

Exploring The Hindrance to Robotics Adoption in Warehouse Operations in Coimbatore City

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Abstract:

In recent years warehouse operations have experienced an increase in the use of robotics to meet the need for better productivity efficiency and accuracy. While growing in popularity, the percentage of warehouses that have converted to using robots has not changed much from year to year. This project will identify the key barriers to or catalysts of warehouse robotics adoption by assessing the underlying economic technological organizational infrastructural and environmental considerations influencing company's decision about whether it is willing to implement robotic systems within its warehouses. Potential economics include initial cost of investment, maintenance costs, and financial readiness. Possible technology includes system complexity, reliability, and compatibility issues. Organizationally key influences include the level of management support, the readiness of employees to adopt new technology, and an organizations resistance to change. In addition to financial, technological, and organizational hurdles, the project also assesses the state of warehouse infrastructure readiness (ex: facility layout, power supply, and system integration). Finally it will evaluate the environmental factors affecting warehouse robotics use (ex: workplace conditions, safety concerns, and regulatory influences). Ultimately this project provides warehouse managers and consultants with valuable insight into the difficulties they face however it also demonstrates the importance of balancing the elements of financial technological and organizational readiness to successfully implement robots into their warehouses.

Keywords — Warehouse Robotics, Automation Adoption, Productivity Efficiency and Technological Implementation.

I. INTRODUCTION OF THE STUDY

Robots are changing the way warehouses operate. They can make the warehouse process faster easier and cheaper but not all warehouses have taken the plunge into this technology. There are challenges that warehouse operators face when adopting robotic technology. The two biggest roadblocks to robot implementation are the high cost of setup and training, and the fact that most warehouse operators do not have the expertise or experience necessary to integrate a robotic system into their existing workflows or to manage the multiple interfaces associated with

these systems. Additionally the challenges associated with employee resistance are a significant hindrance to the adoption of robotic technology in warehouses. To help warehouse operators understand why robots have not yet become mainstream I will explore the roadblocks to the adoption of robotic technology as well as identify the types of preparations that are required in order for a warehouse to successfully transition from a manual to an automated environment..

II. STATEMENT OF THE PROBLEM

The study examines the adoption of robotics in warehouse operations and highlights benefits such

as improved efficiency accuracy and productivity but high costs technological limitations organizational resistance and inadequate support hinder effective implementation making it essential to understand these barriers.

III SCOPE OF THE STUDY

This study aims to know the effectiveness acceptance and limitations for existing automation practices used within warehouse operations and decision making processes.

IV OBJECTIVES

- To identify how economic factor affects robotics adoption in warehouse operation.
- To study the impact of the technology related challenges on robotics adoption.
- To evaluate the overall extent of robotics adoption in warehouse

V RESEARCH METHODOLOGY

- ❖ **Research Design:** Descriptive Research
- ❖ **Area of the Study:** Coimbatore, Tamil Nadu
- ❖ **Sampling Size:** 55 respondents
- ❖ **Sampling Method:** Simple Random Sampling.
- ❖ **Sources of Data:** Primary data and secondary data
- ❖ **Data Analysis Tools:** Simple percentage analysis, Factor Analysis and One-Way ANOVA.

VI REVIEW OF LITERATURE:

- According to Jianming Cai et al (2021) The authors developed an optimization model for robotic mobile fulfilment systems (RMFS) characterizing a storages location assignment and AGV path planning. The study uses an improved A* algorithm to show increases in order-picking efficiency and reduced energy consumption. Their model executes the shift from traditional warehousing to green and intelligent warehousing.
- According to Sadia samar Ali and Kaur (2024) This study assesses Technology 4.0 practices in warehousing based on the fuzzy Delphi and Factor Analysis (BWM) methods. The authors identify and priorities key factors such as

man machine collaboration and automated storage systems. While the findings indicate that technology readiness and human participation has a positive influence on distribution efficiency.

- According to Shan Lee et al (2024) the authors provide a study of the application of robots in the intelligent supply chain with emphasis on CNN. Robot that are trained to identify differing shape increase picking accuracy and energy saving. This will also help build automation system and alignment with ESG standards that promote sustainable and socially responsible warehousing process.

Current role of the employees			
Sn o		Number of respondent s	Percentage %
1	Logistic Manager	20	36
2	Warehouse Supervisor	10	18
3	Supply Chain Analyst	4	7
4	Others	21	38
Employee experience in the organization			
5	0-2	46	89
6	Above 10	9	11
Type Of Company			
7	E Commerce	18	32
8	Manufacturin g	13	24
9	3pl/Logistics	12	22
10	Others	12	22

INTERPRETATION

The comparison shows that respondents are mainly from the (others) category and logistics managers while the 0-2 years category represents the largest experience group. Together this suggest that the responses are largely and making them most influential group in the survey.

FACTOR ANALYSIS

	1	2	3	4	5	
Government rules affects the use of the robots in warehouses	.821					ECONOMIC
Existing systems are not easily connect with robotics	.789					
Robotics improve the speed and accuracy in warehouse work	.776					
Poor power supply and internet connectivity limits automation use	.775					
Environmental safety standards limit robotics usage		.759				
Absence of clear company policy affects the adoption process		.755				TECHNOLOGY
Employees resist changes due to the fear of job loss from automation		.647				
Is your warehouse ready for robotics implementation (infrastructure wise)		.632				
Do you expect robotics to become common in warehouse in the next 5 years			.630			

Lack of proper infrastructure slows down the robot adoption			.550			INFRASTRUCTURE
Lack of skilled workers affected the use of robot			.808			
Robotics technology is difficult to understand and use			.804			
Management lacks awareness about the benefits of the robotics				.709		ENVIRONMENTAL
Industry regulations influence the adoption of robotics				.616		
Robotics in warehouse is beneficial for improvement of logistics efficiency				.795		
High maintenance expenses make it hard to use robots in warehouse use				.662		
The warehouse layout is not suitable for installing robots					.641	ENVIRONMENTAL
The cost of using robotics in warehouse is high					.804	
Are you aware of robotics technology in warehouse operations					.782	

Using robots requires a large investment					.557
KMO and Bartlett's Test	0.817				
Total Variance Explained	49.96 2	58.22 7	65.89 4	752.09 7	77.56 5

(Source: primary data)

INTERPRETATION

Factor analysis identified the key factor influencing the adoption of robotics in warehouse operations, with a KMO value of 0.817 and a significant bartlett’s test $p= 0.000$ confirming the sustainability of the data. Five factors were extracted explaining 77.5665% of the total variance representing regulatory and infrastructure barriers, skill and technology complexity operational benefits cost concerns and awareness with future readiness.

ANOVA ANALYSIS

H0: There is no difference between the awareness and perception towards the role of employees.

H1: There is difference between the awareness and perception towards the role of employees.

Table 2 The role of the employees and awareness and perception

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	972.048	3	324.016	1.232	.308
Within Groups	13153.600	50	263.072		
Total	14125.648	53			

(Source: primary data)

INTERPRETATION

As per the above table there Is no significant difference in the mean responses regarding all awareness and perception factors of robotics adoption across different current roles of the significance value is 0.308 which is greater then the 0.05 level of significance. Hence the null hypothesis is accepted.

H0: There is no difference between the awareness and perception towards the experience of the employee.

H1: There is difference between the awareness and perception towards the experience of the employee.

Table 3 the experience of the employees and awareness and perception

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	15.648	1	15.648	.058	.811
Within Groups	14110.000	52	271.346		
Total	14125.648	53			

(Source: primary data)

INTERPRETATION

As per the above table there Is no significant difference in the mean responses regarding all awareness and perception factors of robotics adoption based on the level of experience employees so the significant value is 0.811 which is greater than the 0.05 level of significance. Hence the null hypothesis is accepted.

H0: There is no difference between the awareness and perception based on the types of the company

H1: There is difference between the awareness and perception based on the types of the company

Table 4 the type of the company and awareness and perception

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	545.574	3	181.858	.670	.575
Within Groups	13580.074	50	271.601		
Total	14125.648	53			

(Source: primary data)

INTERPRETATION

As per the above table there Is no significant difference in the mean responses regarding all awareness and perception factors of robotics adoption based on the types of the companies so the significant value is 0.811 which is greater than the 0.05 level of significance. Hence the null hypothesis is accepted.

FINDINGS

- The study reveals that there is no significant difference in awareness and perception of robotics adoption among employees based on their current role and experience indicating similar viewpoint across different respondent groups
- The analysis shows the demographic factor do not significantly influence opinions regarding awareness ,benefits, barriers, infrastructure and future adoption of robotics in warehouse operations.
- Factor analysis identified the key factors influencing the robotics adoption and confirmed the data was suitable for the analysis.

SUGGESTIONS:

- Warehouse organizations should conduct cost benefit analysis to better understanding about the long term financial advancement of robotics.
- Management should explore government subsidies tax benefits an financial support schemes for automation.
- Companies can adopt phased or partial automation instead of full scale robotics implementation to reduce cost burden.

CONCLUSION:

The results of this analysis suggest that none of the demographic and organizational characteristics of the respondent's are positively related to their willingness to implement robots in warehouses operation. Analysis based on ANOVA methods found no statistically significant differences or associations between any of the independent variables. In addition, the use of factor analysis showed that there were five primary dimensions that affect the implementation of robots in warehouses: regulatory barriers, infrastructure, skill set and technology complexity, operational advantages, concerns about cost, and how aware respondents were of the need to prepare for the future. In summary, the results of this survey demonstrated that perceptions towards the adoption of robots in

warehouses are similar between different groups of respondents.

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