

# Mapping Approach on Construction Material Procurement Process

Zelalem Molla <sup>1</sup>, Neetu Yadav<sup>2</sup>

<sup>1</sup>ME graduate in Gujarat Technological University, India

<sup>2</sup>Assistant Professor at S.N.P.I.T & R.C, Gujarat, India

\*\*\*

**Abstract** - Construction work is different from project to project, site to site and requirements, equipment, and materials that are used. These all activities have a common process which contains the high money flow which is the procurement process. The procurement process is a core part of any project which includes the requirement of the contractor or client to deliver of material at the site. The procurement process involves different levels of personnel starting from the need of material or equipment to the specific activity which involves a group of employees such as purchase department and store chief to financial personnel and engineer and this process differs from company to company. In this study a detailed literature is performed to clearly study the procurement process and a four different procurement process were studied and mapping approach which is used to put the process in a pictorial form was used and this technique is applied to comparatively check the strength and weakness of those four procurement process.

**Key Words:** construction, procurement, mapping approach, material management, material problems

## 1. INTRODUCTION

Procurement process is commonly used in exchange by the word purchasing, but procurement encompasses purchasing since purchasing only have few parties involved but serves identical purpose with procurement. (Said & El-Rayes, 2011) Once a provider is chosen, the contractor needs to consistently follow up on the standing of the ordered material to assure it arrives at the duty site within the quantities and dates fixed. In several firms, this method starts with the generation of a material requisition schedule (e.g. release forms) specifying material varieties, quantities required and dates once the material ought to be delivered (Said & El-Rayes, 2011). On large jobs, the schedule is typically ready by the site workers then sent to the purchasing department to request the material from the suppliers-distributors beneath the contract (Ruparathna et al., 2007). In smaller firms or smaller jobs, the material could also be procured directly by the field personnel to avoid surplus, several contractors request solely 80 % of planned material. Further quantities are purchased once the duty is close to completion and an improved estimate is accomplished.

The current theories in academics circled on engineering procurement were more concentrated in the supplier selection and procurement cost optimization, but the value of procurement had not yet been reached a unified and comprehensive consensus, which made the owners very difficult to promote the purchasing quality by managing the engineering procurement from an overall point of view (Gou et al., 2011) so that owners or buyers may have a unified and comprehensive understanding about the value constitution in procurement process to support their procurement decisions (Gou et al., 2011). The social value of the procurement provides a good external environment for the construction value chain, which is necessary for the development trend of the modern of purchasing (Gou et al., 2011)

Material is mostly requested for delivery to the duty site. In some instances, this might not be possible thanks to storage or access limitations. During this case, the material is delivered to different locations like the contractor's warehouse or another contractor cargo deck.

## 1.1 Stages of Procurement

### Stages of a procurement process



Continuous improvement in the purchasing process increased the quality of project performance (Janipha et al., 2015)

**Need of Recognition:** there should be a reason to purchase a material or equipment for a certain project. This steps will give space of time for the contractor to analyze what is the priority to be given before purchasing and follow up the procurement schedule(Ajayi et al., 2017),

**Purchase requisition:** after identification of the necessary material, a purchase requisition form will be sent to the responsible department financial officer(Crumm, 2012).

**Review of the request:** the purchase requisition form will be reviewed by the accountant and the purchase department for budget approval.(Arijeloye & Akinradewo, 2016)

**Budget approval:** this step is where the requisition form is accepted and a budget for the required material is provided.(Ahady et al., 2017).

**Quotation request:** a request for quotation will be sent to the appointed vendor if the tender is selective or multiple RFQ (request for quotation) will be sent if the tender for supplier is open. This process helps to easily select the suitable vendor for the job according to the price they give.(Sarode & Bhangale, 2020).

**Negotiation and Contract:** after the selection of the vendor on this step delivery, transportation and other necessary procedures will be dealt.(Gamil et al., 2019)

**Receive goods and services:** after the contract agreement as per the specification the right quality and quantity of material will be delivered on the specified time.

**Three-way matching:** this section of the procurement is where purchase order, package slip and vendor invoice get cross checked in order to avoid any kind of bias or theft.(Janipha et al., 2015)

**Invoice approval and payment:** this stage is where the payment is done after the three-way matching is confirmed to be clear. If there is any kind of problem occur in the three-way matching the payment will not be performed until it's cleared.(Lu et al., 2013)

**Record keeping:** after the payment for the vendor a copy for purchase department, the contractor and the owner will be prepared and will be kept in the purchase record file.(RathinaKumar et al., 2018)

## 2. Literature Review

**Zakeri et.al (1996)** recommended that factors such as transport difficulties, waste, inappropriate handling on site, lack of suitable work plan, misuse of the specification, in appropriate material transportation and extreme paperwork adversely affect material management.

**Khyomesh V. et.al (2011)** proper management ethics and practices are required for this component which will improve the efficiency and cost effectiveness of the project and thus helping on time completion of the project.

**Ashwin R. Patil, et.al (2013)** poor documentation of material in appropriate and insufficient storage cause damage in labor output and overall delays that can incidentally increase total task cost.

**A.A Gulghane (2015)** in construction project material management takes significant place due coverage of large portion of the project cost, in material management poor handling of construction material disturbs the overall performance of the project.

**Lenin et.al (2014)** stated that a void created by the absence of proper materials management on construction sites. Research has shown that construction material account for 60-70% of the total cost in construction projects. material management decrease the contractor's profit leading to huge losses and leaving the project in big troubles therefore the proper management of this single largest component can improve the productivity and cost efficiency of a project and help ensure its timely completion. The result obtained from the ranking factors shows that the top five majors is causes of cost overruns are design issues market condition, store issues, contractor issues and external issues.

**Keitany et.al (2014)** stated that material management is a device to improve execution in meeting client benefit prerequisites in the meantime adding to productivity by limiting expenses and making the best utilization of accessible assets. The primary target of the investigation was to evaluate the part of materials management on authoritative execution.in particular the examination expected to survey how stock control frameworks and lead-time influence hierarchical execution .The evaluation demonstrated that stock control framework assumed a crucial part in authoritative execution and accordingly association must guarantee that stock control framework be very engaged with material management exercise consequently accomplishing higher hierarchical execution.

**Eckert et al. (2007)** described an inventory management and its effect on customer satisfaction. A larger sampling of the population determines the customer that were having problems with shipments and their overall customer satisfaction. the large sale, sampling should show more about the shortages and the effect on the financial performance of both the distributors and the retailers.

## 3. Mapping Approach

The free flow mapping technique which is a pictorial diagram adopted in this study is for investigating the procurement process problems in construction project. As cited by (Shen et al., 2004)the technique has been used considered advantageous in presenting flows of processes logically, clearly and in the simplest way (Fisher and Shen, 1992) it is used to examine, compare also to identify and list all critical weakness and strength of different organization simultaneously. It works by listing personnel that are involved in each and every stage of the process and the contribution they made.as cited by(Shen et al., 2004) Map can display employees' ability in an organization and their distribution of practical job experience. Moreover, it also can establish connections among documents (Srinivasan 1996).

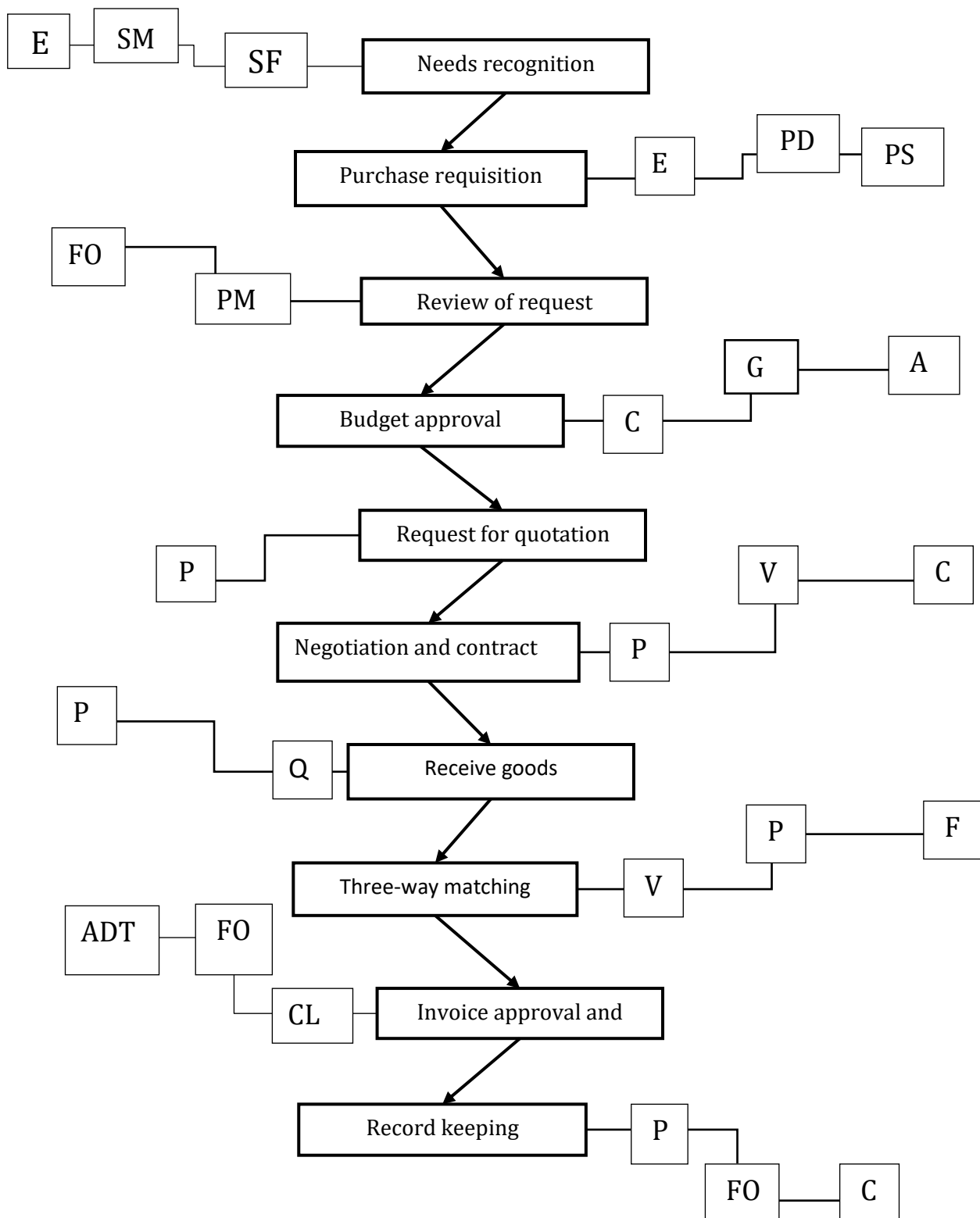


Figure 1: Procurement process of company A

Legend

- |                           |                            |
|---------------------------|----------------------------|
| E= Engineer.              | GM= General manager        |
| ADT= Auditor              | QA= Quality assurance team |
| PT= Purchase team         | SM= Store manager          |
| V= Vendor                 | SF= Site foreman           |
| PD= Purchasing Department | FO= Finance officer        |
| PM= Project manager       | CL= Client                 |

**Table 1:** Strength and weakness of company A

<u>STRENGTH</u>	<u>Weakness</u>
1. Bottom up and Top down is applied	1. It is a long hierarchical process
2. Good communication among department	2. Difficult for quick response to approval
3. Involve experts for decision	3. Many experts and personnel involve which makes it complicated
4. Department manager meeting	4. Quick decision-making problem
5. Good finance control	5. Unnecessary and unproportional work involvement in the department
6. Sustains bias and corruption	6. Traditional procurement method
7. Counter check the process	7. Power dispute over the leading department
8. Strictly documented and require accountability of a request	8. Dispute among department due to not quick response
9. Good for control of quality of material	
10. Fair selection of material	
11. Document	

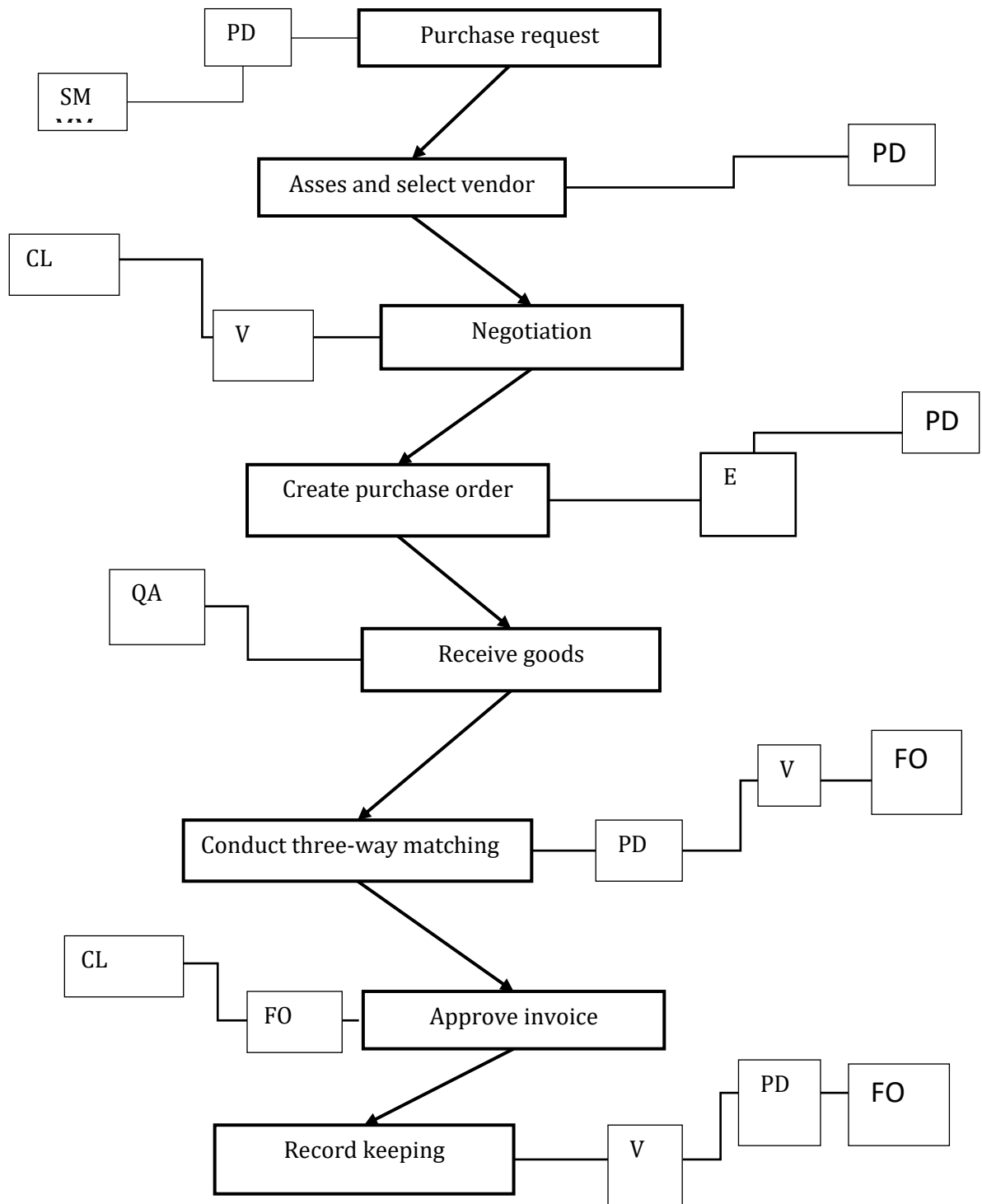


Figure 2: Procurement processes of company B

STRENGTH	WEAKNESS
<ul style="list-style-type: none"> <li>• Bottom up and top down workflow applied</li> <li>• Good communication skill</li> <li>• Quality control</li> <li>• Less personnel involvement</li> <li>• Cross reference on documents</li> <li>• Good financial control</li> <li>• Good document keeping</li> </ul>	<ul style="list-style-type: none"> <li>• Vendor selection given priority before preparation of purchase order</li> <li>• Negotiation of price before detailed assessment of requirement</li> <li>• Vague decision making</li> <li>• Unorganized procurement team</li> <li>• Possible bias</li> <li>• Negotiation and selection of vendor before knowing purchase order</li> <li>• High involvement of purchase department which cause decision making difficult or unfair</li> </ul>

Table 2: Strength and Weakness of company B

Strength	Weakness
<ul style="list-style-type: none"> <li>• Easy process for quick response</li> <li>• Bottom-up workflow</li> <li>• Involve experts</li> <li>• Easy decision making for budget approval</li> <li>• Fair selection of vendor</li> <li>• Good document keeping</li> <li>• Good communication among department</li> <li>• Fair distribution among decision of purchase</li> </ul>	<ul style="list-style-type: none"> <li>• Possible bias</li> <li>• Selection of vendor before preparation of purchase order</li> <li>• Low quality control on delivered materials</li> <li>• Different experts might intrude on other experts' field</li> <li>• Out expert involvement of purchase department</li> <li>• Department power misuse by managers</li> </ul>

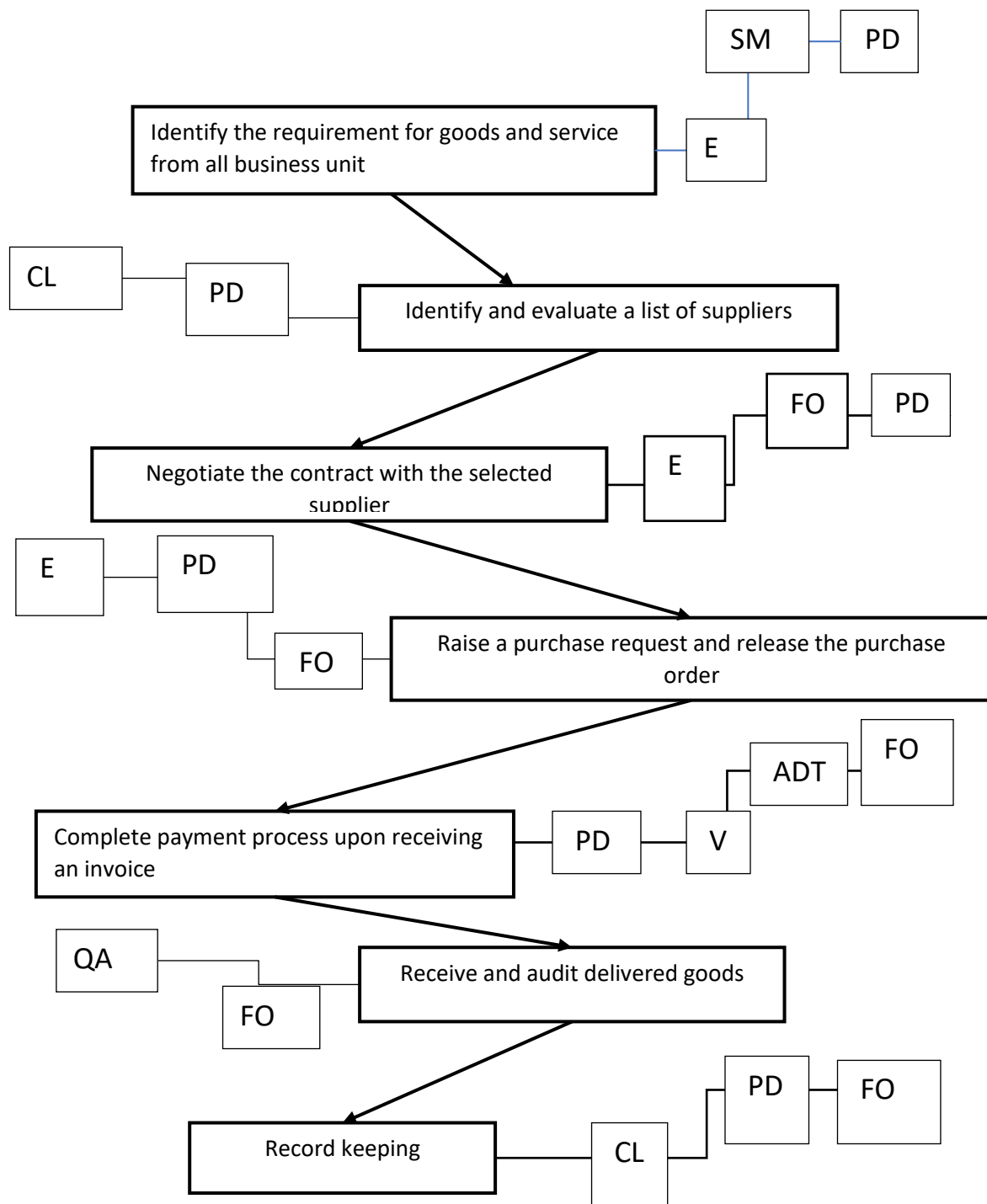


Figure 3: Procurement processes of company C



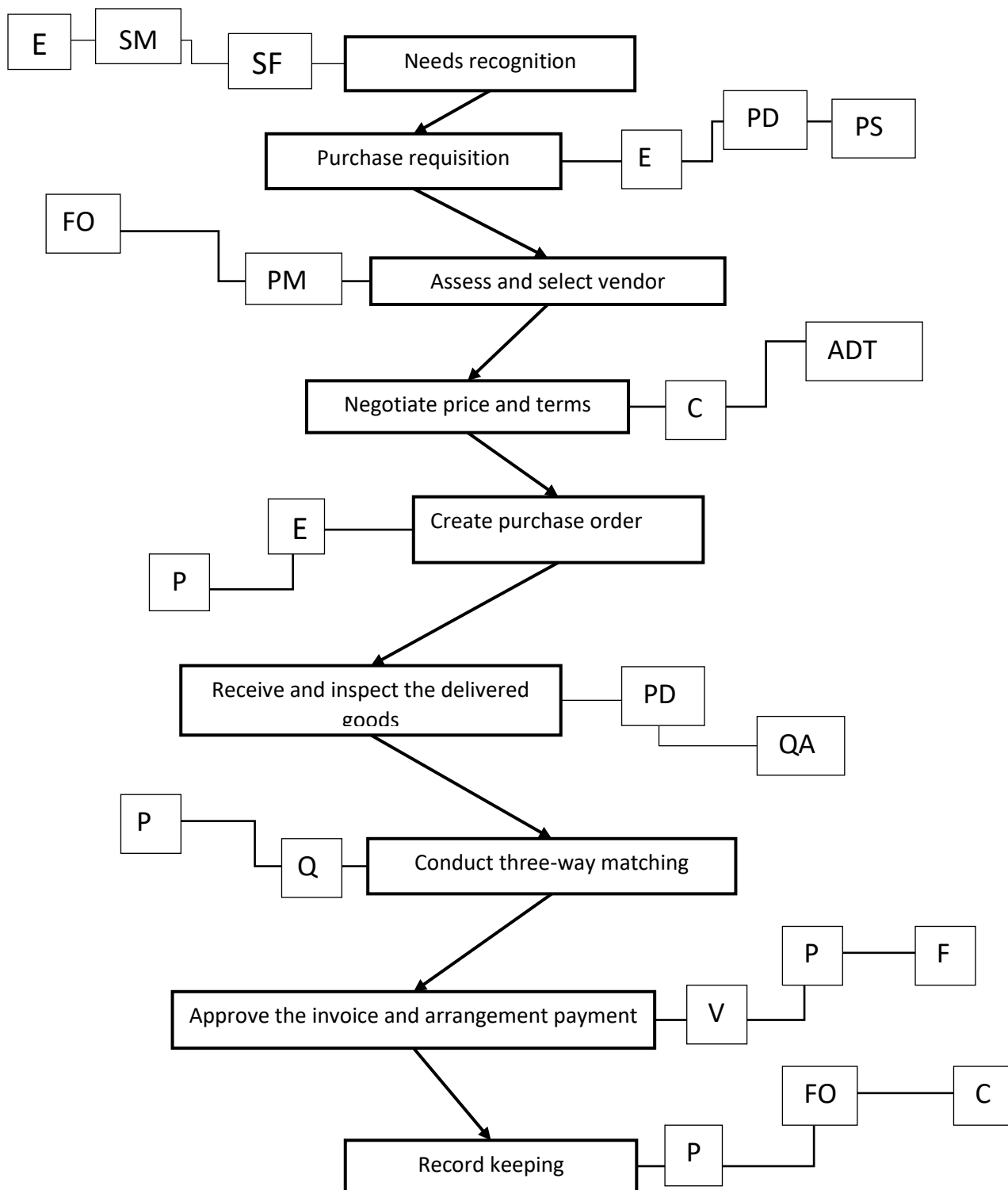


Figure 4: Procurement process of company

weakness	A	B	C	D
Unhealthy communication among departments	1	3	5	5
Disintegrated work flow	1	1	5	5
Negotiation before purchase order preparation	1	1	5	5
Possible bias	1	1	3	5
Vague work flow for purchase order	1	1	5	5
Less accountability	1	1	5	5
Low financial control	1	1	5	5
Unwanted involvement of the engineer	3	3	1	1
Traditional procurement method	3	3	3	3
Possible dispute occurrence among departments	1	1	5	5
Mis information during the process	1	1	3	3

**Table 3:** Response on weakness of the procurement of each company

Strength	A	B	C	D
Bottom up and Top down is applied	5	3	3	3
Good communication among department	5	5	3	1
Involve experts for decision	5	5	3	3
Department manager meeting	5	3	1	1
Good finance control	5	3	1	1
Sustains bias and corruption	3	3	1	1
Counter check the process	5	5	1	1
documented and require accountability of a request	5	3	3	3
Good for control of quality of material	5	5	3	3
Fair selection of vendor	5	1	3	3
Document	5	5	3	3
Bottom up and Top down is applied	5	5	3	3

**Table 4:** Response of each company on the strength of the procurement

#### 4. Data analysis

for the data analysis of this mapping approach RII is used. RII (Relative important index) is used to identify the factor based on the highest magnitude and it helps to select the most significant of all the factors.

- W = Weighting given to each factor by the respondents (ranging from 1 to 5),
- A = Highest weight (i.e., 5 in this case)
- N = Total Number of respondents

Strength	H	M	L	5*H	3*M	L*1	T	N	A(5)*N	RII = E/A*N
S1	1	3	0	5	9	0	14	4	20	0.7
S2	2	1	1	10	3	1	14	4	20	0.7
S3	2	2	0	10	6	0	16	4	20	0.8
S4	1	1	2	5	3	2	10	4	20	0.5
S5	1	1	2	5	3	2	10	4	20	0.5
S6	0	2	2	0	6	2	8	4	20	0.4
S7	2	0	2	10	0	2	12	4	20	0.6
S8	1	3	0	5	9	0	14	4	20	0.7
S9	2	2	0	10	10	0	20	4	20	1
S10	1	2	1	5	6	1	12	4	20	0.6
S11	2	2	0	10	6	0	16	4	20	0.8
S12	2	2	0	10	6	0	16	4	20	0.8

**Table 5:** RII on Strength

In the above table the RII result shows that involving expert for decision(S3) got higher strength side in all the four companies of procurement processes and on the other hand good for control of quality of material got(S9) got the least strength position.

Weakness	H	M	L	5*H	3*M	1*L	T	N	A(5)*N	RII= E/A*N
W1	2	1	1	10	3	1	14	4	20	0.7
W2	2	0	2	10	0	2	12	4	20	0.6
W3	2	0	2	10	0	2	12	4	20	0.6
W4	1	0	2	5	0	2	7	4	20	0.35

W5	2	0	2	10	0	2	12	4	20	0.6
W6	2	0	2	10	0	2	12	4	20	0.6
W7	2	0	2	10	0	2	12	4	20	0.6
W8	0	2	2	0	2	2	4	4	20	0.2
W9	0	2	0	0	2	0	2	4	20	0.1
W10	2	0	2	2	0	2	4	4	20	0.2
W11	0	2	2	0	2	2	4	4	20	0.2

**Table 6:** Response on weakness

In the above table explains the weakness of the companies' procurement process the weakest factor of all in the procurement process is W1(unhealthy communication among department and the least is W9 (traditional procurement method).

## 5. CONCLUSION

Procurement process in construction project can be done in different steps and from the study it was made possible to figure out randomly four types of procurement and as a sample one was selected to show the process. This process shows who is involved in each and every step of the procurement and a mapping approach was used to easily identify the strength and weakness of each procurement process in stepwise. Procurement process should be technologically advanced so as to make the process easy reliable and secure the capital investment. In this pandemic era communication among department shouldn't be a problem for a procurement to be easily executed. With advanced technology except the delivery process procurement processes can be done on line form which make it easy for a vendor to participate from anywhere and for the client to accesses new supplier and obtain good quality of material which is suitable for the project.

## ACKNOWLEDGEMENT

First would like to thank almighty God that eases all the way, my family who supported me since the beginning and my mentor who supported me on the review.

## REFERENCES

- [1] H. Said and K. El-Rayes, "Optimizing Material Procurement and Storage on Construction Sites," J. Constr. Eng. Manag., vol. 137, no. 6, pp. 421-431, 2011, doi: 10.1061/(asce)co.1943-7862.0000307.
- [2] R. Ruparathna, S. M. Asce, and K. Hewage, "Review of Contemporary Construction Procurement Practices," pp. 1-11, 2007, doi: 10.1061/(ASCE)ME.1943-5479.0000279.
- [3] H. Gou, Z. Liu, and Z. Li, "A procurement model with material purchasing value analysis in construction supply chain," Proc. 2011 Chinese Control Decis. Conf. CCDC 2011, no. May 2011, pp. 3858-3863, 2011, doi: 10.1109/CCDC.2011.5968895.
- [4] N. A. I. Janipha, N. Ahmad, and F. Ismail, "Clients' Involvement in Purchasing Process for Quality Construction Environment," Procedia - Soc. Behav. Sci., vol. 168, pp. 30-40, 2015, doi: 10.1016/j.sbspro.2014.10.207.
- [5] S. O. Ajayi, L. O. Oyedele, O. O. Akinade, M. Bilal, H. A. Alaka, and H. A. Owolabi, "Optimising material procurement for construction waste minimization: An exploration of success factors," Sustain. Mater.

Technol., vol. 11, pp. 38–46, 2017, doi: 10.1016/j.susmat.2017.01.001.

- [6] J. Crumm, "Procurement and construction management," *Manag. Gigaprojects Advice from those who've been there, done that*, pp. 197–217, 2012, doi: 10.1061/9780784412381.ch10.
- [7] B. T. Arijeloye and F. O. Akinradewo, "Assessment of materials management on building projects in Ondo State, Nigeria," no. September, 2016.
- [8] S. Ahady, S. Gupta, and R. K. Malik, "A critical review of the causes of cost overrun in construction industries in developing countries," *IRJET*, vol. 04, no. 03/MAR/2017, 2017.
- [9] A. S. Sarode and P. P. Bhangale, "Comparison of Material Procurement Methods of a Construction Projects-Case Study," no. June, pp. 4947–4951, 2020.
- [10] Y. Gamil, I. Abd Rahman, and S. Nagapan, "Investigating the effect of poor communication in terms of cost and time overruns in the construction industry," *Int. J. Constr. Supply Chain Manag.*, vol. 9, no. 2, pp. 94–106, 2019, doi: 10.14424/ijcscm902019-94-106.
- [11] W. Lu, A. M. M. Liu, S. Rowlinson, and S. W. Poon, "Sharpening Competitive Edge through Procurement Innovation: Perspectives from Chinese International Construction Companies," *J. Constr. Eng. Manag.*, vol. 139, no. 3, pp. 347–351, 2013, doi: 10.1061/(asce)co.1943-7862.0000614.
- [12] V. RathinaKumar, K. Lalitha Priya, P. Kumar.I, and C. Ravekumar, "Construction Material Management through Inventory Control Techniques," *Int. J. Eng. Technol.*, vol. 7, no. 3.12, p. 899, 2018, doi: 10.14419/ijet.v7i3.12.16558.
- [13] L. Y. Shen, V. W. Y. Tam, C. M. Tam, and D. Drew, "Mapping approach for examining waste management on construction sites," *J. Constr. Eng. Manag.*, vol. 130, no. 4, pp. 472–481, 2004, doi: 10.1061/(ASCE)0733-9364(2004)130:4(472).