

Material Management Systems in Building Projects: Status and Influencing Factors

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Abstract

Material management plays a critical role in construction projects, significantly influencing time, cost, and quality. Inefficient material management often results in delays, as evidenced by a study of 15 government construction projects in Surkhet district under the Federal Project Implementation Unit (FPIU). The study utilized surveys, field visits, key informant interviews, and document review and Relative Importance Index (RII) is used for ranking of the variables. Findings revealed that most projects relied on manual record-keeping, with 60% not using modern material management software, 76% failing to prioritize material management, and 84% lacking automated loading and unloading systems. Only 64% reported having proper storage systems, and while 71% emphasized material quality, field observations contradicted their claims, showing a complete lack of modern MMS adoption. The study identified 47 influential factors across eight groups, with RII values exceeding 50%, underscoring their impact on material management systems (MMS). Key issues included inadequate use of ICT, lack of prioritization, and minimal automation. Disparities in perceptions were noted between clients, consultants, and contractors regarding knowledge and priority of MMS. The study recommends adopting ICT-based systems, improving procurement regulations, and enhancing material management practices to address these shortcomings, ultimately ensuring efficient and effective project execution.

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Introduction

Material management systems are used to ensure that the right materials are available at the right time and in the right quantities. This is particularly important in government building construction projects, where delays and cost overruns can have significant implications for the delivery of public services.

Several factors can affect the material management system of government building construction projects in Surkhet Valley. One of the most important factors is the availability of materials. Many construction materials, such as cement and steel, are imported, and their availability can be affected by factors such as transportation infrastructure, trade policies, and global market conditions.

Another factor is the quality of materials. Poor-quality materials can lead to delays in construction and increase the risk of structural failures, which can have significant safety implications. Effective quality control procedures are therefore essential to ensure that materials meet the required standards.

The efficiency of the supply chain can also affect the material management system. Delays in the delivery of materials can result in project delays and cost overruns. Effective supply chain management, including inventory control and procurement processes, can help to mitigate these risks.

Several studies have investigated the material management system of government building construction projects in Nepal. For example, a study by Karki et.al (2020) found that poor material management practices, including inadequate inventory control and procurement procedures, were a significant contributor to delays and cost overruns in government building construction projects in Nepal. Another study by Bista et.al (2019) highlighted the importance of effective quality control procedures to ensure that materials meet the required standards.

Methodology

This research was conducted in Surkhet district. Fifteen government' owned building construction projects were selected as population and all fifteen projects were selected.

Study Population and Sample Selection

In this research work: project managers, site engineers, store managers of selected building project were the study population and select the key person as per requirement. Convenient sampling method was used for the sample selection.

Number of Study Populations

SN	Total no. of Building Projects in Surkhet Valley (population)	Store Manager / Engineer/ project manager	Total Population
1	15	3(Each from Consultants, clients and contractors)	45

In the above population on going building were selected in Surkhet valley. The project owners of selected building projects are Government of Nepal. In this research sample were taken by convenient method:

The sample size of respondents represented was calculated based on the following formula (Israel, 1992).

$$n_0 = z^2 pq / e^2 \dots\dots\dots (i) \text{ Where,}$$

n_0 = the first estimate of sample size

z = significant value of z at desired confidence

p = the proportion of characteristics being measured in target population $q = 1-p$

e = standard error

Since the population size is finite, n_0 requires finite population correction and it is made as following assumption.

Assuming: $p= 0.5$ and $e= 10\%$

$$n=n_0/(1+(n_0-1)/N) \dots \dots \dots (i)$$

i) Where,

n_0 = required sample size

N = population size

Calculation:

Here for 90% confidence level; $z= 1.64$; $e=0.1$ and $p=0.5$, $q=0.5$

$$n_0= (1.64*1.64*0.5*0.5)/ (0.1*0.1) = 67.27$$

For finite population;

$$N=45$$

$$n= 67.27/ (1+ (67.24-1)/45) = 28.75$$

Sample size was obtained very small so we conduct the survey in total population size. (i.e. Sample size=45 respondent from 15 building projects).

Sample Size of Respondent

SN	Number of selected buildings projects	Contractor	client or consultant	Total sample
1	15	2 persons (store manager/ engineer/ project manager)	1 person (engineer/project manager)	45 Respondents

Primary Data Collection Technique

i. Questionnaire Survey

The questionnaires were prepared based on fact to find out the condition of material management in building construction project in Surkhet district under Federal Project Implementation Unit (FPIU). The questionnaires were distributed to the respondent of client/consultant (project managers/Engineers) and Contractors (Store manager/project manager/Engineers) for survey. All the questionnaires were distributed by visited them on construction site.

ii. Key Informants Interview (KII)

For cross reference of data obtained from questionnaire survey, the KII was conducted for the validity and reliability of the questionnaire. Key informant interview (KII) was conducted with the project manager (clients) of selected building projects. For the KII following projects are selected. They are:

0:1 Selected Building Project for KII

SN	Name of the Project	Location	Contractor's Involvement	Consultants Involvements	Remarks
1	Construction of rural Pharmacy Building	Birendranagar-03, Surkhet	YR/Jugal JV	FPIU	
2	Construction of Dharapani Health-post	Birendranagar-8, Surkhet	CM/ Shyam and ShankarJV	FPIU	
3	FPIU office Building Construction Work	Birendranagar-6, Surkhet	Majdoor/Subash/JP JV	FPIU	
4	Construction of Provincial Lab Building	Birendranagar-03, Surkhet	Najarjun/Banglamukhi JV	FPIU	
5	Construction of Katkuwa Healthpost	Birendranagar-06, Surkhet	KR Builders Pvt.Ltd	FPIU	

Data Processing, Analysis and Interpretation

The data collected from both secondary sources and primary sources were tabulated and sorted by the help of Microsoft office tools and Microsoft Excel. The collected data were tabulated, classified and necessary statistical value such as mean were determined from software program tool and interpretation along with tabular form, chart, graphs and diagrams.

Rating questions are analyzed by Relative Importance Index (RII) method.

For data analysis RII is used by following equation:

$$\text{RII Value} = \frac{5N_5 + 4N_4 + 3N_3 + 2N_2 + 1N_1}{AxN}$$

Where N_5 = Number of respondents for Not a factor.

N_4 = Number of respondents for insignificant factor.

N_3 = Number of respondents for neutral.

N_2 = Number of respondents for significant factor.

N_1 = Number of respondents for major factor.

A = Highest weightage (i.e A=5)

N= Total number of respondents

Result and Discussion

This chapter deals with the data analysis and presentation of material management system in building construction projects undertaken by Ministry of Urban Development, Department of Urban Development and Building Construction, FPIU of Surkhet in Karnali Province. All the data, results and findings from the analysis are interpreted with the help of simple graph, chart, table or figure.

Analysis and discussions are based on data and information gathered to achieve the pre-determined objectives of the study.

To assess existing materials management practices in building construction projects.

1. Use Any Material Management System

		No of Respondents	Percentage
Use any material management system(ICT)	Yes	18	40%
	No	27	60%
	Total	45	100%

The survey aimed to determine the adoption of Material Management Systems among the respondents. Out of the total 45 participants, 18 individuals, accounting for 40% of the respondents, reported using a Material Management System. On the other hand, 27 respondents, comprising 60% of the total, stated that they did not use any Material Management System.

3. Give Priority or Importance Towards MMS

		No of Respondents	Percentage
Give priority or importance towards MMS	Yes	34	76%
	No	11	24%
	Total	45	100%

The survey aimed to gauge the priority or importance placed on Material Management Systems (MMS) among the respondents. Out of the total 45 participants, a significant majority of 34 individuals, accounting for 76% of the respondents, expressed that they consider MMS to be a priority or important. Conversely, 11 respondents, comprising 24% of the total, indicated that they do not view MMS with the same level of importance.

4. Well Storage System or Store House On Site

		No of Respondents	Percentage
Well storage system or store house on site	Yes	29	64%
	No	16	36%
	Total	45	100%

The survey aimed to assess the presence of a well storage system or storehouse on-site among the respondents. Out of the total 45 participants, 29 individuals, accounting for 64% of the respondents, reported having a well storage system or storehouse on-site. On the other hand, 16 respondents, comprising 36% of the total, stated that they do not have such a storage facility on-site.

5. Use Material Procurement as Per PPMO.

		No of Respondents	Percentage
Use material procurement as per PPMO.	Yes	26	58%
	No	19	42%
	Total	45	100%

The survey aimed to assess whether the respondents follow the Material Procurement guidelines as per the Project and Procurement Management Office (PPMO). Out of the total 45 participants, 26 individuals, accounting for 58% of the respondents, reported that they do indeed adhere to the Material Procurement guidelines outlined by the PPMO. However, 19 respondents, comprising 42% of the total, stated that they do not follow these guidelines.

6. Material Delivery Automatically as Per Schedule

	No of Respondents		Percentage
Material delivery automatically as per schedule	Yes	14	31%
	No	31	69%
	Total	45	100%

The survey aimed to determine whether material delivery is automated and aligned with the schedule among the respondents. Out of the total 45 participants, only 14 individuals, accounting for 31% of the respondents, reported that material delivery is automated and follows the schedule. However, the majority of respondents, 31 individuals, comprising 69% of the total, stated that material delivery is not automated according to the schedule.

7. Professionalism in MMS

	No of Respondents		Percentage
Have professionalism in MMS	Yes	17	38%
	No	28	62%
	Total	45	100%

The survey aimed to assess whether professionalism is observed in the Material Management Systems (MMS) among the respondents. Out of the total 45 participants, only 17 individuals, accounting for 38% of the respondents, reported that professionalism is present in their MMS. On the other hand, a majority of respondents, 28 individuals, comprising 62% of the total, stated that professionalism is not evident in their Material Management Systems.

8. Transportation Problem on MMS

	No of Respondents		Percentage
Transportation problem on MMS	Yes	26	58%
	No	19	42%
	Total	45	100%

The survey aimed to identify whether the respondents encountered transportation problems in their Material Management Systems (MMS). Out of the total 45 participants, 26 individuals, accounting for 58% of the respondents, reported experiencing transportation problems within their MMS. On the other hand, 19 respondents, comprising 42% of the total, stated that they did not face any transportation issues in their Material Management Systems.

9. Automatic Loading/Unloading System for MMS

		No of Respondents	Percentage
Automatic loading/unloading system for MMS	Yes	7	16%
	No	38	84%
	Total	45	100%

The survey aimed to determine whether the respondents have implemented an automatic loading/unloading system for their Material Management Systems (MMS). Out of the total 45 participants, only 7 individuals, accounting for 16% of the respondents, reported having an automatic loading/unloading system in place. In contrast, the majority of respondents, 38 individuals, comprising 84% of the total, stated that they do not have such an automated system for their MMS.

10. MMS Give Satisfaction on Work

		No of Respondents	Percentage
MMS give satisfaction on work	Yes	32	71%
	No	13	29%
	Total	45	100%

The survey aimed to gauge whether the Material Management Systems (MMS) provide satisfaction in the work environment among the respondents. Out of the total 45 participants, a significant majority of 32 individuals, accounting for 71% of the respondents, reported that the MMS indeed gives them satisfaction in their work. On the other hand, 13 respondents, comprising 29% of the total, stated that the MMS does not contribute to their work satisfaction.

11. Focus Towards Quality of Material By MMS

		No of Respondents	Percentage
Focus towards quality of material by MMS	Yes	32	71%
	No	13	29%
	Total	45	100%

The survey aimed to determine whether the Material Management Systems (MMS) place a focus on the quality of materials among the respondents. Out of the total 45 participants, a significant majority of 32 individuals, accounting for 71% of the respondents, reported that their MMS does indeed emphasize the quality of materials. On the other hand, 13 respondents, comprising 29% of the total, stated that their MMS does not prioritize material quality.

12. MMS Includes Safety Provision

		No of Respondents	Percentage
MMS includes safety provision	Yes	34	76%
	No	11	24%
	Total	45	100%

The survey aimed to determine whether the Material Management Systems (MMS) include safety provisions among the respondents. Out of the total 45 participants, a significant majority of 34 individuals, accounting for 76% of the respondents, reported that their MMS does indeed incorporate safety provisions. On the other hand, 11 respondents, comprising 24% of the total, stated that the MMS does not include safety provisions.

13. Centralized Store System

		No of Respondents	Percentage
Centralized store system	Yes	34	76%
	No	11	24%
	Total	45	100%

The survey aimed to determine whether the respondents have a centralized store system in their Material Management Systems (MMS). Out of the total 45 participants, a significant majority of 34 individuals, accounting for 76% of the respondents, reported that they do indeed have a centralized store system. On the other hand, 11 respondents, comprising 24% of the total, stated that they do not have a centralized store system in their MMS.

Conclusion

The study assessed the material management systems (MMS) in government building projects under the Federal Project Implementation Unit (FPIU) in Karnali Province, identifying practices, influencing factors, and strategies for improvement. The findings reveal a reliance on manual record-keeping systems, with 60% of respondents not adopting modern MMS software, 76% not prioritizing MMS, and 84% lacking automated loading/unloading systems. Although 64% of respondents reported well-managed storage systems and 71% claimed satisfaction with material quality, field visits indicated that none of the projects had implemented modern MMS technologies, and only 24% prioritized MMS.

The study analyzed 47 factors across eight groups using the Relative Importance Index (RII). The most critical factors include material-related issues (RII=0.902), management challenges (RII=0.692), government interference (RII=0.840), transportation difficulties (RII=0.827), and

supplier/manufacturer concerns (RII=0.827). Contractual issues (RII=0.822), planning and handling inefficiencies (RII=0.796), and site conditions (RII=0.729) ranked lower. A significant disparity was observed between clients/consultants and contractors regarding the importance of MMS, particularly in terms of knowledge and prioritization.

The study highlights improvement measures such as prioritizing safety (RII=0.782), strengthening government policies on procurement and transportation (RII=0.764), and installing automated material handling systems (RII=0.756). Ensuring appropriate storage facilities (RII=0.742) and conducting market-based planning (RII=0.724) were also emphasized. However, control of material flow and ICT integration received lower priority, reflecting limited interest in technology adoption among project stakeholders.

In conclusion, ineffective MMS practices, influenced by numerous factors, impede the timely and quality completion of construction projects. To enhance MMS, it is vital to adopt automation, improve policies, and address safety and storage concerns while fostering knowledge and prioritization among stakeholders.

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