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A STUDY ON FACTORS INFLUENCING MATERIAL HANDLING PROCESS AT NLC INDIA LIMITED

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ABSTRACT:

Effective material handling and storage systems are critical to ensuring streamlined operations, cost-efficiency, and safety within industrial environments. This study explores optimization strategies for material handling and storage, emphasizing their impact on productivity, cost reduction, and operational efficiency. The research investigates various methods, including automation and the implementation of advanced storage technologies such as automated storage.

The study is conducted through a combination of case studies, data analysis, and a review of existing literature to identify best practices in material handling and storage optimization. Key findings indicate that automated systems significantly reduce cycle time and labor costs, while lean methodologies help in minimizing waste and improving workflow within storage areas.

KEYWORDS: Material Handling, Storage Optimization, Safety protocols, Training, Environmental condition, Technology.

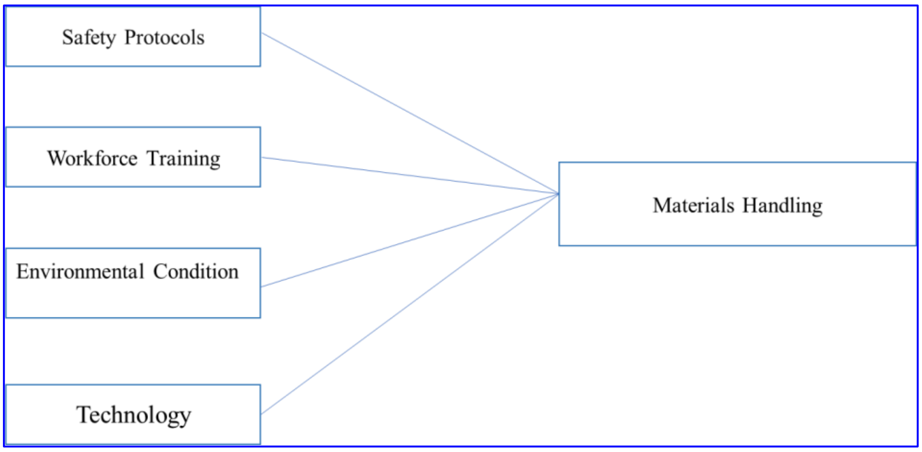
INTRODUCTION:

Material handling equipment selection is an important activity in the design of an effective manufacturing system design. Selecting appropriate material handling equipment can decrease manufacturing lead times, increase efficiency of material flow, improve facility utilization and increase productivity. Borges Vieira, G. B., Pasa, G. S., Borsa, M. B. N. D. O., Milan, G. S., & Pandolfo, A. (2011). Materials handling management: A case study. Journal of Operations and Supply Chain Management (JOSCM), 4(2), 19-30. The research, basic-ally, has entailed the establishment of acceptable handling limits using several different approaches, and the application of ergonomic principles to job design, employee placement and employee training.

The reason for this immense quantity of research is that MH, in particular manual lifting, represents a major cause of injury to industrial workers and cost to industry. Kulak, O. (2005). A decision support system for fuzzy multi-attribute selection of material handling equipments. Expert systems with applications, 29(2), 310-319.Material handling deals with material-flow related processes, including material requirement planning (MRP), scheduling and control of transportation resources (including AGVs, forklifts, and personnel), delivery of materials, buffering, and optimization of materials.

Material handling problem is easily neglected because most people think it is only an auxiliary process to production. From our observation, even in a well-designed assembly line, when the whole line is optimized, including its layout, processes, batching, scheduling, and operations, material handling is still laid outside of the scope of control. In certain industrial sectors, material handling has been the major barrier that results in production breakdowns, low efficiency, and low performance of a production system. Ayoub, M. M. (2020). Manual materials handling: Design and injury control through ergonomics. CRC Press.

CONCEPTUAL FRAMEWORK



OBJECTIVES

- To analyse the efficiency of material handling processes
- To determine the perception of employees towards efficiency of Workforce Training and Skill Level
- To examine difference in perception on employees towards efficiency of Environmental Conditions
- To find out the factor influencing efficiency of Technology and Equipment Utilized

LITERATURE REVIEW

Safety Protocols

Improved safety is one of the main drivers for microreactor application in chemical process development and small-scale production. Typical examples of hazardous chemistry are presented indicating potential risks also in miniaturized equipment. Energy balance and kinetic parameters describe the heat production potential and, together with heat transfer capability, the temperature development in a continuous flow reactor. Besides these calculation procedures, checklists for laboratory safety and risk assessment are the basis for improved laboratory work as well as for equipment-related safety discussions. For complete and larger chemical plants, hazard and operation (HAZOP) studies are the appropriate method of handling hazardous processes and their scale-up. Hao et al., (2008).

Workforce Training

In today's competitive world, it is very difficult and complex task to select one alternative from different sets of alternatives especially when the data are vague and inexact. This paper focuses on the application of one of multi-criteria decision-making tools called the Analytical Hierarchy Process (AHP) for the selection of material handling equipment at a local industry in order to optimize the material handling system. Questionnaires were developed and distributed among experts, employees and workers working in the industry. Zubair et al., (2019).

Environmental Condition

The pitch condition proved to be the most difficult condition to maintain stability regardless of whether or not a load was being handled. Motion direction of a platform, occurring during a lifting task, did not significantly increase muscular activity about the selected trunk musculature but did increase significantly thoraco-lumbar kinematics. Lifting unstable loads, compared to stable loads, in moving environments did significantly increase muscular activity about the selected trunk musculature but did not significantly increase thoraco-lumbar kinematics. Matthews et al., (2007). In doing so, it explores the relationship between the organisation of labour-intensive warehouses and the adoption of LIB forklift by first defining the main variables (i.e., technological, organisational, contextual) affecting the introduction of LIB and then identifying the impact of organisational variables on LIB adoption. By developing an input-process-output model and applying it to a real case, the study showed the impact of the identified variables on the costs related to the electric forklift LIB (i.e., investment costs, operational costs, replacement costs). A sensitivity analysis was performed to explored the relationship between organisational variables and LIB forklift related costs. Findings proved that increasing the number of operator breaks and decreasing their length, a smaller battery is needed to cover the entire working day can reduce the battery investment cost. Nevertheless, short and highly fragmented operator's breaks require a higher battery replacement cost, which might offset the savings brought by the reduction in the battery investment costs. Modica et al., (2021).

Technology

Leading Japanese construction companies are advancing fully automated platforms for high- rise building construction, creating a coordinated environment for robotized cranes, finishing robots, computer workstations, and other automated equipment. These automated construction systems are expected to improve productivity, reduce labor dependence, and enhance safety and quality by integrating resources and processes with high coordination and clear information flow. Key research focuses on designing materials handling systems to sustain automation efficiency. A proposed concept includes a robotic materials handling workcell, leveraging micro-robot and barcode technology, supported by a distributed computer network for efficient materials management. Skibniewski et al., (1992). Technical assistive devices in warehouse manual materials handling, focusing on their economic and human factors impacts. Through a systematic review, the paper categorizes previous studies by the types of devices evaluated and the perspectives taken—either operator well-being, efficiency, or both. Some studies highlight trade-offs between ergonomic and economic benefits, and within ergonomic measures, indicating the need for careful evaluation based on application goals. The paper also identifies research gaps, stressing the importance of understanding interactions between human and system variables to optimize assistive devices in warehouse settings. Glock et al., (2021).

RESEARCH METHODOLOGY:

RESEARCH DESIGN

A research design is the arrangement of condition for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. The research design is the conceptual structure within which research is conducted.

DATA COLLECTION

In this study the survey design consists of a questionnaire provided digitally to the respondents. These respondents are employee with an anonymous company within the industry. Generalisability is according to Babbie (1995) the ability to apply the research result conducted from a sample of a certain population to a broader population. This means that by studying a representative sample from a warehousing or store, for example from a mini store can be achieved for a broader population such as an entire industry (Creswell, 2003; Yin, 2003). Further this type of generalisability is according to Yin (2003) called statistical generalization and has been applied in this study.

SAMPLING

In this study, a statistical method is used to determine the sample to ensure that the size of the sample is representing for the whole population. According to Bryman & bell (2011) the level of confidence should be 95 percent or higher to ensure that the errors caused by only studying a sample of the population is not significant so that it affects the accuracy. The sample frame in this study was selected randomly. A total number of 100 respondents were contacted and was given the opportunity to participate in the survey using convenience sampling technique.

Data Analysis Techniques

The collected data were classified tabulated and analysed with the statistical tools like

- Frequency/ Descriptive analysis
- Mean Analysis
- Independent sample T-test
- One way ANOVA
- Regression Test

RESULT AND DISCUSSION

FREQUENCY ANALYSIS

The frequency analysis consists of four variables associated with the demographic profile of respondent such as Gender, Age, Experience, Annual Income.

TABLE 1

Demographic Variables	**Categories**	**Frequency**	**Percent**
Gender	**MALE**	**80**	**80**
	FEMALE	**20**	**20**
	TOTAL	**100**	**100.0**
	<25	**8**	**8**

Age	**25-35**	**31**	**31**
	>35	**61**	**61**
	TOTAL	**100**	**100.0**
Work Experience	**<1year**	**4**	**4**
	1-5year	**20**	**20**
	>5years	**76**	**76**
	TOTAL	**100**	**100.0**
Income	**<1lakh**	**6**	**6**
	1-5lakhs	**32**	**32**
	>5lakhs	**62**	**62**
	TOTAL	**100**	**100.0**

INTERPRETATION:

Table 1 shows the frequency analysis as follows:

- The frequency and percentage values of gender. It was analyzed from the table that majority of the gender type were Male (80%) when compared to Female (20%).
- The frequency and percentage values of age. It was analyzed from the table that majority of the respondents were between <25years (8%) followed by above 25-35 years (31%) and the age group of above >35(61%).
- The frequency and percentage values of Experience in work. It is analyzed from the table that majority of the respondent <1years work experience (4%) 1-5 years(20%) and >5-year Experience (76%).
- The table that majority of the respondents have below 1 lakh (12.0%) of annual income level followed by income level of 1-5lakhs (35%) and above >5lakhs (45%).

MEAN ANALYSIS:

Mean implies average and it is sum of a set of data divided by the number of data. Mean can prove to be an effective tool when comparing different set of data; however this method might be disadvantaged by the impact of extreme values. This segment examines the factors that influence the employees with the help of four variables such as safety protocols, workforce training, environmental condition, technology. This mean analysis is performed to measure the factor that improves the operational efficiency to the maximum extent.

Variables	**Mean**	**Standard Deviation**	**Rank**
Safety protocols	**3.72**	**1.602**	**1**
Workforce training	**3.24**	**1.615**	**4**
Environmental condition	**3.25**	**1.234**	**3**
Technology	**3.37**	**1.606**	**2**

INTERPRETATION:

From the above table the mean score for various statement ranges from 3.72 to 3.37 indicates Safety protocols has the effective performance. The highest mean score is reporting followed by Workforce training, Environmental condition and lowest mean scores denotes to the Technology.

INDEPENDENT SAMPLE T-TEST:

Null Hypothesis (H0): There is no significant difference between male and females. Alternative Hypothesis (H1): There is a significant difference between male andfemale.

Variable	Gender	T value	Significance
Safety protocols	**Male**	**0.960**	**.000**
	Female		
Workforce training	**Male**	**1.515**	**.052**
	Female		
Environmental condition	**Male**	**1.176**	**.031**
	Female		
Technology	**Male**	**1.686**	**.007**
	Female		

INTERPRETATION:

The independent sample t-test results indicate no significant difference between genders for the variables of Workforce training, Environmental condition and Technology. This conclusion is based on the high significance values and low t-values , which suggest that the mean difference between genders are not statistically significant for any of thevariables. Therefore, sig. value is more than 0.05 and values are considered as equal variance assumed. Therefore, we accept the null hypothesis.

ONE WAY ANOVA ANALYSIS

S.No	Variables		F	Sig
1.	**Age**	**Safety protocols**	**.114**	**.892**
		Workforce training	**.328**	**.721**
		Environmental condition	**.113**	**.894**
		Technology	**0.19**	**.981**
2.	**Education Qualification**	**Safety protocols**	**2.120**	**.126**
		Workforce training	**1.682**	**.191**
		Environmental condition	**5.574**	**.005**

		Technology	**5.067**	**.007**
3.	**Work Experience**	**Safety protocols**	**.290**	**.749**
		Workforce training	**.369**	**.692**
		Environmental condition	**.720**	**.489**
		Technology	**3.001**	**.054**

INTERPRETATION:

From the above table the ANOVA analysis results states that there is no significant difference in variables across age, educational qualifications and work experience. Since the significance level is greater than 0.05 it accepts null hypothesis.

REGRESSION ANALYSIS:

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	**.428[a]**	**.183**	**.149**	**.43836**

a. Predictors: (Constant), Technology, Training, Safety Protocols, Environmental Conditions.

ANOVA						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	**Regression**	**4.098**	**4**	**1.025**	**5.332**	**.001[b]**
	Residual	**18.255**	**95**	**.192**		
	Total	**22.354**	**99**			

a. Dependent variable: Material Handling

b. Predictors: (Constant), Technology, Training, Safety Protocols, Environmental Condition.

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	**(constant)**	**1.356**	**.435**		**3.117**	**.002**
	Safety Protocols	**.271**	**.098**	**.285**	**2.758**	**.007**
	Training	**.040**	**.108**	**.039**	**.371**	**.711**
	Environmental Conditions	**.007**	**.118**	**.006**	**.061**	**.952**
	Technology	**.252**	**.103**	**.245**	**2.452**	**.016**

INTERPRETATION:

The regression analysis reveals the safety protocols, workforce training, environmental condition, technology. The above table indicates regression analysis with B and beta value for the independent and dependent variable which are assumed from the analysis it is found that the factor of two variable environmental conditions and training have no significant positive effects on "Material Handling" but for variables safety protocols, technology has significant value less than 0.05 that is it has greater impact on dependent variable material handling efficiency.

CONCLUSION:

From the above research I conclude that the PCS [PERMANENT CENTRAL STORAGE] plays a vital role in operations by ensuring the availability of critical materials and supplies for uninterrupted production and service delivery. By implementing robust inventory control systems, optimizing procurement processes. Company can drive sustainability initiatives within its store management practices by promoting eco-friendly procurement practices, minimizing waste generation, and supporting local suppliers. By embracing sustainability, company not only fulfils its corporate social responsibility but also contributes to long-term environmental conservation and community development.

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