

Factors Affecting Supply Chain Management of Major Building Materials in Addis Ababa, Ethiopia.

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ABSTRACT

Supply chain management is the study of supply chain process from the initial source of materials to the end user of materials. So the study focus on Factors Affecting Supply chain management of Major Building Materials. The major building masteries are cement and reinforcement bars. The reason of this study is to investigate the main problem of current supply chain management of major building materials such as cement and reinforcement bar in Ethiopia and to forward the appropriate solution to the construction industry. Descriptive research design type has used for this study. The data was collected from contractors, manufacturers and suppliers in cement and reinforcement bar category and the data collecting methods was by questionnaire. The questionnaires had developed in the area of main factors affecting the supply chain management such as cost, quality, quantity and delivery time and detail concrete indicators were listed out inside each group to rank in their output in level of agreement of the respondent. The collected data was analyzed by SPSS and Excel software. From the analysis it was found that all concerned parties agreed up on that for almost all factors the main reason for cost increment, poor quality, and decrease in quality and delay delivery time of those major building materials were unbalanced demand and supply, poor coordination of each other and increment of currency exchange amount of the country. So to come up for short term solution the country must provide enough amount of materials to the exact user with smooth and controllable distributing method and for the long term the manufacturer must produce the required amount of materials within the country by providing the necessary support for them.

Key Words: Supply Chain Management, Major building materials, time, cost and quality.

I. INTRODUCTION

A supply chain (SC) is a network of organizations and processes wherein a number of various enterprises (suppliers, manufacturers, distributors and retailers) collaborate (Cooperate and coordinate) along the entire value chain to acquire raw materials, to convert these raw materials into specified final products, and to deliver these final products to customers (Ivanov et al., 2019:8)

“Supply Chain Management (SCM): Logistics Catches up with Strategy” by Oliver and Webber (1982). They set out to examine material flows from the raw material suppliers through the SC to the end consumers within an integrated framework that is now called SCM. (Ivanov et al., 2019:8)

Construction is a multi-association process, which includes owner, designer, temporary worker provider, expert, and so forth. It is likewise a multi-organize process, which incorporates theoretical, plan, development, support, substitution. (Kaushik, 2018:544)

The construction process is subject to the influence of numerous highly variable and often unpredictable factors. The construction team, which includes various combinations of contractors, owners, architects, engineers, consultants, subcontractors, vendors, craft and management workers, sureties, lending agencies, governmental bodies, insurance companies, and others, changes from one project to the next. (Cradel et al., 2015)

In the construction industry, supply chain of main construction materials is the major

significant point to complete the construction of the project within the specified time, quality and cost. In supply chain management of major building materials currently in Ethiopia, there have a big problem to get those materials within specified time, cost, quality and quantity as required.

The main material means that the material is less in variety while a large quantity of funds needed, such as steel bar and cement which generally accounts for a total fund of 60% to 80%. (Kaushik, 2018:544)

In construction process, the supply chain begins from the production of each material, then distributed by agents, and finally delivered to the end users (contractors). During this process in Addis Ababa, Ethiopia, the time elapsed from the production of the material to the deliverability of those materials to the end user is very high and unpredictable.

Ethiopia is one of Africa's fastest growing, most vibrant economies. Enjoying double digit GDP growth for the past decade, and with a quickly growing population, the nation is ready to become a regional leader in construction. The national budget of the country is 476 billion birr in 2020/2021 calendar year. From this amount current expenditure allocate 133.3 billion birr, capital expenditure allocate 176.4 billion birr, subsidiary to regions allocate 176.4 billion .birr and others 6.00 billion birr. The budget allocation in terms of government department /agency/unit urban development & construction allocate 70.99 billion birr that is 14.91% of the general budget of the country. (Cepheus, 2020)

Therefore, as per the above data Ethiopia invest a lot amount of its budget in to the construction sector, but the performance of the sector has so many complicated problems to complete the projects within the required, cost, time and quality.

II. STATEMENT OF THE PROBLEM

Currently in Addis Ababa, Ethiopia the cost of construction materials is very high with unexpectedly. In addition of this the contractor cannot obtain the required amount of materials as they want within the specified time. Obtaining the required amount and quality of materials is also the current main problems of the contractor; generally the supply system of the main building materials has so many sophisticated problems in the construction sectors.

Statement of the Purpose

The main purpose of this study is to analyze the factors affecting the supply chain

management of major building materials from the initial source to the end user (consumers). It is sub divided to:- Analyse the determinant factors on A) fluctuation of cost, B) decrease in amount, C) decrease in quality, D) late delivery time, of materials and E) Analyse the most determinant category from the above list which has significant influence on the supply chain management.

So to analyze the factors affecting the supply chain management of major building materials this research paper will ask the following questions and find appropriate answers.

What are the determinant factors affecting the A) cost, B) required amount) quality) delivering time, of materials? And E) what is the most determinant category from the above list which affects the supply chain management of major building materials?

Review of Primary Research Literature

For the supply chain management of construction sector, many authors had written a thesis paper and forwarded for us for reference, from them let us see some of them as follow:-

(William J. O'Brien, Kerry London and Ruben Vrijhoef, 2002) had conducted a research paper and in this thesis paper the authors propose a research agenda combining elements from operations management/analytic modelling/logistics research (analytic modelling) and industrial organization theory. Analytic modelling addresses normative aspects of the behavior of individual supply chains or components thereof. In contrast, industrial organization theory addresses descriptive aspects of the behavior of firms in markets and the nature of market structure. (O'Brien et al., 2002:5-11)

(Alfredo Serpell and Roris Heredia, 2004) had written a conference paper and its general objective was to propose a generic application methodology of supply chain management (SCM) to the construction sector by adapting the manufacturing SCM experience and development to the particular characteristics of construction. (Serpell et al., 2004:456)

(Ruben Vrijhoef and Lauri Koskela) had made a research and the authors describe SCM as was a concept originating from the supply system by which Toyota was seen to coordinate its supplies, and manage its suppliers (Womack et al. 1990). (Vrijhoef et al., 1999:134)

(Dhruv Gor, Dr. Jayeshkumar Pitroda, 2018) had made a research on an India construction sector, about issue of deferrals, cost over-runs and quality non-conformance was firmly associated with the Supply Chain Management (SCM) and the

researcher consider that applying Supply Chain Management standards, Use of various strategies and store network coordination can get a noteworthy increment the profitability in construction tasks.(Gor et al., 2018:274).

(Akmal Aini Othman & Sofiah Abd Rahman, 2010) has made a research and the research of this paper will concentrate on one of the processes in SCM that was procurement or also known as supplier relationship management (SRM) from the perspective of dyadic relationship between the contractor (building construction) and the supplier, with the emphasis given on the coordination effort in this process.(Aini Othman et al, 2010:24)

(Sahil Kaushik, 2018)had made a research paper about Material Supply Chain Practices in the Construction Industry of India by dividing the research by five distinct phases which are: Bidding Phase, Sourcing Phase, Materials Procurement, Construction Phase, Post Construction Phase (Kaushik, 2018:545)

(Bethlehem Kebede, 2017) had made a thesis paper on the construction material logistics and supply chain network systems in Addis Ababa.

(Yihalem Girum, 2017) had made a thesis paper concerning assessed supply chain management practices followed in Ethiopian building construction projects focusing on Building construction projects in Jimma Town.

Generally as per the above thesis paper almost all of them were focusing the importance of supply chain management systems to the construction sector, and they try to analyze the construction systems from the initiation to the closing up of the project, which include technical and operational issues of the sector. In these process almost all authors had taken data from

client,Engineers,contractors,subcontractors,manufaturers and suppliers

But in this thesis paper the author try to investigate the operational supply chain management of the building construction sector which was used to purchase main building materials in current situation of Addis Ababa Ethiopia. It was clear that for good performance of the construction project technical aspect of the construction systems must be improved but in this thesis paper the technical aspect of the system was not covered, it was focused only operational systems. In addition of this the data was taken from contractor, manufacturer and suppliers which has the direct relationship with the supply chain management of major building materials such as cement and reinforcement bars.

III. MATERIALS AND METHODS

As described in the above portion the data was collected from contractor, manufacturer and suppliers for the major building materials such as cement and reinforcement bars. For the contractor part, it was taken from graded one general's contractor which had office in the capital city of Ethiopian, Addis Ababa.

To select a representative's sample from a total population this thesis paper prefer to use systematic sampling technique. The formula for systematic sampling is:-

$$K=N/n$$

Where: - N is the population in the sample process.
 n:-sample size

K: - the sampling interval (sometimes known as the skip):

Therefore as per the above procedure, population and number of sampling presented below:-

Table 1.Number of population, sampling and validity test

Concerned parties	Number of population	Number of sample	Number of distributed questionnaires	Number of respondent	Number of valid respondent
Cement Materials					
Contractors	120	30	30	20	20
Manufacturers	10	10	10	5	5
Suppliers	20	10	10	8	8
Reinforcement bar Materials					
Contractors	120	30	30	20	20
Manufacturers	10	10	10	5	5
Suppliers	24	14	14	7	7
Total Amount		104	104	65	65(63%)

The data which was used in this research paper is primary and quantitative data which is collected by distributing appropriate questionnaires to each party in the construction materials supply systems. The questionnaires were prepared by using 5-point Likers scale format.

A Likers scale is composed of a series of four or more Likers-type items that represent similar questions combined into a single composite score/variable and it is used to measure respondents' level of agreement to a particular question or statement.

The questionnaires were prepared as:-

1= strongly disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=Strongly Agree and it is distributed to all respondent which was prepared in English language.

The questionnaires were prepared by the category of cost,quality,quantity and delivery time of the materials and in each group of categories it was developed detail concrete indicators which used to measure the attitude of the respondent for the materials of cement and reinforcement bars as presented below:-

- Q.1 Cost/Quality/Quantity/Delivery time, of local raw materials
- Q.2Cost/Quality/Quantity/Delivery time, of imported raw materials
- Q.3Cost/Quality/Quantity/Delivery time, of transport system
- Q.4Cost/Quality/Quantity/Delivery time, costlabor of the country
- Q.5Cost/Quality/Quantity/Delivery time, of machinery
- Q.6Cost/Quality/Quantity/Delivery time, of profit margin

- Q.7Cost/Quality/Quantity/Delivery time, Unbalanced demand and supply
 - Q.8Cost/Quality/Quantity/Delivery time, of TAX related amount of the government
 - Q.9Cost/Quality/Quantity/Delivery time, of Lack of currency (Dollar) of the country
 - Q.10Cost/Quality/Quantity/Delivery time, of Increment of exchange amount of currency (Dollar)
 - Q.11Cost/Quality/Quantity/Delivery time, Safety of the country
 - Q.12Cost/Quality/Quantity/Delivery time, of access road to the required place.
 - Q.13Cost/Quality/Quantity/Delivery time, of Lack of electric power
 - Q.14Cost/Quality/Quantity/Delivery time, of Lack of water supply system
 - Q.15Cost/Quality/Quantity/Delivery time, of Lack of data internet system
- To check the reliability and internal consistency, the author measure the result of the respondent.

The most common internal consistency measure is Cronbach's alpha (α), which is usually interpreted as the mean of all possible splithalf coefficients. It is typically varies between 0 and 1, where 0 indicates no relationship among the items on a given scale, and 1 indicates absolute internal consistency [Tavakol & Dennick 2011]. Alpha values above 0.7 are generally considered acceptable and satisfactory, above 0.8 are usually considered quite well, and above 0.9 are considered to reflect exceptional internal consistency [Cronbach, 1951]. In the social sciences, acceptable range of alpha value estimates from 0.7 to 0.8 [Nunnally & Bernstein, 1994].(Haradhan, 2017:10)

Table 2.Cronbach's alpha (α) results for questionnaires of major building materials

Section	Types of factors affecting the Supply chain management system materials	Cronbach's coefficient alpha(α) for cement	Cronbach's coefficient alpha(α) for Reinforcement bars
A	Cost of materials	0.816	0.831
B	Quality of materials	0.783	0.764
C	Quantity of materials	0.783	0.690
D	Deliverability time of materials	0.792	0.809

Generally as described in the above alpha value from 0.7 to 0.8, it is acceptable and our result is above 0.7, therefore the validity test is acceptable. Based on the content of the questionnaires, the analysis was done by using relative importance index analysis.

Relative Importance index analysis was selected in this study to rank the criteria according to their relative importance.

The following formula is used to determine the relative importance index

$$RII = \frac{\sum W}{n}$$

$$A * N$$

Where w is the weighting as assigned by each respondent on a scale of one to five with one implying the least and five the highest. A is the highest weight and N is the total number of the sample.

Based on the ranking (R) of relative impotence indices (RII), the weighted average of the respondent will be determined.

According to Akadiri (2011), five level of agreement are transformed from RII values: high (H) ($0.8 \leq RII \leq 1$), high medium (H-M) ($0.6 \leq RII$

≤ 0.8), medium (M) ($0.4 \leq RII \leq 0.6$), medium-low (M-L) ($0.2 \leq RII \leq 0.4$) and low (L) ($0 \leq RII \leq 0.2$).

As per the above categories factors affecting the supply chain management such as cost, quality, quantity and delivery times, the concrete indicators were developed and analyzed by the relative importance index. But it will be very difficult to show all the analysis in detail, therefore the summary of the final result of the analysis with respect to the opinion of the respondent is presented in table below:-

Table 3. Summary of the analysis of relative importance index.

Category of Factors	Rank	Cement Materials			Reinforcement Materials		
		Contractors	Manufacturers	Suppliers	Contractors	Manufacturers	Suppliers
Cost Factor category	1 st	Increment of cost of imported materials	Unbalanced demand and supply	Unbalanced demand and supply	Increment of exchange amount of currency	Increment of cost of imported materials	Increment of cost of imported materials
	2 nd	Unbalanced demand and supply	Increment of cost of imported materials	Increment of cost of imported materials	Increment of cost of imported materials	Increment of Tax related amount	Unbalanced demand and supply
	3 rd	Increment of exchange amount of currency	Increment of profit margin	Increment of profit margin	Unbalanced demand and supply	Lack of currency (Dollar)	Increment of profit margin
Quality Factor category	1 st	Quality of imported materials	Quality of imported materials	Lack of information of concerned party	Quality of imported materials	Quality of imported materials	Quality of imported materials
	2 nd	Poor transportation system	Quality of local materials	Quality of imported materials	Quality of local materials	Interruption of electric power	Lack of information of concerned party
	3 rd	Quality of local materials	Interruption of electric power	Interruption of electric power	Poor transportation system	Lack of information of concerned party	Quality of local materials
	1 st	Unbalanced	Quantity of	Quantity of imported	Quantity of imported	Quantity of imported	Quantity of

Quantity Factor category		demand and supply	imported materials	materials	materials	materials	imported materials
	2 nd	Quantity of imported materials	Unbalanced demand and supply	Unbalanced demand and supply	Unbalanced demand and supply	Unbalanced demand and supply	Lack of information of concerned party
	3 rd	Poor transportation system	Poor transportation system	Quantity of local materials	Poor transportation system	Interruption of electric power	Unbalanced demand and supply
Delivery time Factor category	1 st	Poor coordination of concerned parties	Obtaining of imported materials on time	Obtaining of imported materials on time	Poor coordination of concerned parties	Poor coordination of concerned parties	Obtaining of imported materials on time
	2 nd	Obtaining of imported materials on time	Unbalanced demand and supply	Poor coordination of concerned parties	Unbalanced demand and supply	Unbalanced demand and supply	Unbalanced demand and supply
	3 rd	Unbalanced demand and supply	Interruption of electric power	Unbalanced demand and supply	Obtaining of imported materials on time	Obtaining of imported materials on time	Poor coordination of concerned parties

Summary of Major Findings

A. Factors Affecting cost of materials in the supply chain management.

As we see from the data analysis result the main factors affecting for cost of the materials of cement and reinforcement bars which are commonly specified in all concerned parties are:-

- i. Unbalanced demand and supply
- ii. Incremental Cost of imported raw materials
- iii. Increment of profit margin

B. Factors Affecting quality of materials in the supply chain management

From the final output of major factors affecting the quality of cement and reinforcement materials which are commonly selected by all concerned parties are:-

- i. Quality of imported raw materials
- ii. Lack of information from concerned party
- iii. Quality of local raw materials

C. Factors Affecting quantity of materials in the supply chain management.

From the final analysis data factors affecting the quantity of major building materials which agreed by all concerned parties are:-

- i. Quantity of imported raw materials
- ii. Unbalanced demand and supply
- iii. Quantity of local raw materials

D. Factors Affecting deliverability time of materials in the supply chain management.

The most and all parties agreed factors affecting the deliverability time of materials in the supply chain management are:-

- i. Poor coordination b/n concerned parties
- ii. Obtaining of imported raw materials on time
- iii. Unbalanced demand and supply

E. The most determinant category which affect the SCM

To determine the most category which affect the supply chain management of major building materials, the mean value of the concrete indicators of each category in figure below.

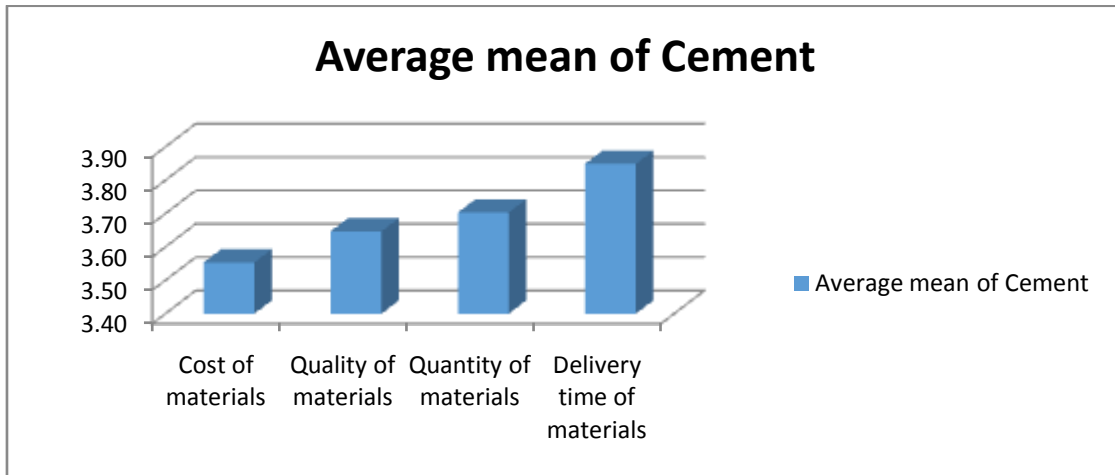


Figure 2. Average mean of categories for cement

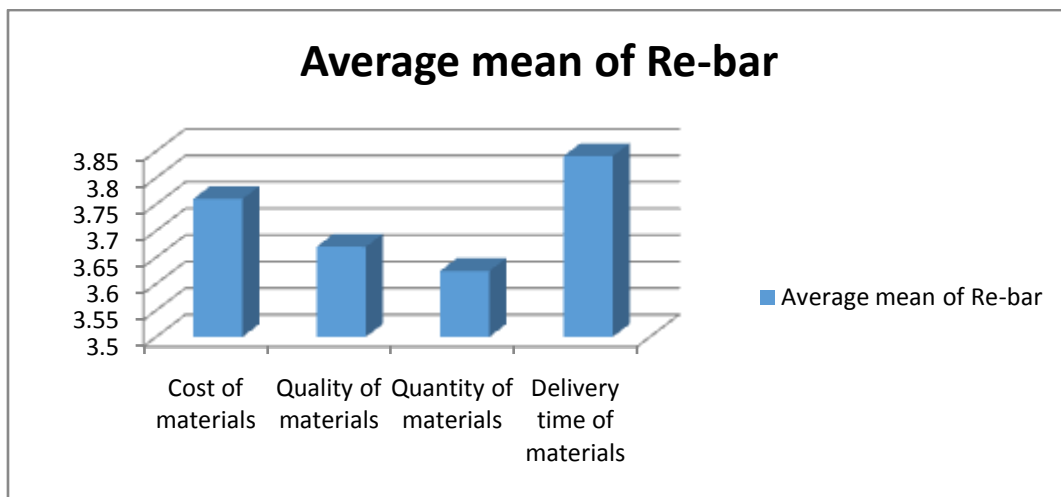


Figure 3. Average mean of categories for re-bar

As we see from the analysis result all the categories nearly the same value of influence on the factors affecting supply chain management, but within small amount most respondents agreed that delivery time of materials was the most and top influence in the effectiveness of supply chain management.

IV. CONCLUSION

1. Unbalanced demand and Supply

As we see from the summary of finding for almost all categories, such as cost, quality, quantity and deliverability time, the main and the primary reason for affecting the supply chain management of major building materials is unbalanced demand and supply of the materials. The demand of the materials in the construction sector is very high but the supply of the materials to the market is very small amount, so this unbalance was affect the overall system of the

sector. According to the Chemical and Construction Inputs Development Institute (CCIDI) report cement demand in Ethiopia reached approximately 12Mt in 2019, but domestic cement products are only providing about 8.9Mt. (<https://www.cement.com>). The same reason is presented for reinforcement bars also.

2. Obtaining imported and local raw materials

For all categories such as cost, quality, quantity and delivery time, the case of imported and local materials have significant influence on the supply chain management. Because these materials are the input of the final product such as cement and reinforcement bars, therefore their direct cost, availability, delivery time will affect the overall systems of the construction sector.

Obtaining imported raw materials from abroad has so many sophisticated problem during transportation, marine, international market, COVID-19, logistic, safety of the country.

So these and the other more uncertainty of the importation problem will affect the deliverability of raw imported materials which is used to the raw materials for the manufacturer will affect the deliverability time of the final required major building materials such as cement and reinforcement bars.

3. Increments of profit margin.

Due to unbalance of demand and supply, the overall market of the systems was affected by few suppliers which have capacity of control the market. The materials mainly supplied for these few suppliers directly from the manufacturer and they have the ability to import the required amount by their own, these led the price of the market to control by them. So the increment of the profit margin of these few suppliers have significant problem to the supply system.

4. Lack of information/poor coordination of concerned parties.

The supply chain management of major building materials was affected by lack of information/poor coordination of concerned parties. As we see from the above explanation the main parties in the operational supply chain management of those major building materials are contractors, manufacturers and suppliers, but during the supply system there is no clear information about how the materials obtained, distributed, purchased and so on.

5. Delivery time, the most determinant categories which affect the supply chain management

All categories, such as cost, quality, and quantity and delivery time have nearly the same value of influence in the supply chain management, but delivery time has slightly more increment when we see the average mean. The implication of this value is all respondents mainly concern about the time delay of materials delivery during the construction process.

V. RECOMMENDATION

1. Unbalanced demand and Supply

As we see from the recommendation, for all categories of factors affecting supply chain management of major building materials demand and supply is the major determinant indicators by all respondent. So to solve this problem the government of Ethiopia, shall have provide appropriate facility for investor to invest them to the manufacturing sector. All availability of land, loan, and currency shall be improved for long term solution.

For short term solution, the government shall allow to import enough amount of major building

materials from abroad to balance the deficiency of demand and supply.

The other short term solution, the increment of cost of major building materials in the construction sector of Ethiopia, there has a general clause which was applicable for the construction sector only. In this standard condition of contract clause number 62, it describe about the price adjustment. In this clause the price of materials will be adjusted within the current market if the condition is written in the special condition of the contract. But in most of our country projects this price adjustment clause is not applicable due to client interest. If the condition is not applicable for particular project, the unexpected increment of cost of materials will have great impact on the performance of the contractor and the performance of the project. So clause 62, on the general condition of the contract (PPA, 2011:38) must be applicable for all projects.

2. Obtaining imported and local raw materials

Imported and local raw materials have significant problem during the manufacturing process. So the government of Ethiopia shall improve the overall problem during transportation, marine, and logistic process, in addition of this the imposed TAX related costs shall be decrease to sustain the market of the materials.

3. Increments of profit margin.

The government of Ethiopia, shall done appropriate methods to distribute the available materials from the manufacturer without the influence of few suppliers to the construction sector. Importation the required amount will balance the overall factors affecting categories problems.

4. Lack of information/poor coordination of concerned parties.

All the concerned parties must have information about the materials all the time. They shall get priority when they need materials from the manufacturer and the suppliers, and they shall get all support to import the necessaries materials to the construction sector from abroad.

5. Delivery time, the most determinant categories which affect the supply chain management

For all factors of supply chain management, the main and permanent solution is balancing demand and supplies, but for the time delay of materials, if justification document presented during the construction process, the government of Ethiopia have general condition of contract, which can apply for time extension on standard condition of contract clause number 73, it

describe about the extension of the intended completion date which occurred due to impossible or enforcing condition of the contractor. (PPA, 2011:44) must be applicable for all projects.

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