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Importance of Knowledge Areas on Material Management and its Influence over Project Life Cycle

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Abstract: ***In Construction projects worldwide, nearly 50-60% of the project cost is estimated for materials involved in the project. This shows the importance of material management in construction industry. Proper management of materials and its supply is a major key to project success [3]. An efficient process of procurement and management of material resources based on good relationships with the suppliers will help increase the effectiveness and efficiency of the organization and achieving lasting success by meeting the expectations of all stakeholders [1]. This project studies the importance of material management through literature review and questionnaire survey. This project analyses the influence of knowledge areas on material management. Questionnaire was prepared based on the factors obtained through literature review. Questionnaire was send to project managers, engineers, vendors, material managers, etc. Through this questionnaire survey, major problems in material management were identified along with the stages of material management, where it was predominant. Also analysis of, which knowledge area has more influence in material management was also undertaken. This project also analyses the influence of material management over various stages of project life cycle. This was also obtained through questionnaire survey. From the questionnaire survey, the various factors of material management which affects the process in various stages of life cycle of project were identified. Through this which of the phases of life cycle of project has more issues related to material management were identified.***

Keywords: Material Management; Knowledge Areas; Stages of Material Management; Project life cycle

I. INTRODUCTION

Materials Management is the process by which an organization is supplied with the goods and services that needs to achieve its objectives of buying, storage and movement of materials. Materials Management is related to planning, procuring, storing and providing the appropriate material of right quality, right quantity at right place in right time so as to co-ordinate and schedule the production activity in an integrative way for an industrial undertaking (The International Federation of Purchasing and Materials Management)[11]. Most industries buy materials, transport them in to the plant, change the materials in to parts, assemble parts in to finished products, sell and transport the product to the customer. All these activities of purchase of materials, flow of materials, manufacture them in to the product, supply and sell the product at the market requires various types of materials to manage and control their storage, flow and supply at various places. It is only possible by efficient material management.

The International Federation of Purchasing and Materials Management have given the definition of terms in materials management given below.

According to it, materials management is a total concept having its definite organization to plan and control all types of materials, its supply, and its flow from raw stage to finished stage so as to deliver the product to customer as per his requirements in time[11]. This involves materials planning, purchasing, receiving, storing, inventory control, scheduling, production, physical distribution and marketing. It also controls the materials handling and its traffic. The materials manager has to manage all these functions with proper authority and responsibility in the material management department.

Material planning, Vendor analysis, Material purchasing, Storing and inventory control, Supply and distribution are the stages of material management.

Cost escalation of materials, on time delivery of materials, Procuring good quality and maintaining the quality till construction and maintenance phase, managing the risk related to materials, cost escalation of materials, inventory related risks, etc. Procurement problems like correct description of materials, insufficient storage area, too early receiving of materials, etc. Procedures and

hierarchy problems and it lead to communication problem of material handling and movement. These are considered to be a common and major problem in material management.

In this paper, identification of factors affecting the material management, Influencing factors of knowledge areas in material management was discussed. Data was collected from the questionnaire survey and ranking the factors was done based on Relative Importance Index (RII) method.

The work of paper is presented as follows: 'problem formulation' includes the identification of major factor influencing the material management, 'methodology' for ranking the factor through prioritizing. Results are taken and analyzed by considering questionnaire survey and likert scale which is described in 'Results and discussions' and 'conclusion' which concludes the work of this paper.

II. PROBLEM FORMULATION

The objective of the study is

Analyze the influence of knowledge areas on various stages of material management.

Analyze the influence of material management over various stages of project life cycle.

Attain proper material management through the project management.

A. Factor Identification

This project focused on ten knowledge areas of project management as a major factor, the sub factors of each main factor are identified and listed below through literature review and experts judgments (project owners, project sponsors, Vendors, material managers, store keeper, engineers) during survey interviews for every stages of material management. It also focus on stages of life cycle of project as a major factor and the sub factors of each main factor are identified and listed below through literature review and experts judgments.

B. Preparation of Questionnaire

The issues listed were compiled to form a questionnaire in order to categorize the problem which is more influencing factors. Further the factors were transposed into survey questions and circulated to the purposefully selected key industry players such as project engineers, project managers, project owners/sponsors, architects, site engineer etc.., from the construction industry to assess the significant factors causing the impacts in material management.

The approach used for data analysis was Relative Importance Index technique. It is used to rank the most influencing factors of IPD. This method is based on the evaluation of critical factors from the respondents (i.e. project sponsors, project manager, clients, consultants or contractors). The five-point likert scale ranged from 4 (very high contribution) to 0 (not applicable contribution) was adopted.

In the likert scale

4= Very High

3= High

2= Moderate

1= Low

0= Not Applicable

C. Material Planning

Table1. Main factors and sub-factors influencing material management

MAJOR FACTORS	SUB FACTORS
Cost	waste from uneconomical shape of material
Communication	Misunderstanding of owner's requirements by design engineer
	Insufficient instructions about handling materials on site.
	Unclear and in adequate details in material specification
Human Resource	Poor use of advanced software
	Poorly defined roles and responsibilities
Procurement	Impossibility to order small quantities

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	locating source of procurement
	Forecasting materials price in market
	storing materials in faraway stores
	Poor store layout.
Risk	Severe weather conditions

B. Vendor Analysis

major factors	sub factors
Quality	Manufacturing defects on materials.
	Re Work Due To Poor Material Quality Used Before
	Delay in performing inspection and testing by the consultant team
Cost	financial condition of the company
	competitiveness of price
Time	timeliness of delivery
Communication	Poor coordination and communication among the contractor and material supplier.

D. Material Purchasing

major factors	sub factors
procurement	Project delay due to slow delivery materials
	Lack of materials (due to closure).
	Ineffective control of storage
Risk	Local Issues causing material delays and un availability
Time	Too early receiving of materials
Integration	Usage of materials without systematic control
Communication	Communication to previous stages

E. Storage and Inventory

major factors	sub factors
Human Resource	Shortage of skilled labour for handling
Quality	Poor storage of materials.
Risk	Burglary, theft and vandalism
Scope	Availability Of Modern Equipment & Methods for handling

F. Supply, Distribution and On Site

major factors	sub factors
Risk	Damage of material on site
Quality	Use of incorrect material
Integration	Using excessive quantities of materials
	Lack of onsite materials control.
	Existence of unnecessary materials on site.

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Table II. Main factors and sub-factors influencing project life cycle

PHASE	QUESTIONS
INITIAL PHASE	Is Proper selection of sponsors is necessary?
	Is source of material plays materials plays a vital role?
	Distance between source and site affects project performance?
	Is feasibility study of transportation facilities to site is must?
	Is separate material manager is necessary for proper flow of materials?
	Is material requirement data is important in initial phase?
PLANNING PHASE	Does proper material requirement plan helps project performance both in cost and time?
	Whether procurement cost affects largely in project budget?
	Does quality plan for every material is necessary to frame?
	Did you collect quality standards for all materials from sponsors/end users?
	Is proper procurement plan helps in smooth flow of materials?
	Is procurement team necessary?
PLANNING PHASE	Does proper hierarchy for procurement team helps good communication and material flow?
	Is location of inventory plays a vital role?
	Does u think inventory plan must be good enough to stack and supply of more materials?
	Do you prefer planning of risk related to material storage and transportation?
	Does proper selection of vendor is important?
	Whether you are following any contract types for procurement?
EXECUTION PHASE	Whether regular checking of quality of materials is important?
	Do you rely on training the new techniques and IT to store keeper and procurement in-charge helps in better flow?
	Do you think proper communication between field engineers and procurement team is must?
	Do you conduct regular meetings for all the employees including material team?
	Do you think proper agreement between vendors is important?
	Do you ensure project team has regular input?
MONITORING AND CONTROLLING PHASE	Does regular monitor and control of material supply is important?
	Are you familiar with change management?
	Do you inform the change in plan or any think to key stakeholders?
	Do you change your vendor during the project period in case of any misbehaviour or anything?
	Do you take any steps or framework to avoid delays?
	Do you check the quality of materials regularly?
	Do you think feedback collection from employees is important?
	Whether you are using any alternative plan in controlling risk?
	Do you monitor the procurement process regularly?
	Do you consider minor wastages as a huge impact on time, budget, and resource?
CLOSING PHASE	Do you ensure the quality standards are satisfied?
	Did you check whether procurement contracts are satisfied or not?
	Do you have any appreciation program for all team members including material team?
	Did you have any meeting on discussion about lesson learnt?

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III. METHODOLOGY

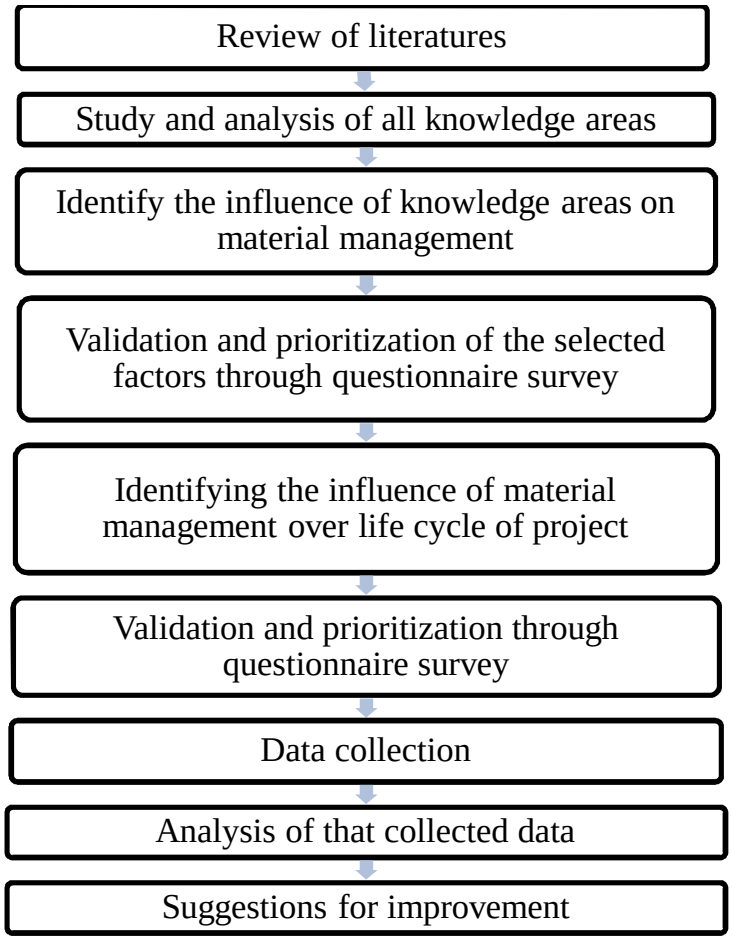

Figure 1.Steps Involved in Methodology

Fig.1 shows the steps involved in methodology of the project, were the major issues are identified through literature reviews and questionnaire surveys were conducted on influence of knowledge areas on material management are validated by the targets people like project owners, project sponsors, material managers, store keepers, project engineer/coordinator, architects, engineers etc., which is most sufficient for further analysis through RII method and prioritized the most influencing factors.

IV. RESULTS AND DISCUSSIONS

The factors identified were measured for their degree of impact on integrated project delivery in the construction industry. Respondents were requested to respond on five-point likert scale of very high, high, moderate, and low, not applicable. A scoring system was used to transform the likert scale into a quantitative variable, where very high scored 5 points and very low scored 1 point. Relative importance index (RII) was then computed for each factor to prioritize them.

A. Questionnaire Survey

The questionnaire is prepared and field survey, online survey is conducted. Totally 70 questionnaires were targeted to the project owners, project sponsors, project engineer/coordinator, architects, engineers etc., and obtained nearly 53 respondents, which is most sufficient for further analysis.

B. Prioritization of Factors

Relative Important index (RII) have been employed for ranking the most influencing factors of material management in the construction project. The RII was used to rank the different causes. These rankings make it possible to cross-compare the relative

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importance of the factors as perceived by the groups of respondents.

$$RII = \frac{\sum W}{A*N}$$

Where

W = Weighting given to each factor by the respondents and ranges from 4 to 0

A = Highest weight (i.e. 4 in this study)

N = Total number of respondents

Table III. Ranking Criteria

S.NO	STAGES OF MATERIAL MANAGEMENT	AVERAGE RII VALUE	RANK
1	MATERIAL PLANNING STAGE	0.59663	1
2	VENDOR ANALYSIS STAGE	0.5927	2
3	MATERIAL PURCHSING STAGE	0.53343	5
4	STORAGE AND INVENTORY STAGE	0.56648	3
5	SUPPLY, DISTRIBUTION AND ON SITE STAGE	0.55	4

Relative important index (RII) is calculated for all sub-factors and Relative important index mean is calculated for all factors, Ranking is given to all main factors according to the RII mean score.

The detailed ranking of all the factors is given below

Table IV. Results Related to Knowledge Areas on Material Management Stages.

VERY HIGH	HIGH	MODERATE	LOW	NOT APPLICABLE
N4	N3	N2	N1	N0
4	3	2	1	0

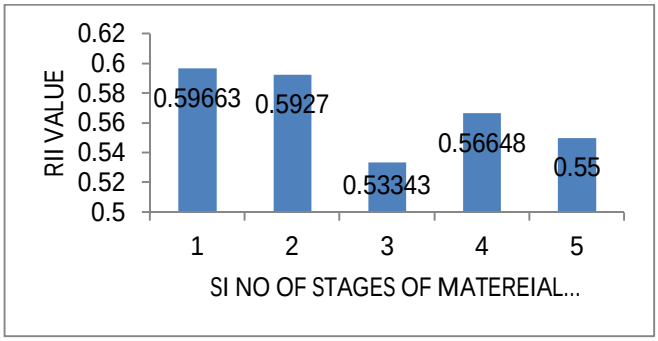

Fig 2. Knowledge Areas on Material Management Stages.

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TABLE IV shows the influence of knowledge areas in stages of material management. From the available respondents through questionnaire the RII value are calculated and ranked through most prioritizing factor. Fig 2 shows the pictorial representation of the knowledge areas on various stages of material management, in x-axis si.no of table 4 are taken (stages in material management) and in y-axis the RII value are taken.

The most critical stage among the five stages of material management are material planning stage, which gives the highest RII value of 0.596 and consider as the most important stage.

Table V. Results Related to Knowledge Areas on Material Management

KNOWLEDGE AREAS	RII	RANK
Cost	0.601064	2
Communication	0.567021	6
Human resource	0.560284	7
Procurement	0.571144	5
Risk	0.647606	1
Quality	0.528723	9
Time	0.590426	3
Scope	0.585106	4
Integration	0.542553	8

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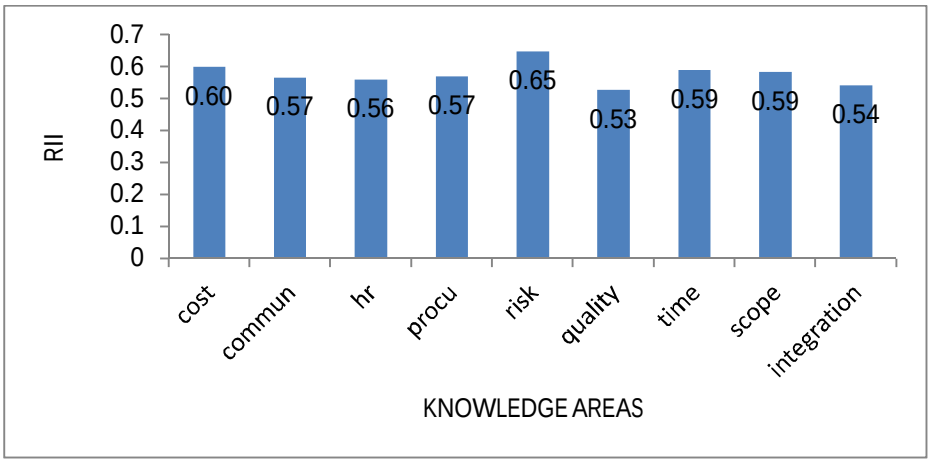

Fig 3. Knowledge Areas on Material Management

TABLE V shows the influence of knowledge areas on material management. From the available respondents through questionnaire the RII value are calculated and ranked through most prioritizing factor. Fig 3 shows the pictorial representation of the knowledge areas on material management, in x-axis knowledge areas are taken and in y-axis the RII value are taken.

The most critical factor among the ten knowledge areas are risk, which gives the highest RII value of 0.65 and consider as the most important factor.

Table VI. Results Related to Influence of Material Management over project life cycle.

PHASES	RII	RANK
INITIATION PHASE	0.640224	5
PLANNING PHASE	0.641827	4
EXECUTION PHASE	0.655448	2
MONITOR AND CONTROL PHASE	0.65192	3
CLOSING PHASE	0.70312	1

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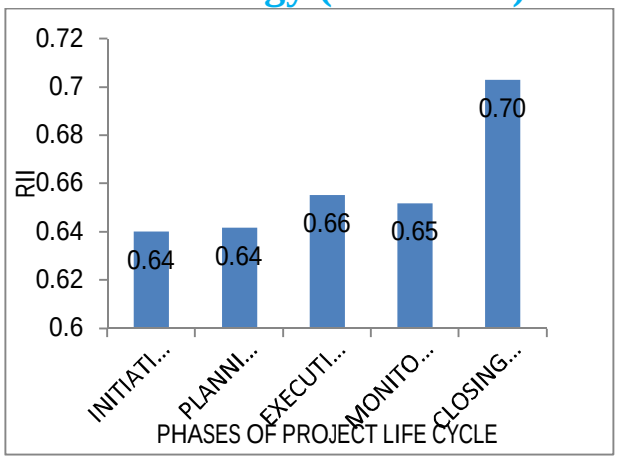

Fig 4.Influence of Material Management over project life cycle.

Table VI shows the influence of material management over project life cycle. From the available respondents through questionnaire the RII value are calculated and ranked through most prioritizing factor. Fig 4 shows the pictorial representation of the influence of material management over project life cycle, in x-axis various stages of project life cycle are taken and in y-axis the RII value are taken.

The most critical phase among them are closing, which gives the highest RII value of 0.7 and consider as the most important phase

V. CONCLUSION

This research work provides methodology for prioritizing the knowledge areas influencing material management and material management over project life cycle. RII is calculated to rank the factor. Thus the critical factors that are significantly affecting the material management were identified.

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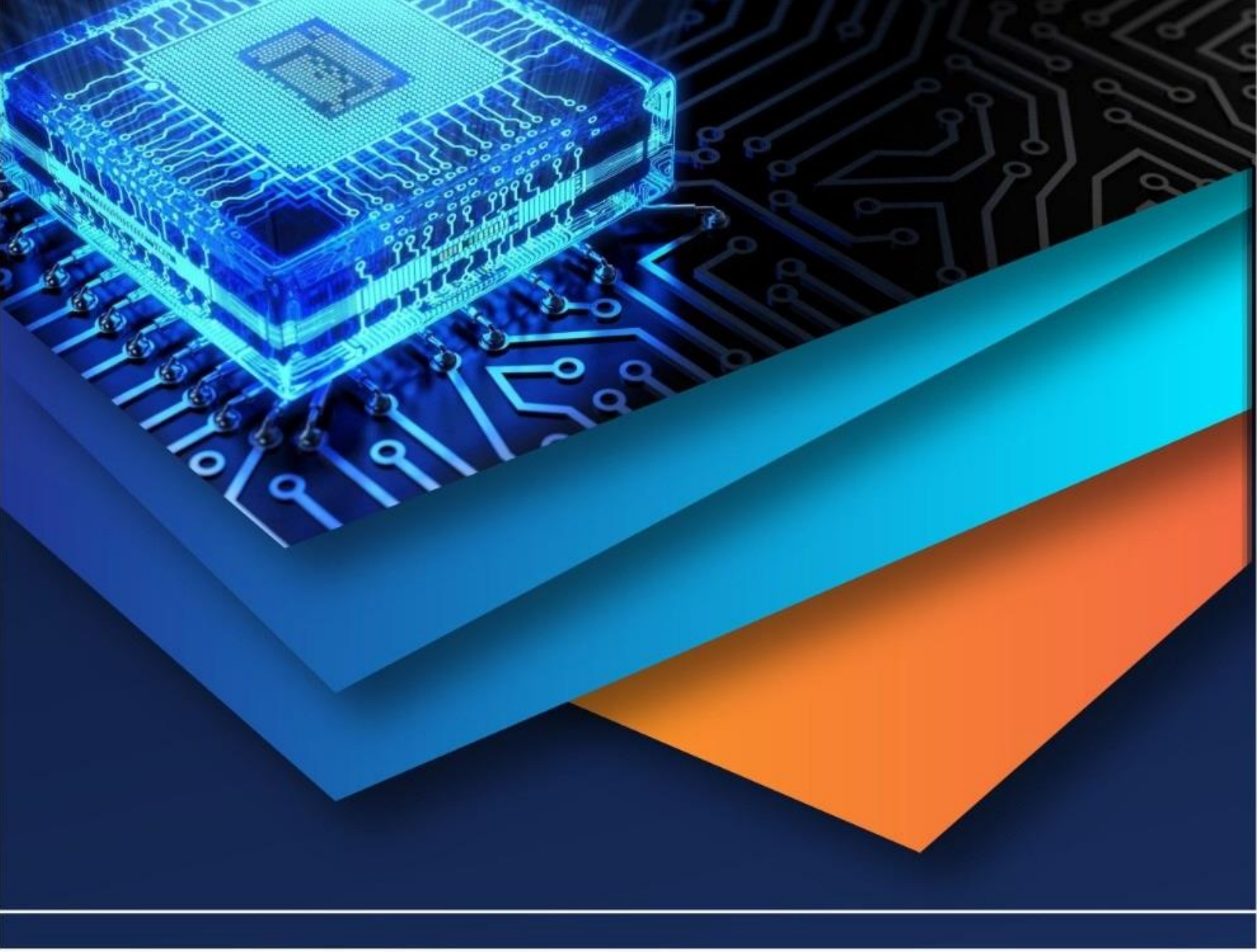

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