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Analysis of the Factors Affecting Material Management in Selected Hydropower Construction Projects in Nepal

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Abstract. The main goal of this research is to identify the most influencing factors that are affecting material management system in under construction hydropower projects in Nepal. Material management in hydropower construction projects is one of the important issues of Nepal with costing around NRs. 500 to 600 billion considering 50% to 60% of total cost of hydropower construction projects. As of fiscal year 2018-19, hydropower projects with total capacity of 4642 MW are already under construction. Material mismanagement in hydro projects could cause huge amount of nation's capital to be expensed on unproductive cost overrun caused due to delays. A total of 15 under construction hydropower projects are taken as the study area for data collection. The respondents are requested to rank their answers in five-point Likert scale. The responses for total numbers of 34 factors categorized into 10 headings viz. Planning, Supplier, Finance, Staff, Transport, Storage and Handling, Management, Contractual Issue, Governmental Interference and Environment / Weather are collected. The factors are then ranked using Relative Importance Index technique. Based upon the responses, material requirement planning under planning group is ranked as most influential factor affecting material management system. Based upon the study, it is concluded that most of the hydro projects are using Enterprise Resource Planning software viz. tally and other third-party software for material management and some of them are using Microsoft Excel. Most of the studied hydropower construction projects are located at remote areas where facilities of electricity from national power grid, internet facility is unavailable. Because of this, material requisition is still executed using phone conversation in some projects. Record keeping is still paper based rather than digital method.

Keywords: Material management, hydropower, low productivity, cost overrun, enterprise resource planning.

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1. Introduction

The material cost in a project can vary from 50% to 60% of the total project cost, so minimizing procurement cost improves opportunities for reducing the overall project cost. Improper material management can result in increased cost during construction. If materials are purchased too early, capital may be held up and interest charges incurred on the excess inventory of materials. Materials may deteriorate during storage or be stolen if proper care is not taken. In addition, if materials are purchased too late, it can lead to project delays. Ensuring the timely flow of materials in any construction project is one of the major challenges in material management [1]. The major characteristics of hydropower projects in the context of Nepal can be listed as multidisciplinary nature, relatively long duration, and remoteness. The hydropower projects are multidisciplinary in the sense that they comprise numerous sectors. Materials used in HCPs (Hydropower Construction Projects) can be categorized based on their use in different phases or sectors of construction. Generally, the materials used in different phases can be categorized as materials required for civil works, tunnel works, hydro-mechanical works, electro-mechanical works, and transmission line works. Management of numerous activities within these phases of HCPs is an important aspect and directly affects the project schedule. Effective material management in each construction phase is critical to ensuring timely execution and successful project delivery.

1.1. **Problem Statement.** Most hydropower projects in Nepal are experiencing cost overruns due to project delays, resulting in significant financial losses. Numerous factors can contribute to these delays. Among them, material management stands out as one of the most important, given its significant share in the total project cost. Therefore, it is essential to conduct a study on the factors affecting material management in hydropower construction projects in Nepal.

2. Literature Review

As of 2018–19, the total installed electricity generation capacity in Nepal was only 1,182 megawatts (MW), including 621 MW owned by the Nepal Electricity Authority and 560 MW owned by private investors, whereas the peak electricity demand was 1,320 MW [3]. Among numerous feasible hydropower projects, a total of 302 projects had already received survey licenses, and 172 projects had secured generation licenses. Hydropower projects with a total capacity of 4,642 MW were under construction [3]. The construction costs of hydropower projects in Nepal are estimated to vary between $2,000–2,500 per kilowatt [4]. Considering the cost of hydropower generation in Nepal at $2,000–2,500 per kilowatt, the total cost of under-construction hydropower projects (4,642 MW) is estimated to be nearly NRs. 1,021 billion. This signifies that the country's largest share of infrastructure investment is concentrated in hydropower construction projects.

According to Lenin et al. [1], material management in hydropower construction projects (HCPs) constitutes a major component—approximately 50% to 60%—of the total project cost. The estimated cost for under-construction HCPs is around NRs. 500 to 600 billion. Negligence in material management can lead to project delays and subsequent cost overruns, resulting in substantial unproductive expenditure of the nation's capital. Adoption of best practices in material management, particularly through identifying the factors influencing material management, is crucial to avoiding these inefficiencies and saving a significant amount of public funds.

Mat Jusoh et al. [5] identified a total of 50 influential factors for effective material management, categorized into eight components: management, purchasing, expediting, transportation, site storage and condition, supplier, contractual, and governmental interference. Among these, the management category contained the highest number (12) of influential factors. The results of this study contributed to the development of an effective material management model aimed at enhancing project performance and supporting decision-making processes among practitioners.

The reviewed literature consistently suggests that material management in construction projects is influenced by numerous factors. Ineffective material management can lead to delays, cost overruns, reduced quality, and other negative outcomes. These influencing factors vary depending on the type and scope of the project. However, a common classification of factors includes: planning, supplier, finance, staff, transport, storage and handling, management, and environmental/weather conditions. Each of these factors contributes to material management challenges with different levels of severity. A key outcome of previous research is the identification and ranking of the most influential factors, which helps prioritize efforts in improving material tracking and control. The literature recommends that organizations address these factors in the order of their significance to ensure successful project completion in terms of cost, time, and quality.

This research aims to build upon the aforementioned studies by identifying the most influential factors affecting material management in hydropower construction projects in Nepal. Similar to earlier works, this study categorizes the collected data based on feedback from respondents using measurement scales. Furthermore, it explores the tools and techniques currently employed in HCP material management. While previous studies have examined building and highway projects, the specific case of HCPs has not been thoroughly investigated. Therefore, this research helps to fill this gap by focusing on the influential factors in the material management of HCPs in the Nepalese context.

3. Methodology

Professional engineers working with contractors including project manager, project engineers, site engineers, store in-charge, supervisor of various HCP in Nepal are the respondents for this study. Fifteen under construction hydropower projects in Nepal are selected for the study. The developers of the selected projects are still in the business and are pioneer in the field so these projects resemble the majority of projects in the hydropower construction sector in Nepal. The reason behind choosing the under-construction projects is that the present condition of material management in hydropower construction site can be identified. The studied HCP are scattered all over Nepal comprising of nine districts under four provinces namely Koshi, Bagmati, Gandaki and Sudurpaschim. It is believed that overall picture of the material management situation related to HCP for all geographical regions of Nepal are incorporated in this study.

Considering the literatures, the list of influential factors affecting material management in construction project are prepared. Among the list, 34 influential factors in material management, significant and relevant to the HCP is identified and categorized into 10 groups for this study namely; Planning, Supplier, Finance, Staff, Transport, Storage & Handling, Management, Contractual Issue, Governmental Interference and Environment / Weather. The influential factors affecting material management under separate groups

are presented to respondents through questionnaire. It is backed by the research done by [5] in which 50 influential factors for effective material management is presented in questionnaire, categorized into 8 specific components/groups. Similarly, based upon the researches by Ahmad, et al. (2018) [10] responses for twenty factors affecting material management were collected through questionnaire. Also, according to the research by E & Venkatasubramanian (2017) [11] a total 23 factors affecting material management were studied categorizing into 8 separate groups.

3.1. **Data Collection.** Both qualitative and quantitative approaches are used for the collection of most influential factors affecting material management in selected HCP of Nepal. The questionnaire is designed such that respondents can rank to their answers based on the Likert scale. The five point Likert scale is adopted for scaling the responses, having 1 signified strongly disagree and 5 signified strongly agree. Data are collected from the filled questionnaires from respondents including professionals working with contractors/consultant and developers of selected HCP. Due to COVID-19 situation, questionnaires are collected using Google document form rather than face to face meeting. The special sets of structured key questions are included for project managers of selected HCP to identify the current tools and techniques used and possible measures for effective material management. Considering six responses from each studied project, 90 questionnaires are distributed, from which only 55 responses from overall projects are received i.e. 61% of the responses are received from the questionnaire. Table 1 below shows the result of numbers of responses according to their position in the HCP. The selected HCP are all under construction so current tools and techniques of the material management being used are identified and evaluated in real time.

Table 1. Numbers of Responses According to Position in HCP

Position in HCP	**Number of Responses**
Assistant Project Manager	1
Civil Engineer	3
Costing Engineer	2
Electrical Engineer	2
Electrical Site In charge	1
Electro Mechanical Engineer	1
Powerhouse In charge	1
Project Engineer	5
Project Manager	5
Resident Engineer	1
Senior Engineer	1
Site Engineer	20
Site In charge	6
Store In charge	4

3.2. **Data Analysis.** The data collected from both primary and secondary source are summarized, classified, tabulated and categorized. Computer software such as MS Excel, SPSS are used for the tabulation and compilation of the data. SPSS is used for generation of frequency table of various factors affecting material management. Relative Importance Index (RII) technique is used for the data analysis for the research. For validity, all the factors are retrieved from previous researches related to material management so it is

considered valid whereas the Cronbach's Alpha is used to determine the internal reliability. The Cronbach's Alpha for reliability for a total of 55 samples including 34 questions is calculated as 0.89 which is considered reliable.

4. Result and Discussion

4.1. **Existing Practice of Material Management System.** Based upon the responses from the HCP, the existing material management process starts with calculation of the material quantity requirements based upon the bill of quantity of the project. Then synchronizing with construction schedule, forecast of the material requirements prior to the execution is prepared and provided to procurement department. Likewise, procurement department arranges for selection, purchase and delivery of materials. The responses from the studied HCP suggest that every construction company is carrying out material management at their projects. It is done with schedule of the procurement of materials prepared and found to be similar in all of the studied projects.

4.2. **Existing Tools and Techniques Used in Material Management System.** The study found that, only few projects are using third party ERP (enterprise resource planning) software for material management because most of the studied construction sites are located at remote areas where facility of electricity from national grid and internet communication facilities are unavailable. It is also very difficult to connect internet communication facility. The cost of internet connection, according to respondents can vary from NRs. 2.5 million to 3.0 million for the project duration excluding maintenance and operation cost. The implementation of modern ICT (Information and communications technology) technologies such as wireless communications, bar coding, RFID (Radio frequency identification) in these construction sites is very challenging.

4.3. **Factors Affecting Material Management System.** Ranking of the factors affecting material management system is done by responses through questionnaire are calculated according to the highest RII value as is shown in table 2 below. The table 2 shows the results of opinion for each factor from selected HCP. Figure 1 mentioned below is the chart comprising of list of factors affecting material management in studied HCP according to RII rank order. The numerical value at left side of figure 1 indicates the corresponding RII value for each factor, whilst the numerical value at right side of the figure 1 indicates the corresponding rank of each factor affecting material management in studied HCP.

4.3.1. *Planning.* Material requirement planning has highest rank among other 34 factors with RII of 0.916 followed by organizing and scheduling procurement with RII 0.891 and site work schedule with RII 0.855. The result from the research by E & Venkatasubramanian (2017) also supports that the material requirement planning is the most significant factor related to material management. This similarity indicates that material required planning is the highest effecting factors because planning is the first and foremost activity, which is done before starting of any project. Once starting of the project gone wrong then other procedure followed by it is likely to be mistaken. The result is also supported with the study by [12] which suggests that organizational weakness is the most affecting factors in material management. The organizational weakness can be directly linked to poor material required planning because any organization with weak management, staffing ultimately leads to the poor planning. Another reason behind the similarities in result can be the four basic information's of the material requirement planning viz. when to place an order, how much quantity to be ordered, who should be the supplier and when the

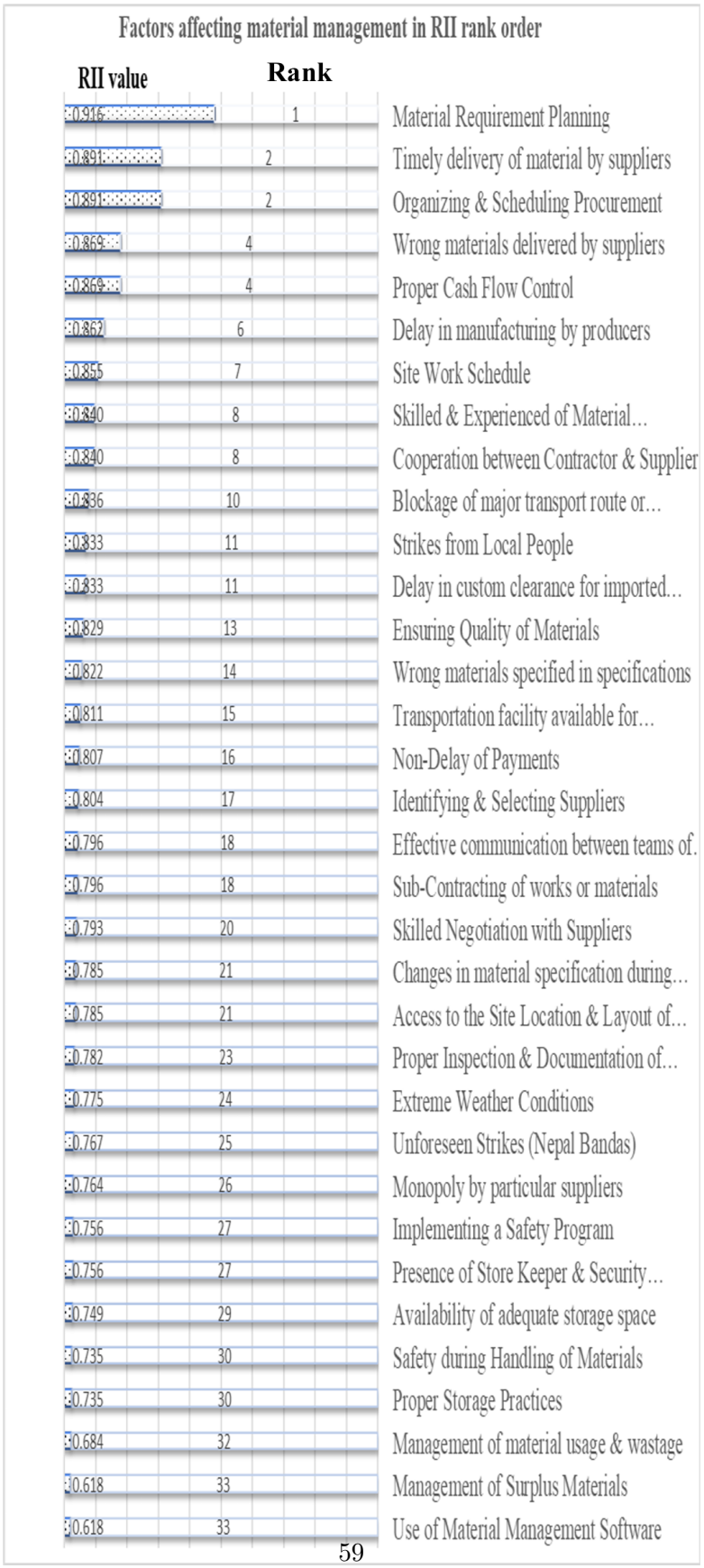

FIGURE 1. Factors Affecting Material Management with RII Rank Order.

TABLE 2. Factors Affecting Material Management with Relative Importance Index (RII) and Ranking

Group	Factors Affecting Material Management	RII= $\Sigma W/N \times A$	Factors Rank	Group RII= $\Sigma W/N \times A$	Group Rank
PLANNING	Material Requirement Planning	0.916	1	0.887	1
	Organizing & Scheduling Procurement	0.891	2		
	Site Work Schedule	0.855	7		
FINANCE	Proper Cash Flow Control	0.869	4	0.838	2
	Non-Delay of Payments	0.807	16		
GOVERNMENTAL INTERFERENCE	Delay in custom clearance for imported materials	0.833	11	0.833	3
SUPPLIER	Identifying & Selecting Suppliers	0.804	17	0.827	4
	Skilled Negotiation with Suppliers	0.793	20		
	Cooperation between Contractor & Supplier	0.840	8		
	Sub-Contracting of works or materials	0.796	18		
	Monopoly by particular suppliers	0.764	26		
	Timely delivery of material by suppliers	0.891	2		
	Delay in manufacturing by producers	0.862	6		
	Wrong materials delivered by suppliers	0.869	4		
TRANSPORT	Transportation facility available for delivery of materials to site	0.811	15	0.811	5
	Access to the Site Location & Layout of project	0.785	21		
	Blockage of major transport route or highways/feeder roads	0.836	10		
CONTRACTUAL ISSUE	Changes in material specification during construction	0.785	21	0.804	6
	Wrong materials specified in specifications	0.822	14		
STAFF	Skilled & Experienced of Material Management Team	0.840	8	0.798	7
	Presence of Store Keeper & Security Personnel	0.756	27		
ENVIRONMENT / WEATHER	Unforeseen Strikes (Nepal Bandas)	0.767	25	0.792	8
	Strikes from Local People	0.833	11		
	Extreme Weather Conditions	0.775	24		
MANAGEMENT	Use of Material Management Software	0.618	33	0.756	9
	Proper Inspection & Documentation of Materials	0.782	23		
	Ensuring Quality of Materials	0.829	13		
	Effective communication between teams of management	0.796	18		
	Implementing a Safety Program	0.756	27		
STORAGE & HANDLING	Proper Storage Practices	0.735	30	0.704	10
	Safety during Handling of Materials	0.735	30		
	Availability of adequate storage space	0.749	29		
	Management of material usage & wastage	0.684	32		
	Management of Surplus Materials	0.618	33		

items to be delivered, which are generally considered as of prime importance in material management regardless of any project type.

4.3.2. *Finance.* According to the research by Ahmad, et al. (2018) [10] and Dhakal (2019) the highest affecting factor in material management is found out to be related to financial status of company and shortage of fund respectively. However, it contradicts with the findings of this research in which financial factors like proper cash flow control and non-delay of payments are ranked at 4th and 16th only. The contrast may be because, generally in HCP the successful execution of financial closure is performed before the starting of construction. So, it is expected that there will be no financial problems during construction of the project expect for some of the unforseen variation works.

4.3.3. *Governmental Interference.* According to the literature reviews from the studies in other countries, it seems delay in custom clearance for imported materials is considered as the least affecting factor. Even in most of the researches this factor is not even considered in questionnaire. However, in this research, its effect on material management is found to be high with overall rank of 11th. The reason behind this dissimilarity can be the capacity of other nations in production i.e. countries like India, Pakistan, Malaysia etc. are capable of producing materials required for construction industry by themselves so there shall be no issues of custom clearance. Whilst in context of Nepal, large portion of materials used in construction are imported from neighboring countries. In addition, the reason for

dissimilarity can be the red tapes by government in construction industry. This means, as compared to red tapes by government in Nepal other countries mentioned in literature review may has less or no governmental interferences related to the construction industry. This is supported based upon the research by [12]in which governmental regulations are the 3rd most affecting factor in material management on highway projects in Nepal.

4.3.4. *Supplier.* With the glance on table 2, timely delivery of material by supplier is the high affecting factor with over rank of second. This result is similar to the study by [12] in which suppliers default is also ranked as 2nd most affecting causes of material and equipment procurement delay on highway projects in Nepal. Similarly, the result indicated that wrong materials delivered by suppliers is ranked as 4th most affecting factors which is supported based upon the research by Kulkarni, et al. (2017) in which rejection due to low quality materials delivered by suppliers is the most affecting factor in material management. In most of the construction projects, generally there is gap in proper communication between supplier and organization which causes delay in order, production and delivery. The reason behind the similarity in results of study can be because of the gap in proper communication. It is also supported according to the study by [13] in which poor communication between supplier and purchase is 3rd most affecting factor.

4.3.5. *Transport.* Findings have showed that blockage of major transport route is high affecting factor with overall rank of eighth. It is backed according to the research by [12] in which transportation delays is one of the major affecting factor ranking 4th in context of highway projects in Nepal. It is also supported with the fact that infrastructure facilities available in Nepal is not reliable due to hilly topography which is prone to calamities like landslides, flood etc. affecting the road networks during heavy rain. In addition, in the literatures based upon other countries like Pakistan, Malasiya and Nigeria the transportation is not considered as high affecting factor in material management. This contrast may be because of geography of these countries. The transportation in plain areas is relatively easier than in hilly terrain. Also, the reason behing the dissimilarity of results may be because of the transportation infrastructure facitlity available in those countries, which is way better than infrastructures in Nepal.

4.3.6. *Contractual Issue.* According to respondents' data, wrong materials specified in specifications has high effect with RII 0.822 in compare to the changes in material specification during construction with RII value of 0.785 with high-medium effect in material management. The reason behind similarities in findings is that, generally in construction projects it is more likely that specified materials are unavailable at market due to various circumstances like market situation, price fluctuation, changes in design, unavalibility of certain products etc. Also there is possibility that client's requirements can change during construction period, engineer cannot fully consider the requirements of client during design. It is also supported based upon the research by [6] in which misunderstanding of owner's requirements by design engineer comes under highest affecting factor in material management. Because of these changes, specification of materials are also changed which affects in material management.

4.3.7. *Staff.* Among the factors inside staff group, the factor viz. skill and experience of material management team is categorized as high affecting factor. The result of this study matches with the findings by [13] and E & Venkatasubramanian (2017) [11] in which skill and experience of material management team of staffs are ranked as most significant and 7th most influenting factors in material management respectively. In most

construction project, there comprises a team performing the material management works, staring from ordering of materials to delivery at site. Without proper communication and well defined system to integrate these activities, efficient material management is impossible. Whereas the proper communication and integration is dependent upon the traits of executing personnel.

4.3.8. *Environment / Weather.* With a glance on table 2 related to environment and weather group, unforeseen strikes like Nepal bandas and extreme weather conditions with RII values of 0.767 and 0.775 respectively are categorized as factors with high-medium effect. Whereas, the strikes from local people with RII value of 0.833 is ranked as high affecting factor in material management. It is backed with the fact that in Nepal, it is more likely to occur unforeseen strikes and strikes from local people in project area due to the unresolved and exaggerated grievances of local people. Whilst, these factors are not even considered as important factor in studied literature reviews. This dissimilarity may be due to policy in construction industry and geographical conditions respectively. The deviations in result suggest that unlikely in Nepal, unforeseen strikes and strikes from local people may not happen in the studied countries. May be these are managed by countries policy in construction industry. Moreover, Nepal is prone to numerous extreme weather condition like landslide, flood, earthquake etc. due to global climatic condition.

4.3.9. *Management.* The result suggests that the factor namely ensuring quality of material has high effect in material management with overall ranking of 13th. It is known to all that quality cost more but lack of quality cost even more. One of the most important functions of material management is insuring right quality of material deliveried at right time. For all construction projects ensuring quality in every steps help in successeful completion of the project. The result shows that implementing a safety program factor is ranked as 27th among 34 factors. The result is similar to the studies based upon the literature reviews. In both of these researches, safety is considered as low affecting factor. This could be because of lack of proper experiences relating material management to implementing a safety program in construction projects. The study indicates that use of material management software is the factor which has rank 33 out of 34, almost last among the listed factors affecting material management. It contradicts with the result based upon the study by [7] in which use of latest technologies helps in improving material management. This dissimilarities in result can be because of the technological gap between construction industries in other countries and Nepal. Also, use of advanced softwares for material management in HCP in Nepal is not yet practised. So, lack of experiences in these type of technologies can also lead to the non priotization of using these.

4.3.10. *Storage and Handling.* Availability of adequate storage space is considered as high-medium affecting factor as a problem related to storage spaces is less likely to occur in HCP. The result indicated that abundant free spaces are available for laydown and storages in HCP.

4.4. **Suggestions for Improving Material Managmenet System.** The responses suggest that coordination and communication is the key factor and common suggestions made by responders of all studied HEP for improving material management system. In order to improve coordination between team of material management, each personnel have to understand his role, responsibility and should be accountable. For effective communication, right information has to be conveyed to right person at right time. In addition, implementation of full functions of ERP software in the HCP can be another way in improving coordination. Because, the integrated information provided by the software is

key for proper material management. This computer-based technology provides information about employee, equipment, vendor, inventory, petty/sub-contractor, bill of quantity, purchase, quotation, accounting, communication, and payments etc. at real time so that tracking of project's progress is possible at any time.

5. Conclusion

The material requirement planning is ranked with highest RII value so it is recommended to be executed with highest priority. The result indicated that, among 34 factors affecting material management, 16 of them have high effects whereas 18 of them have high medium effect. It suggests that all the factors have high importance and none of them can be neglected during material management in HCP. Based on the averaged overall RII values from the study, the factors affecting the material management at the hydropower construction projects in Nepal are by rank planning, finance, government interference, supplier related, transport related, contractual issue, staff related, environment/weather, management related and storage & handling related factors. The review of the literature and the available project specific documents roughly matches the results of the questionnaire survey. The study also suggests that almost all the HCP in Nepal are using ICT in various ways for material management, some project use it more effectively than other does. Despite the importance of ICT in material management, the study has shown that effect of material management software has low ranking than other factors. It has more challenges to implement modern ICT technologies in HCP sites. In addition, the unreliability of internet access and the prohibitive internet collection price have forced many HCP, located in remote parts of Nepal, to use alternative methods of material requisition. The factors affecting material management varies from project to project, the variation on these are identified as varying management system, varying geographical condition, varying site location / accessibility, varying payment terms etc. In addition, proper coordination / communication between different teams of construction is the key for effective material management.

Scope and Limitation of the Study

The study is focused within the selected hydropower construction projects of small to medium size owned by private developers and promoters only. Factors affecting material management are listed form previous literature reviews that can be changed or separate list can be prepared with further study. The prepared list affecting material management were ranked using RII method only.

References

[1] P. Lenin, L. Krishnaraj, D. Narendra Prasad, and V. Prasath Kumar, "Analysis of Improper Material Management Affecting Cost in Construction Project," *International Journal for Research in Applied Science and Engineering Technology*, vol. 2, no. V, pp. 486–492, 2014.

[2] NEA, "A Year in Review, Fiscal Year 2019/2020, Annual Report," *Nepal Electricity Authority, Nepal*, 2009.

[3] H. Gunatilake, P. Wijayatunga, and D. Roland-Holst, "Hydropower Development and Economic Growth in Nepal," *Asian Development Bank South Asia Working Paper Series*, 2020.

[4] M. M. Sherchan, "archieve.nepalitimes.com," 2000. [Online]. Available: `http://archive.nepalitimes.com/news.php?id=9945#.YWveOhpBzIU`. [Accessed: Sep. 15, 2021].

[5] Z. Mat Jusoh, N. Kasim, M. U. Ibrahim, N. Sarpin, M. H. Mohd, and R. Zainal, "Influential Factors for Effective Materials Management in Construction Projects," *International Journal of Sustainable Construction Engineering & Technology*, vol. 9, no. 2, pp. 45–55, 2018.

[6] H. Patel, J. Pitroda, and J. Bhavsar, "Analysis of Factor Affecting Material Management and Inventory Management: Survey of Construction Firms in Gujrat Region of India," *International Journal of Advanced Research in Engineering, Science & Management*, pp. 1–6, 2017.

[7] N. Kasim, A. A. Latiffi, and M. S. Fathi, "RFID Technology for Materials Management in Construction Projects—A Review," *International Journal of Construction Engineering and Management*, vol. 2, no. 4A, pp. 7–12, 2013.

[8] N. Kasim, "ICT Implementation for Materials Management in Construction Projects: Case Studies," *Journal of Construction Engineering and Project Management*, pp. 31–36, 2011.

[9] N. Kasim, R. Kusumaningtias, and N. Sarpin, "Enhancing Material Tracking Practices of Material Management in Construction Project," *International Journal of Sustainable Construction Engineering and Technology*, vol. 10, no. 2, pp. 61–73, 2019.

[10] M. H. Ahmad, Y. I. Badrashi, M. Z. Ahad, Z. Khan, and F. A. Khan, "Factors Affecting Material Management in Construction Industry of Khyber Pakhtunkhwa Pakistan," *International Journal of Advanced Research in Science Engineering and Technology*, vol. 5, no. 11, pp. 7249–7258, 2018.

[11] A. E. and C. Venkatasubramanian, "Factors Affecting Material Management in Construction Industry," *International Journal of Civil Engineering and Technology (IJCIET)*, vol. 8, no. 5, pp. 869–880, 2017.

[12] M. R. Manavazhi and D. K. Adhikari, "Material and Equipment Procurement Delays in Highway Projects in Nepal," *International Journal of Project Management*, vol. 20, pp. 627–632, 2002.

[13] M. M. Sivagami and M. A. Ram, "Assessment of Role of Material Management in Construction Projects," *International Research Journal of Engineering and Technology (IRJET)*, vol. 6, no. 5, pp. 930–934, 2019.