

# Strategies for Effective Supplier-Buyer Relationships in Construction Supply Chains; A Case



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*One of the prime contributors to project profit is construction equipment in the supply chain of the construction sector. Inadequate design/implementation of proven strategies may affect the supply chain. Here in, a case of a major infrastructure company in India is discussed. Strategies that enable effective collaboration and coordination between supplier and buyer were not available during the Covid times resulting in longer lead time with under/over utilization of inventory. This affected the bottom line and the reputation of the company. A novel framework based on Kraljic's portfolio analysis is proposed for enhanced efficiency, resilience, and higher margins.*

**Keywords:** Construction, Supplier Strategy, Kraljic Matrix, AHP, Resilient

## 1. Introduction

In the construction industry, the cost of construction equipment covers a major chunk of money of the overall project cost. These capital expenditures not only consist of the initial investment but also involve the spares that are used throughout its use during a project cycle. Unlike manufacturing where the relationship between the supplier and buyer is usually long-term, in the construction industry for buying construction equipment the relationship between the supplier and the buyer is usually at arms-length for initial investment. But for the consumables and the spares, the organization (Buyer) must have an appropriate strategy that would help in minimizing the effort, streamline the supply chain to make it resilient and robust post-Covid and prepare an organization responsibility matrix that will assign a role to every department in the organization. In the course of the project, an attempt has been made to study the resource management of construction equipment and its spares for a tunnelling construction project. This study also involves preparing an appropriate purchasing strategy for spares and consumables of different construction equipment of the case project based on portfolio analysis.

### 1.1 Resource Management

Resource management is an important aspect of all construction projects. In Larsen & Toubro construction it is one of the most emphasized aspects as it involves both material management and manpower management. One of the major challenges faced now a day in the construction industry is high inventory without any proper strategy for material management of construction equipment. Resource management covers majorly 3 portfolios.

- Material Management
- Manpower Management
- Machinery Management

One of the important verticals of resource management is purchasing strategy for construction equipment and its spares. Though being a giant firm in the construction sector no standard purchasing strategy is applied for different types of materials. The rule of thumb method may work in normal situations but during the COVID-19 pandemic, its consequences were catastrophic as the supply chain was completely disrupted. It resulted in an inevitable overrun in both schedule and cost.



Figure 1 Schematic of Procurement Process

**1.2 Portfolio Analysis**

For purchasing strategies of different materials portfolio approach has been readily used in the manufacturing sector. As there are no standard purchasing strategies for all materials. so one size fits all <sup>[21]</sup> would not work as different materials have different attributes like supplier availability, the value of the materials, the substitution of a supplier, profit impact, quality impact etc. advantages of portfolio analysis are <sup>[19]</sup>

- reduces the impact of volatility of the market
- saves time from each monitoring each product
- fewer wastages
- improves decision making
- collaboration only where required
- decentralized purchasing

**2. Literature Review**

**2.1 Literature Studied**

Bildsten et al. <sup>[11]</sup> (2010) analyzed purchasing strategies of a pre-fab housing factory in the construction sector. They have identified that purchasing cost of different equipment and spares in the construction sector is a large portion of the total revenue. Using the Kraljic portfolio analysis methodology to categorize different materials they have prepared different strategies for different categories. Considering different criteria, they have prepared a questionnaire for supply risk and the strategic impact they have classified different materials into four categories as per the Kraljic model i.e. non critical items, strategic items, bottleneck items and leverage items. The criteria they have taken under consideration are the percentage of the total cost of purchasing, available suppliers, time horizon, level of switching cost, level of satisfaction with the supplier, level of customer adaptation and switching cost.

Ferreira et al. <sup>[21]</sup> (2012) analyzed a case study in the construction sector and the purchasing strategies using an analytical hierarchy process integrated with Kraljic portfolio analysis. They have selected five criteria for strategic impact and nine criteria for supply risk for which using questionnaire AHP two pairwise comparison matrices were prepared. Then using portfolio analysis each material was categorized in the Kraljic matrix.

**Table 1** Criteria Taken Into Consideration by Ferreira et al

Supply Risk	Profit Impact
<ul style="list-style-type: none"> <li>• Suppliers available on the constructions site local market</li> <li>• Product availability</li> <li>• Substitution possibilities</li> <li>• Product storage costs</li> <li>• Legal Requirements</li> <li>• Ease of supplier substitution in case of failure</li> <li>• Logistical proximity of supplier market</li> <li>• Number of available suppliers</li> </ul>	<ul style="list-style-type: none"> <li>• Total amount purchased</li> <li>• Expected growth in demand</li> <li>• The level of standardization of the product</li> <li>• Perceived bargain power of the buyer</li> <li>• The importance of the product in the project sequence</li> </ul>

Perdana et al. <sup>[31]</sup> (2021) analyzed purchasing strategy of a case study in open-pit coal mining using AHP integrated with KPM. They have differentiated supply risk into market risk, performance risk and complexity risk. For profit impact, they have taken criteria like cost of goods sold (COGS), quality impact etc. They concluded that for consumables like non-critical items decentralized purchasing can be done whereas high-value purchases come under strategic or bottleneck items for which long-term collaboration with the supplier can be done.

Sanjay Kumar et al. <sup>[41]</sup> (2015) have worked on the bench-marking Kraljic approach in the boiler industry. They have analyzed its importance in supply chain management. They have considered different factors to strategize the relationship between supplier and buyer.

- Capability to maintain a long-term relationship between the supplier and the buyer
- Existing collaboration between the supplier and the buyer
- Sustained communication and negotiation with the buyer

They have also discussed various buyer-supplier constraints like uncertainty in demand, buyer-supplier incompatibility, uncertainty in price changes etc. based on the questionnaire they have analyzed the cost of products and cost of relationships on different attributes.

From the above study it can be seen that Kraljic Portfolio model can be used in construction sector for purchasing strategy. As the organization under study has more or less centralized purchasing strategy, so Kraljic model can be used to decentralize the purchasing strategy finding out the non-critical and leverage items. It can be helpful for the organization reducing the ordering cost for these materials.

**2.2 Gaps Identified**

- Most of the research published is mostly focused on the manufacturing sector, and prefab construction sector.
- Deduction drawn from the aforementioned research work may not be applicable in tunnelling construction.

- As the supplier, equipment and spares used in tunnelling and hydel projects are different having their own legal and organizational policies, these works may not attribute to this cause. In this case analysis of purchasing strategies for the tunnelling sector is required.
- Implementation and responsibility matrix for different personnel and departments within the organization that may be prepared which is not focused in the above works.
- Vendor development and long-term to give preference to reliable and nearby vendors strategy, can be focused in this case study.

### 3. Methodology

#### 3.1 Methodology Adapted

A period of eight months is scheduled for comprehensive research on this topic. The main objective of this work is to create an appropriate purchasing strategy for a case study of the construction sector using the Kraljic portfolio method and create a responsibility matrix to implement it in the organization.

This research work involves mainly seven steps.

1. Literature Review
2. Criteria Selection
3. Preparation of Questionnaire
4. AHP Comparison Matrix Construction
5. Weightage Calculation of Criteria
6. KPM Construction
7. Interpretation of Obtained Results

In this research, an extensive study of previous works on this topic is done first. After a comprehensive literature review, different criteria for supply risk and profit impact were taken into account and a feedback method is used for the selection of criteria. A feedback form is prepared and sent to managers and employees of different departments like procurement, plants & machinery, Planning, and execution. As per their feedback different criteria are selected for supply risk and profit impact. The next involves the preparation of a questionnaire and interpreting its answers (coded between 1-9) to create an AHP pairwise comparison matrix. From the AHP matrix weightage for each criterion is found. Multiplying the weightage of each criterion with the score obtained for different items (0-1), the Kraljic matrix is to be prepared taking supply risk on one axis and profit impact on the other. The last step involves interpreting the results obtained by deciding the appropriate strategy for each portfolio and deciding the organizational responsibility of different personnel and department to implement it.

$$\text{Final value} = \sum \text{weightage of criterion } i * \text{score } i$$

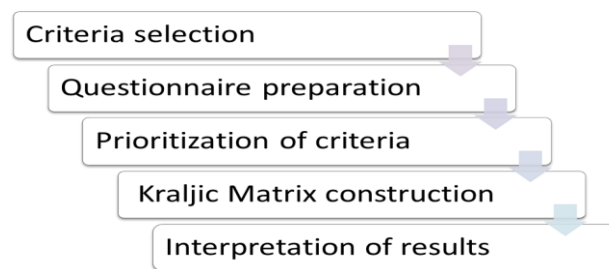


Figure 2 Sequential Flow Chart of Methodology to be Adapted

#### 3.2 Analytic Hierarchy Process (AHP)

The analytic hierarchy process is a multi-dimensional decision-making technique first introduced in 1980 by Saaty [8]. It is one of the most commonly used multivariate analysis techniques used to convert any decision-making problem to a multi-level hierarchy with the first tier being objective, the second tier being criteria and the third tier being the alternatives available. From the questionnaires, the intensities of the importance of criteria are done pair wisely.

By doing a pairwise comparison an  $(n \times n)$  matrix is prepared  $n$  being the no of criteria taken into consideration. In this project, two pairwise comparison matrices are prepared, one for supply risk and another for profit impact. In the comparison matrix, criteria are taken both along the column and the row. The value of the cell at the intersection i.e.  $c_{ij}$  of  $i$  th column and  $j$  th row gives the relative importance of  $i$  th row criteria as compared to the  $j$  th column criteria. From the above comparison, matrix weightage can be calculated for each selected criterion.

#### 3.3 Kraljic Portfolio method

Peter Kraljic in 1983 created a portfolio approach [7] for purchasing models which can be used in various sectors and was first published in Harvard Business school review. Though created long back, it is still widely in use and popular among companies. This tool helps in purchase classification, reduces cost, saves time and helps prepare an action plan for each portfolio. Kraljic classified each product, commodity, and service based on two factors i.e. supply risk and profit impact.

Supply risk could be high because of many reasons like non-availability of raw materials, government regulations, political instability, natural disasters, few supplier availabilities, non-standard product etc. during the Covid-19 pandemic this situation came into occurrence as the supply chain was completely disrupted across the globe. The profit impact of a product is high if it has a major influence on the bottom line of the organization. Based on these two factors products are categorized into four portfolios. These categories are

- Strategic items
- Leverage items
- Non-critical items
- Bottleneck items

Leverage	Strategic
<ul style="list-style-type: none"> <li>• Competitive market</li> <li>• Alternate supplier available</li> </ul>	<ul style="list-style-type: none"> <li>• Performance based collaboration</li> <li>• Critical for both</li> </ul>
Non-critical	Bottleneck
<ul style="list-style-type: none"> <li>• Routine items</li> <li>• Large product variety</li> </ul>	<ul style="list-style-type: none"> <li>• Supplier has power</li> <li>• Monopolistic market</li> </ul>

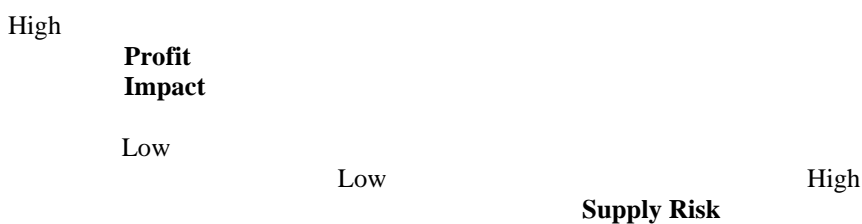


Fig 3: Kraljic portfolio model

**Strategic items**

Strategic items are products having high supply risk and high-profit impact. These are complex items or non-standard items having few no of specialized suppliers available in the market. Heavy construction equipment generally falls in this category having few reliable and proficient suppliers. Strategic items generally cause a lion's share of the total cost. Logistically and strategically level, long-term collaboration is required with the supplier for this method. In the construction sector, these products have the highest impact on the quality of the project. These equipment require a skilled workforce for installation, operation and maintenance. Switching cost to other suppliers is very high which comprises financial costs, cost of efforts and emotional costs.

**Leverage Items**

Leverage items are products having low supply risk and high-profit impact. These items are standard items having generally many suppliers, so having a competitive market gives the buyer the power position. As these items have a high impact on the profit, the strategy for these items should be to reduce their purchase cost. Pricing is the most motivating factor for these items.

**Bottleneck Items**

Bottleneck items are products having high supply risk and low-profit impact. These items are non-standard items not having a huge contribution to the total purchasing cost. As there are only a few suppliers available in the market, so giving the supplier the advantage while negotiating. The strategy for these items should be to have a long-term collaboration with the supplier or finding an alternate supplier. Buyers must ensure that the supply chains of these items are not disrupted even at a premium cost. In the construction industry, few products fall into this category.

**Non-Critical Items**

Non-critical items are products having low supply risk and low-profit impact. Having many possible suppliers, the issue involved with these products is often the ordering cost becomes higher than the price of the product. In the construction industry, these products generally consist of consumables like nuts, bolts, clamps etc. The probable strategy for these items should be to automate and decentralize the purchasing process. The power of purchasing these items should be at the site level with less discussion and approval policy about it.

**3.4 Case Study**

This work focuses on the application of this AHP- integrated Kraljic matrix in the New Austrian Tunneling Method (NATM) based project of a large multi-national (Indian origin) Construction Company with a turnover of 40 billion USD. This case study was suitable because of the several years work experience of the company in the construction sector, availability of the

well-compiled data and documentation and a well-structured management hierarchy and the presence of many experts in the construction sector for the survey.

### 4. Results & Discussions

From the feedback taken from employees and managers of the organization criteria for supply risk and profit impact have been selected. The selected criteria are given in table 2. Using the above criteria, two pairwise comparison matrixes one for supply risk and another for profit impact is prepared by using the scales of comparison given in table 3.

Table 2 Criteria Selected from the Survey within the Organization

Criteria selected for supply risk	Criteria selected for profit impact
<ul style="list-style-type: none"> <li>No. of available suppliers</li> <li>Spares availability in the local market</li> <li>Spares lead time</li> <li>Substitution possibility</li> <li>Local hire equipment availability</li> </ul>	<ul style="list-style-type: none"> <li>Total purchase cost</li> <li>Level of standardization</li> <li>Importance in the project sequence</li> <li>Impact on quality</li> <li>Business growth</li> </ul>

Table 3 Scale of Intensity of Importance

Scale	Intensity of Importance
1	Equal importance
3	Moderate importance
5	Strong importance
7	Very strong importance
9	Extreme importance
2,4,6,8	Intermediate values

Using the above methodology, appropriate strategies for different portfolios can be designed. Then for different strategies, an organizational responsibility matrix can be constructed. From the figure below it can be seen that for non-critical items key performance indicator is functional efficiency. So focus should be on decentralized purchasing management with the relationship time horizon between supplier and buyer should be less than one year. For leverage items key performance indicator is pricing. So, an appropriate strategy should be to go for centralized procurement with the relationship time horizon between the supplier and buyer being one to two years. In the case of bottleneck items, reliable sourcing for long-term and cost management are the key performance indicators. So decision-making should be decentralized but centrally coordinated. In the case of strategic items, long-term availability is the key factor. So, a centralized decision-making policy with long-term strategic collaboration with the supplier can be adapted.

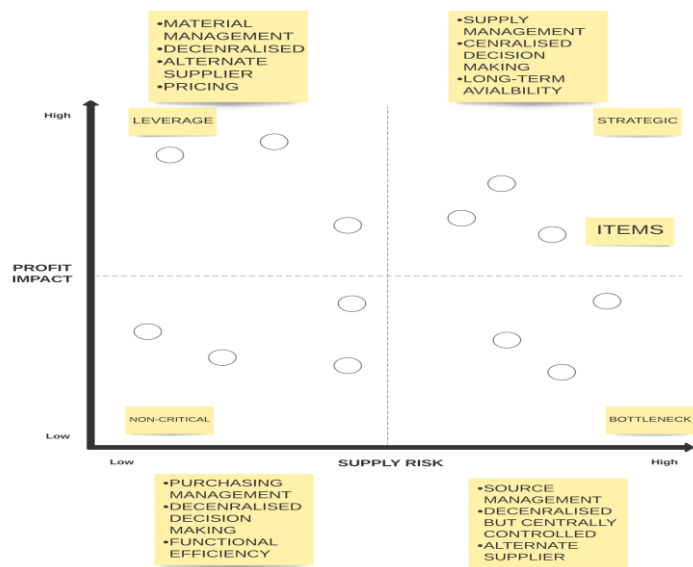


Figure 4 Distribution & Probable Strategies for Different Portfolio

### Current Procurement flowchart

As procurement process of an organization is a complex process and it involves different departments and different levels for different materials. From the above study, the procurement process of the organization is found and is represented in a flow diagram.

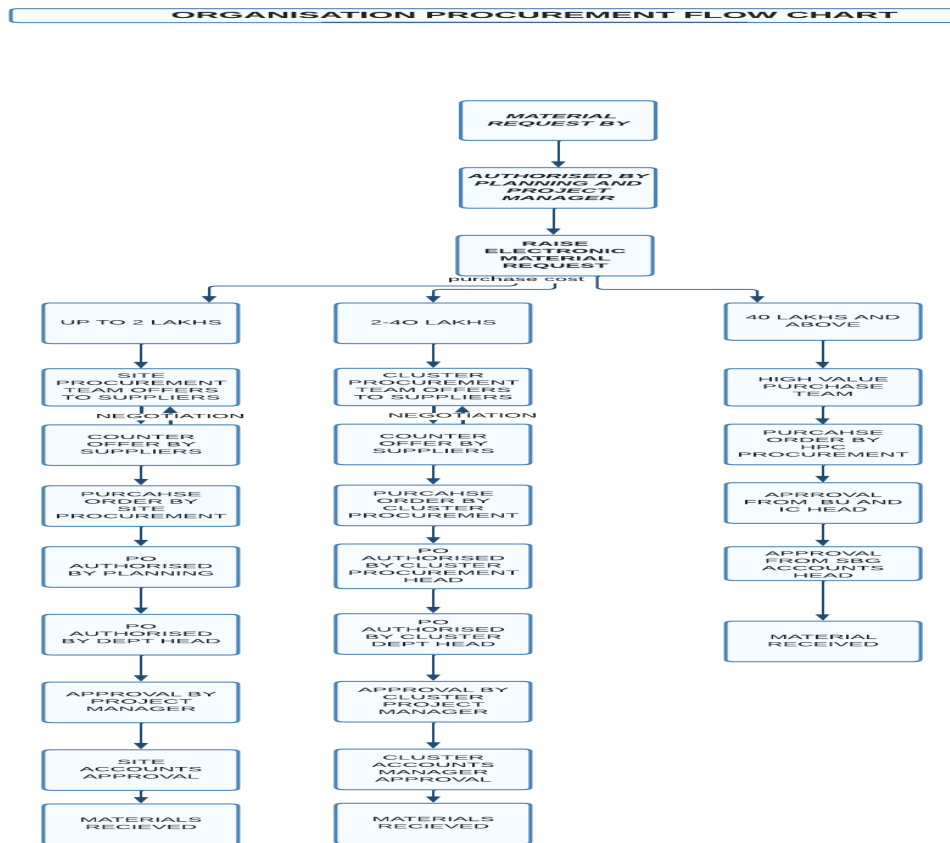


Figure 5 Flow Chart of Organization Procurement Process

**Suggested Procurement flowchart (using Kraljic model)**

Using Kraljic portfolio model a new procurement flow chart is prepared based on different portfolios as shown in fig 6. Also a responsibility matrix is prepared for different personnel and department of the organization as shown in Table 4.

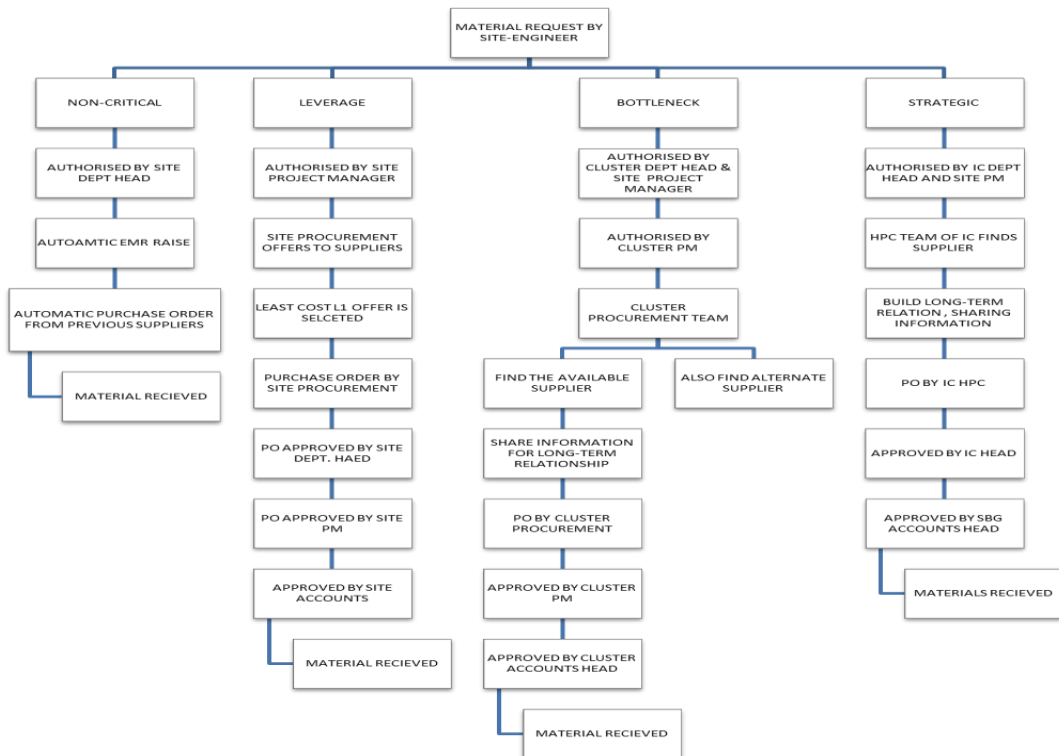


Figure 6 Portfolio based Procurement Flow Chart

Table 4 Responsibility Matrix for the Purchase Strategy

–	Portfolios			
	Non-critical	Leverage	Bottleneck	Strategic
Site engineer	Request for material	Request for material	Request for material	Request for material
Site dept. Head (ex-	Authorizes EMR	Authorizes EMR & Approves	–	–
Cluster dept. Head (ex-			Authorizes EMR & Approves	
IC dept. head				Authorizes EMR
Site project manager		Authorizes EMR & Approves	Authorizes EMR	Authorizes EMR
Cluster project manager			Authorizes EMR & Approves	
Site	Automatic PO prepared	Offers to suppliers and selects		
Cluster procurement			Finds supplier, prepares PO &	
Site accounts	Approves PO	Approves PO	–	–
Cluster			Approves PO	
HPC team		–		Finds supplier &
Cluster head			Collaborates with the supplier	
IC head				Collaborates with
SBG accounts head	–	–	–	Approves PO

## 5. Conclusion

This case study identifies the research gap in purchasing strategies and the application of the AHP-integrated Kraljic portfolio analysis model in this field of the construction industry. Using AHP prioritization of criteria is done along with probable relation between the buyer and the seller is identified for different items to avoid future disruption in the supply chain like during the Covid-19 pandemic which resulted in both cost and schedule overrun. It could help the organizations in minimizing inefficient management practices usually conducted in the construction industry by identifying key performance indicators for different portfolios and acting towards them for a better bottom-line figure.

The configured matrix can be post-validated taking each item individually. This is an easy, viable, compatible and rational strategy that can be adapted by practitioners on a regular scale in various case studies for a wide range of sectors. Intuition-based or thumb rule categorization should be given away by the organizations. Items lying in the junction of two portfolios should be taken into consideration for an integrated purchasing strategy. There is a need of coordination between the top management and the site management for better adaptation to these methods keeping a mental picture of the different extremes.

This method can be used for vendor development for strategic and bottleneck items by building trust, planning & design coordination, training, information sharing and using technology i.e. sharing of required data. Further advancing this may help in vendor management inventory for specific items by building trust which in-term will reduce the inventory required by collaborative order fulfillment. This method reduces the effort for the purchasing strategy of no-critical items and optimizes the overall supply chain system of the organization assuring better product service level.

## 6. References

- Bildsten, L. (2021). A project-based purchasing portfolio matrix applied to the Australian Construction Industry. *SN Business & Economics*, 1(10).
- Ferreira, L. M., & Kharlamov A. A. (2012). Application of Kraljic's purchasing portfolio matrix in construction industry – A case study. *International conference on industrial engineering and operations management*.
- Perdana, A. & Mulyono, N. B. (2021). Purchasing strategies in the kraljic portfolio matrix – A case study in open pit coal mining. *Indonesian Mining Professionals Journal*, 3(1), 45–58.
- Gangurde, S. R. & Chavan, A. A. (2016). Benchmarking of purchasing practices using Kraljic Approach. *Benchmarking: An International Journal*, 23(7), 1751–1779.
- Heavy Civil Infrastructure: L&T corporate: L&T India. L&T Corporate | L&T India. <https://www.larsentoubro.com/corporate/products-and-services/construction/heavy-civil-infrastructure/>.
- The largest infrastructure company in India: L&T ECC. L&T Construction. <https://www.lntecc.com/>
- The Mind Tools Content Tea, The Kraljic portfolio purchasing model: Assessing risk and maximizing profits [https://www.mindtools.com/pages/article/new\\_STR\\_49.htm](https://www.mindtools.com/pages/article/new_STR_49.htm)
- Wikimedia Foundation. (2022, July 15). Analytic hierarchy process. [https://en.wikipedia.org/wiki/Analytic\\_hierarchy\\_process](https://en.wikipedia.org/wiki/Analytic_hierarchy_process)
- Angel Bee. (2018, May 18). How does portfolio diversification help you reduce investment risk? Angel BEE - A Mutual Fund Investment App by Angel Broking <https://www.angelbee.in/mutual-fund-basics/how-does-diversification-help-you>