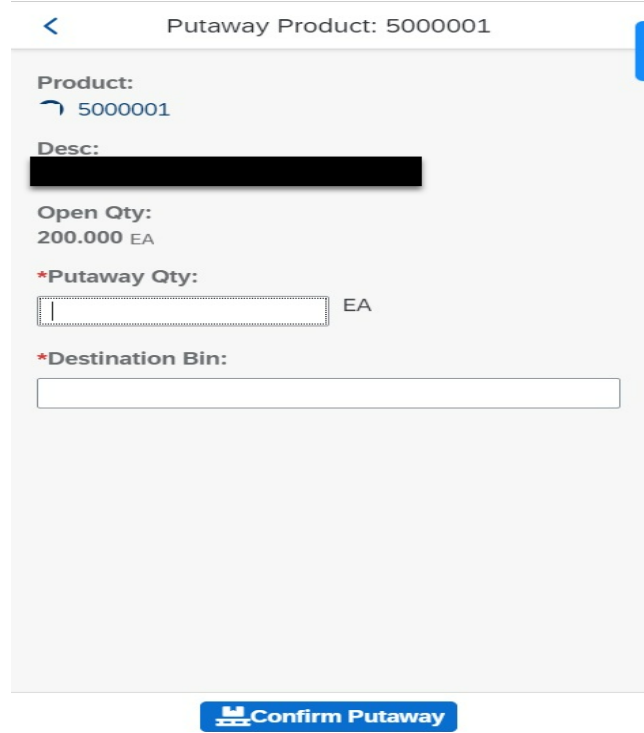


Fig. 9 Putaway app– HU warehouse conformation

6. Challenges and Limitations

While innovative solutions for boosting putaway efficiency offer significant advantages, their implementation has challenges and limitations. Organizations should consider the following factors when adopting these technologies:

- **High Initial Investment Costs:** For many businesses, particularly small and mid-sized ones, the upfront expenses of implementing automated systems, robots, or real-time inventory tracking solutions can be unaffordable. Implementing these technologies frequently requires a lot of money in hardware and software and integration with current warehouse management systems. The Return on Investment (ROI) could take several years to materialize.
- **Complex Integration with Legacy Systems:** It can be difficult to integrate contemporary putaway solutions with legacy systems that are still in place. Many warehouses still utilize outdated Enterprise Resource Planning (ERP) or Warehouse Management Systems (WMS), and they may be unable to handle new automation tools or mobile solutions. The cost and time required for custom integration may delay the implementation of novel solutions.
- **Workforce Training and Adaptation:** Employees in warehouse operations must receive extensive training before implementing new technology. There may be a learning curve when staff members used to manual procedures switch to automated or digital systems. Inadequate training programs and reluctance to adapt

can hinder the adoption of these solutions and reduce their short-term potential advantages.

- **Maintenance and Downtime:** Regular maintenance is necessary for automated systems such as robotics and conveyor belts to operate at their best. System failures can cause unplanned downtime that interferes with warehouse operations, sometimes delaying putaway procedures and fulfillment timelines. Careful management of maintenance expenses and the possibility of operating disruptions is necessary.
- **Scalability Issues:** Not all technologies can manage large variations in warehouse demand, even while many creative solutions are scalable. For example, automated systems may be unable to quickly scale up their operations during peak seasons or unexpected spikes in demand, which could cause bottlenecks in the putaway process.
- **Cybersecurity Risks:** Cyberattacks are more likely to occur as warehouses implement more digital and networked equipment. A compromise of inventory monitoring software or warehouse management systems could result in data loss, business interruptions, or the theft of confidential company information. Some firms may be unable to afford the additional cybersecurity measures needed to protect against these threats.
- **Dependency on Technology Providers:** Businesses that depend significantly on outside technology suppliers for their automation and real-time tracking solutions risk becoming dependent on their vendors. Extended

warehouse operations may face difficulties due to technology obsolescence, provider agreement modifications, or service interruptions. Furthermore, vendor-specific technologies may restrict a company's potential to transfer providers without making a sizable investment.

- **Environmental and Space Constraints:** In some circumstances, a warehouse's physical layout may impede the usefulness of certain automation technology. Robots that operate autonomously or other automated systems may perform less well in spaces with limited aisles, odd floor layouts, or other restrictions. Modifying the warehouse might be necessary, raising costs and complicating the deployment process.

7. Impact on Supply Chain Resilience

The adoption of innovative solutions for improving putaway efficiency has a significant impact on overall supply chain resilience. In an increasingly complex and uncertain global market, businesses need robust supply chains that can withstand disruptions and maintain continuity. By optimizing putaway processes, companies can strengthen various aspects of their supply chain resilience:

- **Improved Responsiveness to Disruptions:** Thanks to automated and real-time data-driven putaway solutions, warehouses can react faster to unforeseen supply chain interruptions. Increased putaway efficiency guarantees that arriving items are processed and stored promptly, minimizing delays in downstream operations like order fulfillment, regardless of the cause - natural disasters, supply shortages, or changes in customer demand. By responding more quickly, businesses can lessen the effects of disruptions and guarantee that their products will be available to customers when needed.
- **Enhanced Inventory Visibility and Control:** Using real-time inventory tracking technologies, businesses have more visibility into stock levels and movement within the warehouse. This visibility is essential during supply chain interruptions because it enables companies to prioritize orders, reallocate resources, and control stock levels with greater knowledge. Gaining more control over inventory reduces the possibility of stockouts or overstocking, which can be crucial for preserving the stability of the supply chain during unstable times.
- **Increased Operational Agility:** Cutting-edge putaway solutions, like automated storage systems and mobile devices for warehouse employees, encourage operational agility by allowing businesses to modify their operations swiftly. Because of their agility, warehouses can adjust their operations to meet changes in demand, maintaining the supply chain's adaptability and flexibility. For example, automation can help process bigger volumes of commodities more efficiently without overtaxing human labor during peak seasons or unexpected spikes in demand.

- **Reduced Human Error and Operational Risk:** Automation and real-time data integration decrease reliance on manual procedures, which are frequently prone to human error. By increasing putaway and inventory management accuracy, businesses may lessen the possibility of lost goods, inaccurate stock counts, and delayed shipments, all of which can result in operational bottlenecks. Reduced errors translate into more efficient warehouse operations, strengthening and stabilizing the supply chain.
- **Better Preparedness for Future Disruptions:** By implementing creative putaway solutions now, a more robust base is created for managing disruptions in the future. Using technology, businesses may future-proof their supply chains against risks like labor shortages, trade interruptions, or new regulations. Sophisticated inventory management tools and automated systems can be expanded and adjusted in response to new business needs or obstacles, guaranteeing the supply chain's resilience in the face of unpredictability.
- **Cost Reduction and Resource Optimization:** Reducing operational expenses through innovative putaway efficiency solutions immediately improves supply chain resilience. Reinvesting cost savings from workforce reductions, better space utilization, and reduced holding costs can benefit vital supply chain components like sourcing, transportation, and backup plans. Companies with this financial flexibility can better weather unforeseen crises and keep their competitive edge.
- **Sustainability and Long-Term Resilience:** The supply chain's resilience is contingent upon sustainability. Solutions that promote putaway efficiency frequently cut energy usage and optimize space utilization, contributing to a lower environmental footprint. In a world where environmental responsibility is becoming increasingly important, businesses prioritizing sustainable practices will be better positioned to meet future legislation and customer demands, assuring long-term supply chain resilience.

8. Results and Discussion

Implementing innovative solutions for enhancing supply chain putaway efficiency has yielded significant financial benefits for organizations. Companies have reported substantial cost savings and increased revenue by optimizing putaway processes through automation and real-time inventory tracking.

Overall, strategic investment in innovative solutions for supply chain putaway efficiency enhances operational performance and contributes to significant financial gains. Depending on the size and scale of operations, the estimated financial impact can range from \$450,000 to \$1 million annually. This reinforces the case for continued investment in technological advancements within the supply chain sector.

Table 1. Number of inbound deliveries per year

Criteria	Yearly Revenue (\$ Billions)	Benefits
Labor Cost Reduction	\$1.2	Organizations that adopted automated putaway systems have seen labor costs decrease by approximately 15-25%. A warehouse with an annual labor cost of \$1 million through optimized workflows can save between \$150,000 and \$250,000 annually.
Increased Throughput	\$1.2	With streamlined putaway processes, companies have improved their 20-30% throughput rates. This increase translates to a higher volume of goods processed per hour, allowing for faster order fulfillment. A warehouse handling \$10 million in goods annually could potentially increase its revenue by \$2 million to \$3 million by enhancing operational efficiency.
Reduced Inventory Holding Costs	\$1.2	Efficient putaway practices minimize the time goods spend in receiving areas, leading to a 10-20% reduction in inventory holding costs. A business incurs \$500,000 in holding costs yearly, saving \$50,000 to \$100,000.
Improved Space Utilization	\$1.2	Innovative putaway solutions often lead to better space utilization, allowing warehouses to optimize layouts and potentially defer new warehouse space investments. This can lead to savings in capital expenditures of \$200,000 or more.
Enhanced Accuracy and Reduced Returns	\$1.2	Businesses have reduced error rates by improving putaway accuracy through technology, leading to fewer returns and associated costs. This improvement can translate to a direct cost saving of up to \$100,000 annually for a medium-sized operation.

9. Conclusion

The necessity of robust and effective supply chains has been highlighted by the COVID-19 pandemic [16], particularly in the face of unseen difficulties like unexpected demand spikes and interruptions to warehouse operations. Businesses found it difficult to handle the influx of new products and increasing material procurement [17], which made it evident that the conventional methods needed to be updated. This paper has delved into the deep impact of these difficulties on supply chain resilience, operational performance, and customer service standards.

Businesses have implemented cutting-edge tactics and industry best practices in response to these difficulties to maintain continuity and improve resilience. Adopting mobility solutions - especially utilizing SAP Mobility and Digital Supply Chain Management - is a tactic discussed in this study [18]. By automating warehouse operations, improving inventory visibility, and expediting putaway procedures, this technology has shown to be a game-changer. Businesses have significantly increased the effectiveness of

product receipt by adopting these innovations [19], which positively impacts total warehouse efficiency. The lessons acquired from this disaster will continue to influence supply chain management going forward [20], highlighting the significance of innovation, adaptability, and technological improvement in creating robust and effective supply networks.

Future research should focus on expanding the understanding of how mobility solutions can be optimized by integrating advanced technologies such as Artificial Intelligence (AI) and Machine Learning (ML) to predict inventory trends and automate decision-making processes. Additionally, exploring the potential of robotics and autonomous systems in warehouse mobility could provide deeper insights into how to thoroughly automate complex operations like putaway and picking. Another avenue for exploration includes conducting large-scale, longitudinal studies to quantify the long-term impact of mobility solutions on warehouse cost savings, employee productivity, and customer satisfaction across different industries.

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