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An Assessment of the Suitability of a Total Quality Management Approach to Identify the Positive Measurable Impacts for the Construction Phase of a Project

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Abstract: ***An increased demand of quality in the construction industry has been a major cause of finding new systems and developing frameworks that are fit for purpose. Construction companies around the world are trying to increase their productivity and index of quality and they are developing new methodologies through research and development.***
This research work has identified and addresses the important issues related to the implantation of Total Quality Management (TQM) in the construction industry. The main aim of the study is to improve the understanding of TQM within the construction sector, and to highlight current barriers faced by construction companies in the implementation of Total Quality Management (TQM) philosophy.
The findings of this study suggest that TQM can be successfully implemented among construction companies. The conclusions and recommendations are drawn from the best practice of TQM implementation as a guideline for construction companies to consider in adopting the TQM philosophy, which in turn will increase productivity, stream line the processes and improves the quality of the services and the products offered by the construction industry.
Keywords: Total, Quality, Management, Project, Construction

I. INTRODUCTION

TQM is an organizational based approach focusing upon work processes with regards to improve organizational performance. It allows for continuous Improvement by engaging in the correct coordination of all work processes in all units of the organization with the sole aim of exceeding customer expectations. Quality is emphasized upon with the aim of reducing waste and rework to reduce cost and increase efficiency in production in the organization. In the late 1800s, Fredrick Taylor encouraged use of scientific methods to study work processes. His concept suggested that there was only "one best way" to do work. Once the best way was found, it had to be made standard until the next best way is found through scientific study. Scientific management has also discussed possible ways of finding that "one best way", but is it valid in current construction project environments?

This research is conducted on commercial operations and quality management methodologies. The concept of "Quality management" is certainly well known. Quality has many parameters and therefore its management becomes complex. Management of organizational processes has been looked upon as tool for quality management. Quality has been looked upon as an end product of process centric organizations.

The area of quality management, developed rapidly during the last century. Management of organizational processes and quality assurance are the means by which organizations achieve their objectives [2]. Methodologies surrounding this discipline have transitioned through number of generations while becoming more mature and agile to meet current organizational needs. The benefits provided by these methodologies can be visible in the performance of leading corporations of last decades. They provided with better operations with improved quality of products, increased customer satisfaction and long term sustainability of organizations. Being conscious of the importance of quality for all types of organizations, quality is a key wepesi needed to achieve and sustain a competitive advantage. This has made clear that quality matters indistinguishable from the country or economic sector the organizations worldwide belong to. Quality is an interdisciplinary field that catches the attention from all industries and economic sectors, with particular attention being paid by the construction sector worldwide. Xiao and Proverbs (2002) introduced in their research that consumers' constant benefits are associated with the excellence of construction ventures. They also recommended that less priced and rapid development of structure must be avoided which can affect quality of the constriction venture [3].

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This study is focused on the methodology of TQM. Objective of research has been to identify the relation between construction process and quality aspects. Through an extensive literature review and case study analysis, the aim is to understand relations and evolutionary traits of TOM.

II. AIM OF STUDY

The aim of this research is an assessment of the suitability of TOM approach to identify the positive measurable impacts for the construction phase of a project.

III. OBJECTIVES OF STUDY

1) To analyse the construction sectors activities concerning quality by using existing management models.
2) To describe the role of quality management role not as isolated activity but intertwined with all managerial processes and operational processes of construction companies.
3) To evaluate and assess the impacts of quality assurance, quality control, quality in management and total quality management.
4) To find outcome of TQM application on business performance in construction companies.

IV. QUESTIONS OF STUDY

Three research questions will be proposed established on aims of the research and broad literature review. These questions are listed follows:-
Q1: What is TQM?
Q2: What is overall business performance inside TQM?
Q3: What are the outcomes of TQM application on overall business performance in construction businesses?

V. METHODOLOGY OF STUDY

In the context of TQM the main objective of research is to study how a TQM approach should be implemented in the construction sector to identify positive measurable impacts for the construction phase of a project. So as to answer the objectives of the research a literature based study is proposed to be conducted, which is not only meaningful in academic study, but also a strategy used widely in practice.

VI. RESEARCH SCOPE AND LIMITATIONS

The research scope and boundary for this research necessitates a review of the construction industry and the study of TQM processes along with the importance of this concept in today's professional capacity. This is proposed to be carried out through a theoretical review.

VII. BACKGROUND OF THE STUDY

Globally the construction sector is experiencing transformation like never before. Economic shifts around the world are challenging previously dominant economies to meet the needs of 21st century. In its place the emerging construction markets are setting benchmarks. In order to sustain and even enhance competitive advantage in an increasingly global competition, companies must continuously and consistently embrace best practice management disciplines, strategy and technologies [4].
High quality in products and services are considered to be norm in most parts of the world. Organizations however have been focused around another quality aspect, Quality of Operations [5]. There is a relation between quality of operations and processes. Once any organization perceives themselves and their business in terms of process, then there is considerable amount of possibilities for the processes to be constantly redesigned for continuous improvement in order to improve quality. Continuous Process Improvement (CPI) is a term commonly used to describe TQM [6, 7].
To survive in high competition construction organizations must ensure the quality of their products and operations. It is becoming increasingly difficult to run large international corporations, remain innovative and profitable, and ensure operational excellence.
Growing complexity of business demands for approaches on business processes and quality assurance that can be implemented rapidly and through entire organization. Although there are various orientations for quality like quality assurance, quality control, TQM, etc. However, criticisms are still widespread about pathological situations in construction [8].

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"The attention to quality is a feature of advanced societies and its implementation depends on the corresponding stage of development" [8]. The price to be paid for a building is an echo and reflection of the quality prospects and expectations. Cheaper buildings probably use poor and inferior materials and are probable to be less durable and less attractive. In addition, the quality is likewise connected to the time and cost of when it is delivered.

Joseph Juran, a renowned quality management thinker, has highlighted that executives only understand the language of money and therefore the choice of these methods is heavily influenced by their ability to provide tangible financial improvements through combination of process and quality improvements.

That can be implemented rapidly and through entire organization. Although there are various orientations for quality like quality assurance, quality control, TQM, etc. However, criticisms are still widespread about pathological situations in construction.

"The attention to quality is a feature of advanced societies and its implementation depends on the corresponding stage of development", [9]. The price to be paid for a building is an echo and reflection of the quality prospects and expectations. Cheaper buildings probably use poor and inferior materials and are probable to be less durable and less attractive. In addition, the quality is likewise connected to the time and cost of when it is delivered.

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VIII. WHAT IS QUALITY?

Quality is a word that everybody uses frequently on a daily basis within their vocabulary. However, even if it is very commonly used word; it has a variety of interpretations and applications depending to the user and the different situations. Most people who claim to "know" the meaning of the word, say they can tell when a product or service has quality when they "see it".

By breaking down the word quality, it is possible to analyse its verbal logic. Quality is created commencing Latin prefix "quails" that is "such as the thing really is" [10, 11]. One of the most known generalized and international definitions is the one given by the ISO, within ISO 9000:2000. The standard states: "Quality is the degree to which a set of inherent characteristics fulfils requirements, ie. Needs or expectations that is stated, generally implied or obligatory".

It is worth to mention the significant contribution made by a group of authors to the quality theory. The legacy of these men has been crucial for building up over the years the quality knowledge we count on nowadays. This group of men is most known as "The Quality Gurus", because they developed a theory and method to quality inside the industry which made a significant effect. The word "guru" means as a noble individual, an intelligent individual and an educator. Below, I present definitions of the quality concepts given by some gurus who developed the quality philosophy (however the next chapter will be dedicated to the Quality Guru in detail):

Philip B. Crosby (1979): "Quality is conformance to requirements"

Joseph M. Juran (1967): "Quality is fitness for use"

Edward Deming (1986): "Quality should be aimed at the needs of the customer, present and future"

Genichi Taguchi (1986): "The lack of quality is the losses a product imparts to the society from the time the product is shipped"

Considering all existing quality descriptions, some are broader than others, still there is no such a thing as an official and unique definition for the word quality. But in most quality existing definitions, the common element is that quality aims to meets customer's expectations or desires.

IX. PRODUCT QUALITY DIMENSIONS

From the concepts presented above, there is still place for ambiguities when it comes to translating those "quality meanings" into measurable or tangible attributes to be clearly seen on products. With this in mind, Garvin (1984) developed one of the most recognized sets of quality dimensions for products.

The 8 dimensions of quality involve the perceptions from managers, operators and customers in respect to quality on products. This because what quality is for a customer may not be exactly the same as what quality is for a manager. Quality perceptions may be different among these groups, and listing product quality dimensions allow sharing the same perception of quality by managers, customers and operators.

Garvin's eight product quality dimensions are:-

1) Reliability: discusses tendency of a commodity to function as it is supposed to over its useful designed life.

2) Performance: mentions about effectiveness with a commodity achieved its projected purpose.

3) Features: constitutes the characteristics if commodity that complement commodity's essential performance.
4) Durability: means limit to which a commodity endures stress deprived of deteriorating.
5) Serviceability: Means how easy a product can be repaired. If commodity is comparatively simple to preserve and repair? The easiest its reparation is, the more serviceable that product is.
6) Conformance: Ensures commodity approves all requirements and corresponds to the specifications, or numerical dimensions for the product performance such as durability, size, speed, capacity, weight.
7) Aesthetics: refers to the subjective attributes of the product such as taste, smell, sound, look and feel. The closest the product attributes matches the customer preferences, the highest quality that product will be in terms of aesthetics.
8) Perceived Quality: This dimension depends on customer opinion about the product. The commodity can have acceptable measurements of quality but sometimes there might be negative insights about the commodity by the customers.

X. WHAT IS QUALITY MANAGEMENT?

Quality Management is defined as an integrated approach to achieving and sustaining high quality output, focusing on the maintenance and continuous improvement of processes and defect prevention at all levels and in all functions of the organization, in order to meet or exceed customer expectations" [12]. Agreeing with Flynn et al. (1994), Quality Management has been a vital constituent in manufacturing methodology to accomplishing and satisfying a competitive benefit. During the early 90's, the current service boom we experience nowadays had not started yet. This explains why most of the efforts on Quality Managements where in its majority aimed towards quality in products. This can be seen in the Quality Management's measurement instrument postulated by Flynn et al. (1994), which was designed considering the world class manufacturing. The measurement instrument postulated by Flynn et al. (1994) composed of fourteen parameters, which demonstrate several methods of Quality Management practice magnitudes, Le. (upper management backing, excellence statistics, process management, product design, employee management, contractor participation and consumer participation). Above magnitudes were also acknowledged by Flynn et al. (1994), and constituted during the early 90's a newly develop theoretical framework which was the base of the measurement instrument. It is worth to mention that the seven dimensions were identified taking as focal point products and not services. This can be seen in the existence of the dimension "Product design" and the absence of a "service design" dimension. This particular dimension considered the design weakness to be the greatest source of product failure. Another definition about Quality Management is the one given by ISO 9001:2005. It defines Quality Management as "Coordinated activities to direct and control an organization with regard to quality." ISO 9000:2005 Classified all accomplishments to manage the organization in matter of quality in the following way:

Quality Planning: this is the main section of Quality Management dedicated on quality goals and identifying quality essential operating processes, assets to accomplish quality goals

Quality control: Section of Quality Management dedicated on accomplishing quality parameters.

Quality assurance: Section of Quality Management dedicated on in case assurance about quality parameters will be achieved.

Quality Improvement: section of Quality Management dedicated on improving capability to accomplish quality parameters.

The Quality Management concepts given by Flynn et al., (1994), and ISO 9000:2005 are similar in the sense that both of them perceive quality management from a holistic point of view. Both think the way to obtain sustainable quality output is by involving the entire organization at all levels. While a difference between them is that Flynn's theoretical framework was designed and centred exclusively towards quality in products, while ISO 9000: 2005 was broader and focused in both product and services.

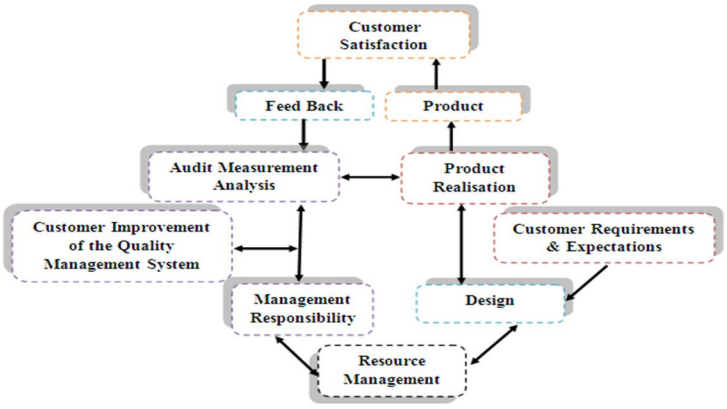


Fig1: TQM Process within Organizations [14]

XI. HISTORY OF QUALITY MANAGEMENT

Quality Management has evolved over time. Based on Bergman and Klefsjo (2010), the most relevant echelons during this progress will be depicted.

The Prehistory: Here the quality lied on specialization of the work. Great craftsmanship was the way to get products of high quality.

The industrial revolution:

Assembly: By trying to solve problems in assembly, specifically problems related to the high variation among the different parts to be assembled, Honoré le Blanc, established a method for production of muskets. The system was to produce muskets to a typical pattern with the use of exchangeable section and assembling them. This is how the Musket assembly line was bom. This system was later adopted in US and succeeded there thanks to the setting of tolerances. If tolerances are defined and the component parts are manufactured according to these settings, all the component parts can be easily assembled.

Taylorism: Federick Taylor (1911) separated planning function from the execution function. Managers and engineers were in charge of the planning function, while operations were assigned the execution function. Operation was separated from inspection. Job was segmented into specific tasks, there was a focus on increasing efficiency and quality assurance relied on inspectors. Defects were present but removed by inspection.

Walter Shewhart: He applied a statistical perspective to the production process. He suggested the control chart as a tool for handling variations. Shewhart pointed out how to maintain the data and draw conclusions from it, so the variation in the production process will be under control and supervised.

Edwards Deming (Late 40's) and Joseph Juran (mid-50's) both of them emphasized the importance of top management support on continuous quality improvements. Deming stated that quality cannot be achieved by depending on inspection and highlighted the statistical process control. Juran highlighted the importance of working continuously on quality improvements. The big difference among these two quality gurus was that Deming ignored the cost of quality, while Juran claimed that reducing these costs is vital for any business.

Japan after 2nd World War (1950-1985): After Second World War Japan started to rebuild its industries, helped by the innovative ideas of Deming and Juran.

Kaoru Ishikawa: believed in the utility of statistical methods to solve problems. Ishikawa designed "The seven quality control tools". He suggested the use of "seven quality control tools" during Quality control circles. Ishikawa aimed to involve all the company (operators, top managers, engineers, administration staff...) within the quality improvement process.

Taiichi Ohno: (1950) He was the developer of the Toyota production system (TPS). He stressed the importance of reducing waste and unnecessary work. He created the Kanban method and the Just in time concept. These production techniques are the cornerstones for lean production as we know it today.

The western quality revolution During the 80's USA started the awakening process for improving the quality on its products. This as a reaction to the international competence and the progressive and superior quality inherent to Japanese products. After 3 decades that Deming had helped Japan to improve the quality and its industry, USA finally adopted Deming's quality teachings.

Six Sigma started in 1986 as analytical technique to decrease deviation in electric production procedures in Motorola - USA. This business management strategy aimed to increase quality of output techniques by locating and eliminating the origins of deficiencies and decreasing the statistical dispersion in not just manufacturing, services and business processes.

Quality Awards: In 1987, as a way to incentive the quality initiatives among American organizations, USA founded the "Malcolm Baldridge National Quality Award". A couple of years later in Europe, (1992) the European Foundation for Quality Management (EFQM) established the European Quality Award. Nowadays this is known as EFQM Excellence Award. It is worth to mention that these are not the only Quality awards. Awards have been established within different countries worldwide (e.g. Utmärkelsen Svensk Kvalitet given by SIQ in Sweden since 1992).

Lean Production: in 1985 was the given name to a production practice based on the Toyota Production System and the teachings giving by Taiichi Ohno [24]. Lean was focused on preserving value with less work. Lean production has evolved in Lean thinking and lean six sigma.

TQM-Total Quality Management was first introduced at 1985 by Navigational Air Systems Expertise to represent Japanese management method for quality improvement. TQM is perceived as a holistic concept of principles, procedures and mechanism that are combined to achieve higher consumer gratification with less resource consumption.

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Quality Management Systems: During 1987, in Europe, the first version on ISO9000:1987 was published. This represented the beginning of the Quality Management Systems as currently known.

XII. TQM CONSTRUCTION CASE STUDIES

The objective of this side is to discuss and present results of case studies selected specifically for this study concerning the subject of TQM implementation in the largest construction companies of Malaysia and Oman.

Case Study 1: Study of Quality Management in Malaysian Construction Projects [27], this research explores preliminarily the practices of quality management, management commitment in quality management, and quality management implementation problems in construction ventures in Malaysian construction sector. The case study offers vision on quality management in construction ventures in Malaysia.

From outlook of construction establishment, quality management in construction ventures must preserve excellence in construction mechanism at mandatory to attain consumers' approval that transports affordability and professional existence for businesses [28]. Quality management is judgmentally mandatory for construction business to withstand in existing construction sector which is extremely interesting and economical [29, 30]. The role of quality management for a construction company is not an isolated activity, but intertwined with all the operational and managerial processes of the company.

The research applies semi-structured interview approach with twelve project management practitioners. It was an exploratory study in nature aimed to ascertain perceptions and experiences of practitioners in the industry with the following objectives:-

Performance of quality management in construction ventures from perception of tools and techniques,

Level of assurance of administration near execution of quality management in construction plans;

Difficulties related to execution of quality management in construction ventures.

From the results of the interviews it was established that there are five ISO 9001 certified companies out of twelve companies interviewed. Two out of seven non-150 certified companies are currently working towards getting certified,

It is perceived that quality management is part of project management and concern of every company interviewed. However, the purpose of quality management is mainly for fulfilling their obligation under the construction contract rather than increasing customer satisfaction as emphasized in the philosophy of TQM.

Few quality management tools and techniques were revealed from the interviews such as project quality plans, weekly site reports, and work method statements. A project quality plan is prepared normally upon request of the client or consultants. Weekly site reports are used as the monitoring tools of site activities whereas work method statements are used as guidelines for operation on sites.

The respondents were asked if they encounter problems for execution of quality management. They were also asked to state other problems of execution of quality management faced if there is any. Problems with subcontractors (83%), problem with more paper works (75%), and an increase of time (75%) were the three main problems highlighted.

Other problems which are encountered by at least half of the respondents are unwillingness of project staff to accept the quality system (67%), inadequate technical expertise/skills (67%), increase of cost (58%), and ineffective communication (50%). One respondent pointed out that external factors such as contract amount, efficiency of consultants also have implication on the execution of quality management.

Result of study specifies that quality management in construction ventures in Malaysia wants strengthened and there are problems in relation to quality management implementation that require attention and further research.

Case Study 2: TQM Practices in Big Construction Companies: A Case of Oman [31].

The research undertaken by Abu Bakar et al. (2011), aimed to classify level of usefulness of execution of TQM ethics by construction suppliers in Oman in topmost position construction business by Chamber of Commerce and Industry of Oman.

Vital aspects reserved into version connecting inner workforce of those businesses such as length of service with the company, how many years of experience, department of work. A numerical exploration method was accepted in this study, where surveys were circulated to 114 highest staff of exceptional and grade 1 suppliers to classify level of quality applies in establishments and establish to monitor instructions of TQM or not.

The perception of Quality was centred on team work as majority of the contractors defined quality as a measure of team work. This evidenced the importance of team work to the achievement of TQM in an organisation. However, it is observed that none of these contractor organisations have an implemented formal quality management program (0%) and whereas these contractors plan on installing a formal quality management program there is still a hand full of contractors who have no plans for any formal quality

management program (36%). However Most of them (75%) asserted the benefits of TQM to their organisation noting that it improves cost estimating amongst others like the project design etc.

The perception of quality is such that they believe that when quality is ensured; defects are eliminated giving the contractor a competitive advantage with TQM costs being minimal (2-5%). The researchers observed that most of the respondent contractors have a good knowledge and perception of Total Quality Management. Generally, it can be said that they believe that TQM program can work in Oman construction companies; hence, they consider teamwork as the best means of achieving quality. It has also been observed that there is shortcoming in training programs for all organizational staff members including the sop and middle managers

Lastly and not last, this section described outcome of case studies selected for this investigation. Results of the studies were both in qualitative and quantitative form, where the results demonstrated and reported the situation of the construction companies in Malaysia and Oman, and identified the concept of TQM from different angles.

In general, it can be stated that the lack of understanding of TQM within the construction companies is a major issue, which dictates that there is a need to run training programme for all staff members at all levels within the company. The quantitative results emphasise on what was found from the interviews and indicated that a few of the construction companies have a solid foundation that could be used as an introduction to the implementation of TQM framework. Moreover, it addresses the effectiveness of total quality management as a solution to the areas that need to be improved.

XIII. CONCLUSION

1) From the results of the research it is envisaged that TQM can be successfully implememed into the construction industry, only if there are good interactions and similarities between the construction organizations administration and TQM structure.

2) Main obligation for execution of TQM in construction businesses mentioned as follows: management contribution, flexibility in work environment, emphasis on consumers, training. Performance measurement, cooperation, monitoring and contimious improvement.

3) With intense competition and quality being at the forefront of business organizations, additional revenue making procedures for profitability elements) linked to controlled structure which organisation not able to afford to overlook to preserve highest place in market. The consumer is not absorbed in complex improvement parts of quality, Consumer demand is quality product and service as an end user. Quality is most important for consumer requirements. Little irregularity from consumer requirements can be bad quality of design.

4) If quality execution is patchy and not consistent in emire segments and subdivisions of construction association, then in case of time-constrained projects to fix agreed cour requirement is very challenging. Here technique is needed to diminish gap between consumers and improvement group. Concrete technique is required to incorporate the demands of consumer in strategy. To accomplish this objective Quality Function Deployment should be used to evolve design quality, with goal of substantial consumer requests. Interpreting consumer requirements into project goals and quality assurance idea should be used through manufacturing stage and procedures at each level.

5) Following aspects are very important for success of TQM execution which is given as follows: management assurance, consumer satisfaction and training. Nevertheless price. Features and period of plans are important constraints in customer's viewpoint who measured difficulties of construction businesses in the Malaysia and Oman case studies.

6) After analysing the case studies, it is important that one division in complete construction organisations analysed, who have knowledge of TQM philosophy. Other subdivisions in business should realize benefits of TQM and what improvement it can bring to the industry, method for procedures which can standardise and streamline operational procedures. To be precise that workforces are conversant through quality issues (QA/QC) TQM should be planned, executed and company should make worker attentive of advantages in working principles. Outcomes of study suggest TQM can be productively executed in construction industry around the world.

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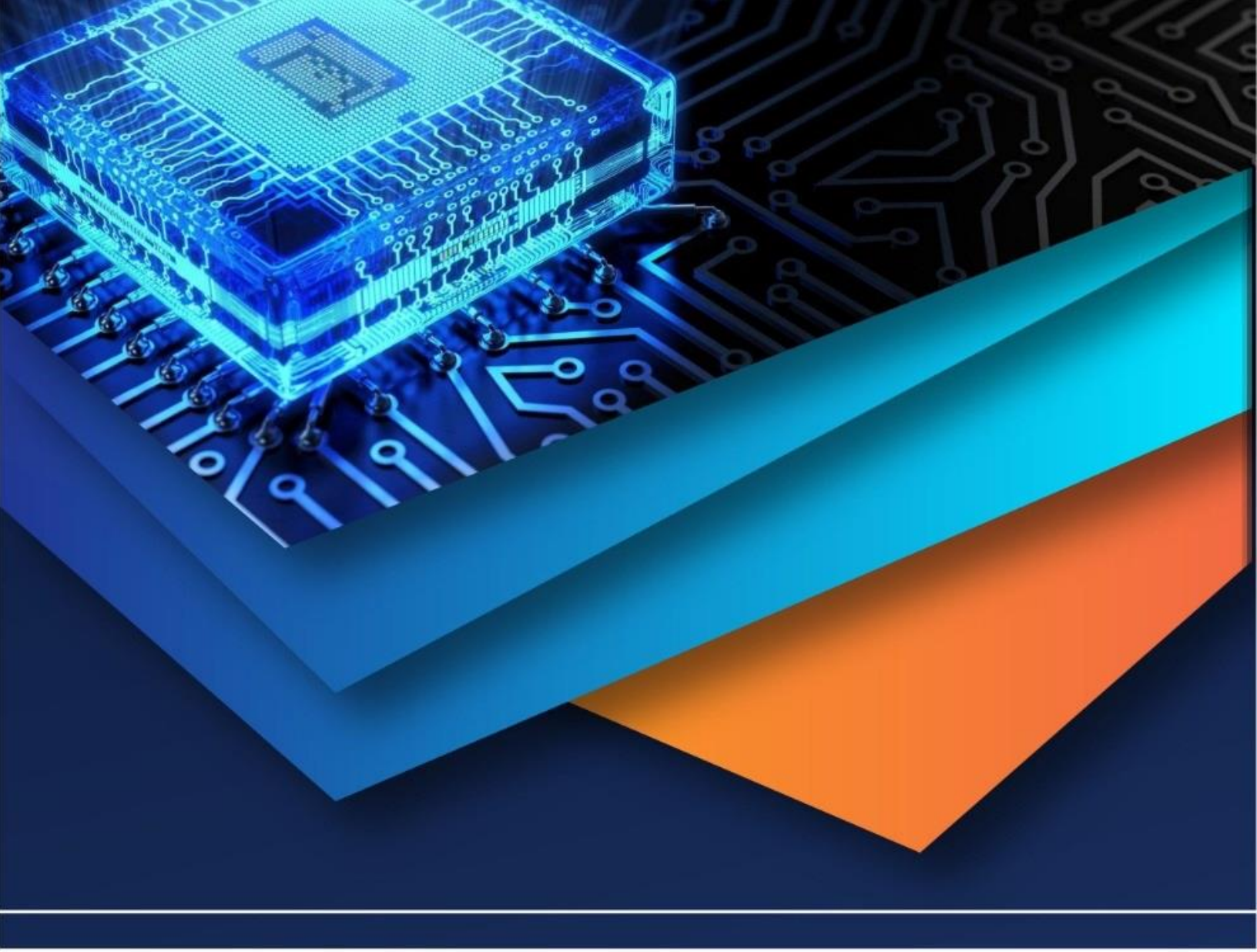
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