

**Evaluating the Feasibility and operational impact of
Auto-store Solution in HealthCare Distribution
Facility**

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Abstract

Healthcare distribution centers continuously face pressure to improve the accuracy and speed of their operation, especially for critical life-saving cases that required providing the needed medicine and operation tools no matter of the ordering time or the status of the physical warehouse operation. Despite the earlier automation attempts such as Warehouse Management System (WMS), and Semi-automated conveyors, the solutions still did not fully addressed the delay in the order fulfillment cycle which is very critical in the healthcare operation, the space limitation in the piece picking area, travel time of the operator and the rising market expectation.

The Research explore the feasibility of implementing one of the most trending solutions in the operation and warehousing which's the Auto-store automation in the new mega distribution center in Riyadh (KSA), assessing the operational values as well as the implementation and integration challenges, and the expected ROI by reviewing the recent literatures and evaluate the industry bench mark to evaluate and determine whether the auto-store can achieve the desired objective

Chapter 1: Introduction

Healthcare distribution and operational environments are becoming very complex due to the increased products portfolio, SFDA and regulatory requirements, and the urgent demand from the end customers such as Hospital and clinics.

The pressure is to deliver the product faster in some scenarios within four hours, with the best quality of the product's shape and maintaining the precious temperature control in order not to impact the life of the patient. Ultimately, the goal is to ensure the On-Time-in-Full (OTIF) delivery performance.

This research focus on exploring some emerged trend in the automation of the operation world, and focus in adopting the Auto-store solution to automate the piece picking area of Healthcare Distribution Center in Riyadh, where the products are very sensitive and required special handling and high accuracy.

The Chapter introduces the background of automation in healthcare sectors, identifies the main operational challenges and evaluates the feasibility of the auto-store solution

Background

The last decade has rapidly witnessed a global shift toward automation. The published researches indicate that automation has improved the accuracy in the logistics operation by up to 40%, which is particularly critical in healthcare business where single picking error can affect patient safety. Earlier automation initiatives such as implementing Oracle Warehouse Management System and Integrating Semi-Automated conveyor have delivered an improvement in the accuracy and travel time. However, they were not completely sufficient to meet the growing operational complexity.

Healthcare distribution faces many challenges that are less prevalent in some other industries:

- Strict Batch and Expiry Control
- Product recall based on Ministry of Health requirements
- Temperature Controlled storage area
- Compliance with SFDA and global medicine standard
- Urgent fulfilment for patient needs

Advanced automations promise high density storage, improved picking and rapid retrieval. However, they raise concern about cost, complexity, cyber security and team adaptability.

Problem Statement:

Delay in order fulfilments, space limitation in piece picking area, and the growing need for more precise and accurate picking have become critical and serious challenges in the operation of Healthcare distribution. Although multiple automation initiatives and solutions were implemented in the last decade in the main warehouse centers for one of the biggest Healthcare distributors in Saudi Arabia, the digital transformation started when deciding to initiate the first layer of the Automation by implementing Oracle Warehouse Management System, then moving to have semi-automated conveyor solution integrated to the running WMS to reduce the travel time within the warehouse and improve the accuracy and the team productivity. Despite all the above effort the market expectation tremendously increased, demanding faster order fulfilment for common and urgent patient requirements that include live saving cases.

Existing researches, and advancement in the technologies provides a wide range and variance type of trending automation solutions. However, in the same time it raises many concerns and indicated challenges that could cause a delay to move forward with the automation such as big investment cost, team resistance, expected integration and cyber security issues.

Therefore, clear need for research to evaluate and explore the possibility of utilizing the Auto-Store solution in the new mega Distribution Center located in Riyadh city to be one of the first of its kind in the region. The study tried to balance between the conceptual benefits mentioned in the published papers, and the actual implementation with real customer reference that prove the case and confirm the potential ROI that could convenes the business owners to fund and support the project

Trend of the Industry

The automation is not an option any more, and the global warehouse automation is expected to exceed 41 billion USD by 2027 (McKinsey - 2023), hence, automation is not an option and must occur but definitely in the correct manner, and following the right approach to avoid impacting the sensitive healthcare operation.

Inventory volume and inventory complexity were identified as the main driver to accommodate the automation, along with the organization internal capabilities and external demands that jointly shape the logistics automation approach (A Study on the Application of Logistics Automation in the Healthcare Industry). Moreover, some of the reference researches clearly highlighted that the gained precision of the automation in Healthcare sector increased by 40% which is one of the ultimate goal here. (Recent Advances and Challenges in Industrial Robotics: A Systematic Review of Technological Trends and Emerging Applications)

Research Objective

The overall aim of the research is to solve and accelerate the operation of the order fulfillment process cycle, improve the space utilization along with the accuracy of the picked material that's critical for healthcare patients and ensuring the solution is aligned with industry regulations and address real live operational challenges.

1. To review the related recent studies and researches, their recommendations and encountered challenges. The main purpose is to count on formal references prior to move to the selection and to figure out the best in class solution that would definitely improve the process and still fulfill the SFDA requirements to keep the products and batches physically isolated
2. To assess the different options, and ensure the selected solution is the best fit for the healthcare industry, and piece picking scenarios
3. To Validate the current implementation of auto store solution, and quantify the outcomes based on real live scenarios avoiding any assumptions or hypothetical expectations

Research Objective (Cont.)

4. To evaluate the common risks identified in the previous research, including user resistance and slow adoptability, long ROI cycle, and integration complexity
5. To identify the key operational success factors, the reliability of the solution, and compatibility to integrate with the current version of Warehouse Management System, and process redesign requirements, and long term scalability. The overall objectives are directly aligned with the challenges in the problem statement, elaborating the current status quo and what could be offered to bridge the gap and deliver the right solution considering many business concerns to produce measurable and practical outcomes

Chapter 2: Literature Review

2.1 Overview of Automation in Healthcare Logistics

Automation in Healthcare logistics has expanded and demanded rapidly due to the high volume of order processing, government regulations, and precise accuracy sensitivity connected with the patient critical operation. Recent studies highlight that Healthcare distributions faces unique operational challenges temperature control for high value drugs, batch level traceability and urgent fulfillment cycles that require high reliable and efficient systems. Therefore, the automation solutions are becoming essential tools for reducing error and improving the operational productivity and increase the service level, but, should consider the significant concern in the energy and maintenance costs associated with automation technologies [\[1\]](#).

Automation in healthcare logistics has been growing very fast due to the increased number of orders, strict regulations, and the high accuracy required in patient-critical operations. Several recent studies highlighted that healthcare distributors deal with complex storage conditions such as temperature control, expiry management, and sensitive handling requirements, which make the manual operation very challenging to maintain at a consistent level [\[2\]](#).

2.2 Goods-to-Person Automation Technology

Goods-to-Person that include Put-to-Light and Pick-to-Light are emerged as leading approaches in the modern automated warehouses. Auto-Store system provide rapid stock retrieval and high density storage utilizing small spaces to maintain more stock especially for piece picking, also, it reduce the travel time within the warehouse which make it suitable for warehouses with space constraints. Shuttle systems offer higher throughput but require more complex infrastructure. Autonomous Mobile Robots (AMR) add flexibility by enabling dynamic routing. However, each technology carry certain limitation, Auto-Store has restricted product size combat ability, Shuttle require significant investments and AMR could struggle in high congested environment. Boysen and Stephan explained that Auto-Store can significantly improve storage capacity and reduce manual handling by delivering the bins directly to the picker [3]. A comparison by Chung and Khodabandeh shows that each solution has advantages and limitations depending on the SKU size, daily volume, and available space. For the healthcare distribution Auto-Store aligns well with the need for accuracy, controlled storage, and space utilization, which are all important factors in this industry [4].

2.3 Key Drivers for Adopting Automation in HealthCare Distribution

The following points addressed the main driver behind adopting the automation in the healthcare warehouses and distribution centers

- Inventory Complexity
- Regulatory pressure and requirements
- High picking accuracy
- Space utilization for piece picking
- Urgency and process acceleration

2.4 Barrier and Challenges of Automation

Even though automation always brings many benefits, still there are several challenges impact such decision as follows

- High investment
- Minimal regional references
- Integration challenges
- Internal resistance
- Data and cyber security

2.5 Research Gap

While many studies highlighted the automation benefit such as improved speed, precisions and overall accuracy, there are lack of researches focus on the implementation of the Auto-store specifically within the healthcare distribution sector, and particularly in the Gulf region.

This gap highlights the needs for focus evaluation of the Auto-Store sustainability, performance outcomes, and the different implementation consideration within the Gulf region

Chapter 3: Research Methodology

3.1 Research Design

The study will follow a mixed-method approach that combines both qualitative and quantitative inputs. This is important because evaluating an automation solution such as Auto-Store requires understanding not only the technical performance, but also the operational experience and industry direction.

- **Qualitative analysis** will come from industry reports, published studies, and discussions with people who already operate or manage similar automation systems.
- **Quantitative indicators** will include accuracy levels, space utilization, throughput, and other measurable performance factors collected from real implementations.

3.2 Data Collection

Data will be gathered from three main sources:

- Reviewing recent studies, research papers, and market reports related to warehouse automation and Goods-to-Person systems.
- Interviewing operations managers or automation specialists to capture hands-on knowledge and real challenges from the field.
- Examining available operational data from Auto-Store deployments, focusing on performance trends and actual outcomes.

These sources will help ensure that the study reflects both theoretical insights and real operational experience.

3.3 Data Analysis

The collected data will be analyzed to understand the actual impact of automation compared to traditional warehouse operations. This includes:

- Comparing performance indicators before and after automation.
- Mapping the results back to the research objectives to confirm whether the solution addresses the identified gaps.
- Validating the findings against SFDA compliance requirements and other healthcare-related considerations.

This step helps ensure that the analysis remains practical and aligned with industry-specific needs.

3.4 Tools and Techniques

Several tools and techniques will support the evaluation:

- Warehouse capacity and storage modeling
- Process mapping to visualize current vs. automated workflows
- ROI estimation models to understand financial feasibility
- Assessment frameworks for WMS and system integration readiness

These tools will help present a structured evaluation and reflect the operational improvements Auto-Store can offer.

Summary

Overall, this methodology provides a clear and measurable approach to evaluating the feasibility of the Auto-Store solution by combining operational data, industry research, and practical insights from subject-matter experts.

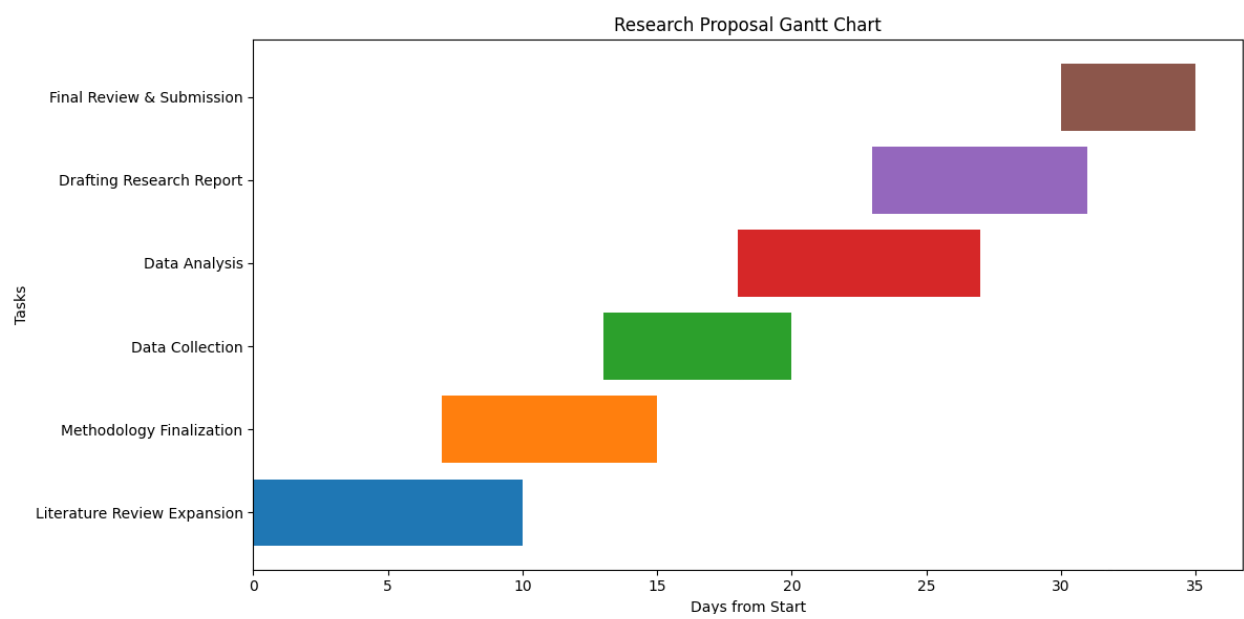
Expected Outcomes

The study expected to provide the following

- Validated perspective of the Auto-Store and if it could significantly improve order fulfillment speed and accuracy in the Healthcare
- Quantified improvement indicator for accuracy, productivity and space saving and utilization
- Clear understanding of the risks and related limitations including integration challenges
- List of implementation success factor to guide the stakeholders to take the right decision

Gantt Chart

The referenced below Gantt chart elaborate the timeline spent on this research. Which outlines the phases along with the literature review, data preparation, development, evaluation and final documentation along with the durations. Also, ensures that the project progresses methodically and within the allocated timeframe.



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