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Use of Big Data in Supply Chain Management

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Abstract: The rapidly expanding interest in the application of big data analytics (BDA) in supply chain management (SCM) among academics and practitioners has prompted an assessment of current research progress in order to define a new agenda. the use of sophisticated analytics tools to improve supply chain management The apps are divided into three categories: descriptive, predictive, and prescriptive analytics, as well as the supply chain operations reference (SCOR) model domains of plan, source, make, deliver, and return. This review answers to the demand by offering a new classification scheme that provides a comprehensive picture of current literature on where and how BDA has been used in SCM. The classification system is based on Mayring's (2008) content analysis method and addresses four research questions: (1) In which aspects of SCM is BDA used? (2) To what extent is BDA employed in these SCM domains in terms of analytics? (3) What are the different types of BDA models utilised in SCM? (4) How are these models developed using BDA techniques? The consideration of these four topics reveals several research gaps, pointing to future study directions. Purpose - Rapid innovation and globalisation have created a plethora of opportunities and choices for businesses and consumers in the marketplace. Due to competitive pressures, sourcing and manufacturing are now done on a global basis, resulting in a huge increase in product availability. The purpose of this article is to determine whether real-time business intelligence (BI) is required in supply chain analytics.

Design/methodology/approach – The paper argues for and analyses the benefits and drawbacks of BI. Findings – The article focuses on the need to review the classic BI notion of integrating and consolidating information in an organisation in order to help service-oriented businesses that want to keep their customers. Using a BI methodology to improve the effectiveness and efficiency of supply chain analytics is a vital component of a company's ability to establish a competitive edge. Originality/value – This study contributes to a better understanding of the difficulties surrounding the usage of business intelligence tools in supply chains.

Keywords: Supply chain management, Business analytics, Information systems, Big Data, Big data analysis

I. INTRODUCTION

A product's supply chain is the network of companies and facilities engaged in the transformation of raw materials into finished goods and the distribution of those goods to customers. Physical, financial, and informational transfers between enterprises occur in a supply chain. The use of data and analytical tools to make better decisions about material flows in the supply chain is the focus of supply chain analytics. To put it another way, supply chain analytics focuses analytical ways to make better supply and demand choices. By minimising sourcing, transportation, storage, stockout, and disposal expenses, well-planned and implemented actions contribute directly to the bottom line. As a result, analytics has long played a key role in supply chain management, beginning with military operations during and after WWII—particularly with George Dantzig's development of the simplex approach for solving linear programming in the 1940s. With the introduction of enterprise resource planning (ERP) systems in the 1990s and more recently with 'big data' applications, notably in descriptive and predictive analytics, supply chain analytics became more integrated in decision making.

To stay afloat in today's rapidly changing, increasingly competitive global market, with increasingly volatile customer and market behaviour and progressively decreasing product life cycles, businesses must analyse accurate and timely data (Gangadharan and Swamy, 2004). This study can be used to provide analytical insight into business problems and opportunities by focusing on financial operations, customers, and goods using common business words. A growing number of novel, channel-oriented applications (e.g., e-commerce support, call centre support) create a new challenge for traditional transactional applications that must be decoupled from channel-oriented applications to allow for sufficient flexibility in assigning access/distribution privileges for any enterprises that maintain direct contact with large numbers of customers.

Cost-cutting plans that deliver on the promise of value engineering are difficult for any company. Any company would welcome the opportunity to employ predictive modelling to forecast the chances of success for a new product line. However, recognising dead or outmoded stock and managing it through product ageing plans is a difficult task for the supply chain.

Choosing the appropriate method for managing returns and determining whether it is more cost effective to recycle or refurbish damaged products is always a challenge for any supply chain process. Complexities rise as the business or environment becomes more dynamic, i.e., where change is a constant aspect and a factor to factor into business management. The essential question, as defined by Azvine et al. (2007a, b), is how businesses respond to changes today, and what steps can businesses take to forecast and prepare for change as the nature of business and the environment becomes more dynamic. To achieve this, a system for determining the status of a firm in reference to its performance targets at any given time is required. The use of business intelligence (BI) is a key part of this investment.

The role of real-time BI in supply chain analytics is examined in this research. The paper claims that it is vital to reassess the BI idea, which combines and consolidates information in an organisation, in order to help service-oriented businesses that are desperately seeking client loyalty and retention. The paper discusses the role of real-time BI in supply chain analytics to support the thesis. The article also looks at the challenges and benefits of BI. The remainder of the paper is laid out as follows: The second section discusses business intelligence (BI) and its components. The third section provides an overview of real-time big data in SCM. The fourth section discusses benefits of big data in supply chain analytics. Section 5 presents the future scope of big data in operations and supply chain industry and Section 6 concludes the paper.

II. LITERATURE SURVEY

(Barney 1991) established and advocated the resource-based view as a strategic tool for understanding how to create and retain competitive advantage. The differences between competing firms in a given market, according to RBV, arise from each firm's unique capacity to identify and build a bundle of valuable, rare, inimitable, and non-substitutable resources (e.g., assets, capabilities, organisational processes, firm attributes, information, knowledge) in order to create business value (Barney 2001, Hoopes, Madsen et al. 2003) and achieve sustainable competitiveness (Barney 1991). RBV has been hailed as a critical strategic instrument in supply chain management, but it has also sparked controversy. Priem and Butler (2001), for example, contend that the RVB is not “currently a theoretical structure” (p. 22), despite the fact that they acknowledge that the RBV has assumed “stability in product markets and shunned assigning resource values” (p. 22). The same authors went so far as to propose that there is a "tautology in the RBV" in another work (2001). (p. 57). Several authors have effectively employed the RBV (Ellinger, Natarajarathinam et al. 2011, Chae, Olson et al. 2014, Gligor 2014, Khanchanapong, Prajogo et al. 2014, Gligor, Esmark et al. 2015, Hitt, Xu et al. 2016, Han, Wang et al. 2017) and DCT (Ellinger, Natarajarathinam et al. 2014, G (Gligor, Esmark et al. 2015, Han, Wang et al. 2017). Some of them, such as Chae et al. (2014), went even farther by demonstrating the ability of analytics to serve as a unique resource for enhancing manufacturing plant performance. Others have commented on how this technology can improve performance in any industry (e.g., Han et al. (2017)).

Supply chain analytics promises to extract and provide relevant information for company decision makers from massive amounts of data generated and captured by supply chain systems.

Data collected across the supply chain is crunched, numbers are examined, and information is provided for decision makers in order to configure supply chain functions. For supply chain system analysis, technologies ranging from mainframe-based multidimensional spreadsheets to PC-based statistical analytic applications are used. Building these supply chain-based analyses of combining data from numerous sources is the biggest problem every business faces today.

Limited capacity to raise prices, high customer expectations, and low levels of loyalty have created obstacles for all retail firms in an already competitive industry (Taylor et al., 2004). Retailers expect supply chain analytics to help them cut costs and improve customer experience. Only by identifying the enterprise's analytical needs and well-defined key indicators for organisational strategy can retail firms expect stronger and more effective supply chain analytics.

Many businesses have been encouraged to believe that ERP, SCM, and CRM systems can improve company processes and customer service while also providing corporate reporting and analytics. ERP and CRM systems, on the other hand, are integrated across the enterprise's information architecture and operates on their respective modules. Both systems operate in their own domains and do not follow the integrated business rules and definitions. Traditional transactional systems aren't built to support effective enterprise reporting and analytics. As a result, it's clear that SCM alone won't be able to deliver the required benefit at the proper moment in a business. Clearly, a BI system must incorporate data from all operating systems. As a result, BI and SCM requirements must be created together. Supply chain analytics gives you a bird's-eye perspective of your complete supply chain, revealing every product and component in it. It's used for making strategic decisions. It identifies cost-cutting opportunities and encourages revenue growth. It usually keeps track of past data and allows for a better grasp of total costs.

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Figures from drill-down and roll-up procedures explain what caused the performance level. The principal key business drivers for supply chain an include product ordering, worldwide outsourcing, web-based purchasing and selling, and JIT manufacturing.
Supply chain analytics offers a unified picture of the whole supply chain, as well as pre-packaged KPIs and statistics. It also assists a company with the major drivers of supply chain activities, such as planning, procurement, manufacturing, logistics, and returns. As a result, a business may examine and act to improve supply chain efficiency. Supply chain analytics identifies cost-cutting opportunities, improves supplier management, promotes production efficiency, and optimises delivery by analysing supply chain performance against goals and over time.

III. METHODOLOGY

Customer information, sales information, market and competitor information, product and service level requirements, promotion/brand information, demand forecasting, inventory, capacity utilisation, process planning and control information, skill inventory, human information, sourcing/vendor information, networking information, logistics, warehouse information are all examples of information in the context of SCM. As a result, the importance of data in the context of SCM cannot be overstated. Figure 1 depicts the critical role of data in the supply chain (Biswas & Sen, 2016). It is an example of a typical data-driven supply chain structure. Demand is initiated at the customer end and flows through subsequent stages to the supplier end in this structure. Goods and services are supplied along a path from the supplier to the customer. Return of goods for repairing, remanufacturing, and recycling takes the opposite path as demand. The data generated in subsequent stages is broadly classified into four categories based on the type of process and nature of usage. Supplier data are fundamentally linked to the activities associated with the sourcing process. Manufacturing data is generated as a result of the manufacturer's conversion activities. Following manufacturing, the product is delivered to warehouses, from which it is distributed to end users. The delivery information is provided by delivery data. Customer information related to sales and product demand is included in sales and distribution data.

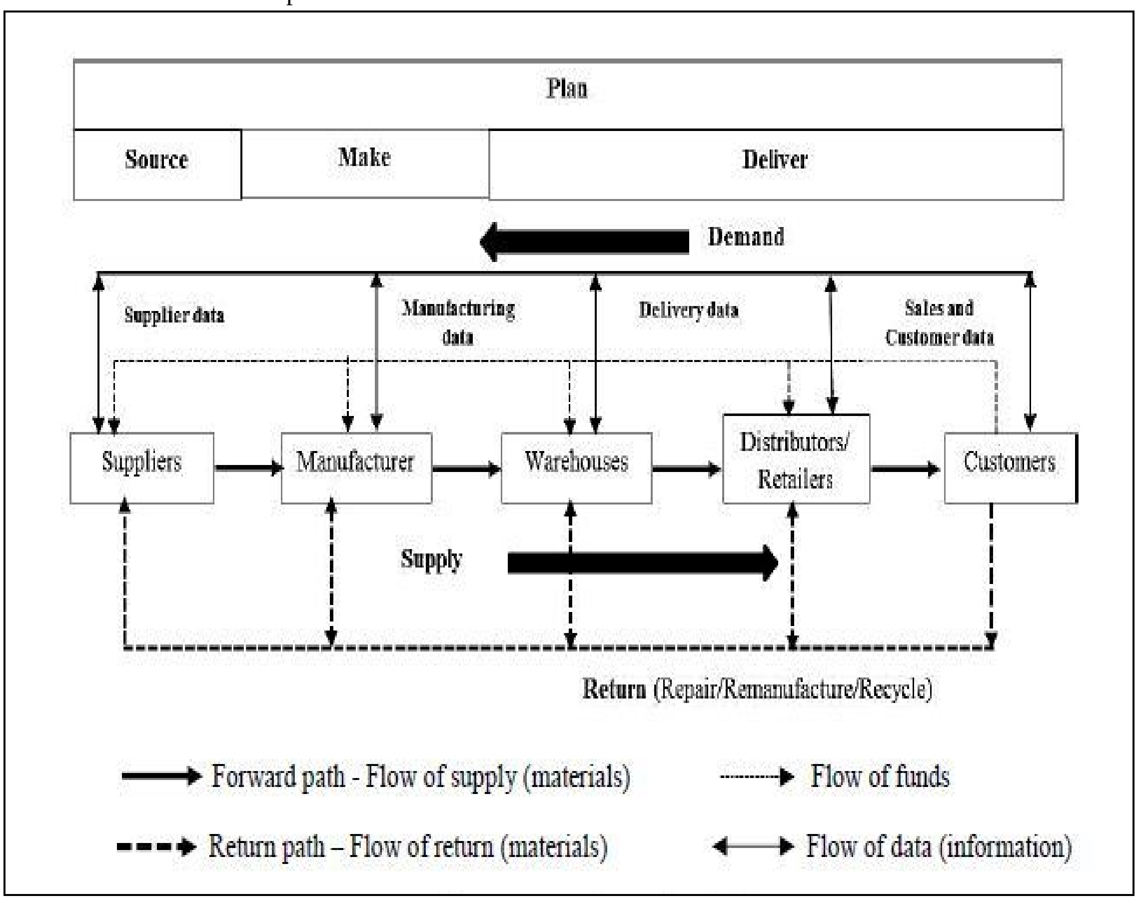

Fig. 1 Supply chain flowchart using data analysis

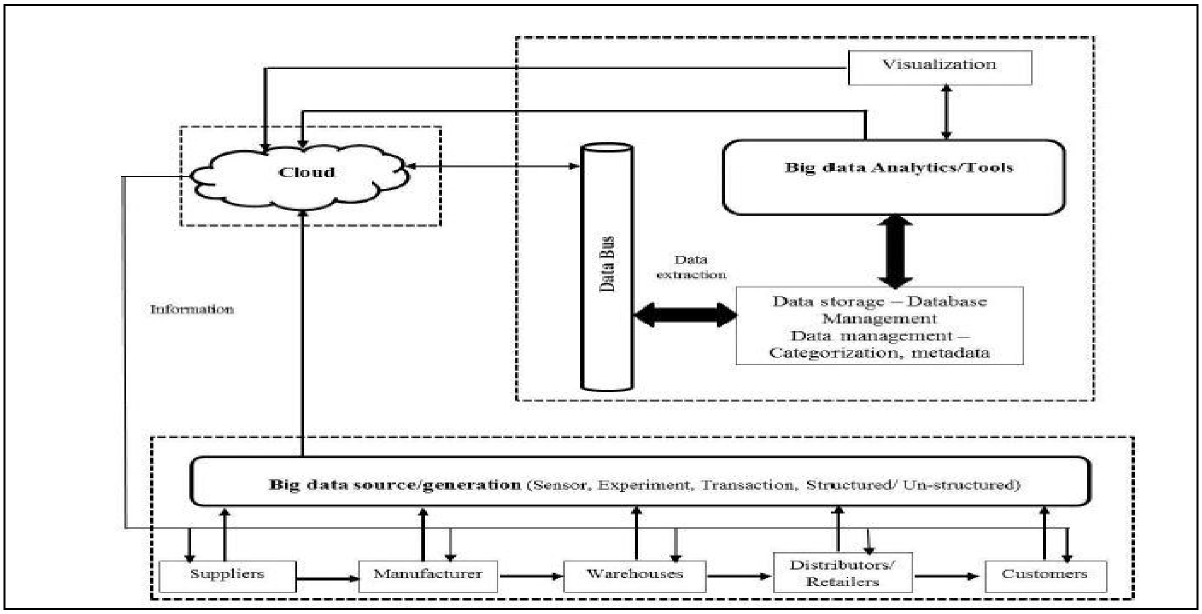

Fig. 2 Supply Chain chart composed by Big Data

Figure 2 depicts the architecture, which consists of six components: I sensor and other data acquisition devices, (ii) cloud infrastructure, (iii) data bus, (iv) data storage and management system, (v) data analytics engine, and (vi) data visualisation and rendering system. All objects and devices that receive raw input data at various points along a supply chain are included in the sensor and other data acquisition system. The input data generated in various formats by various source objects is passed through the cloud infrastructure. The data storage and management system receives data from the data bus and stores and retrieves it efficiently. The data analytics engine is the heart of the architecture. The data analytics engine includes intelligent processing algorithms for efficiently extracting meaningful and valuable information from massive amounts of raw streaming or static data. The data visualisation and rendering system visualises the analytics results so that the correct decision can be made quickly and effectively. The data visualisation and rendering system visualises the analytics results so that the correct decision can be made quickly.

IV. ANALYSIS & RESULT

According to a research by Accenture (2014), organisations who used Big Data Analytics in a systematic way saw higher returns on their investments, as illustrated in Figure 3. As it is obvious that a clear and systematic approach to Big Data Analytics may give a strong Return on Investment, Big Data and Big Data Analytics can be used in Supply Chain sectors such as Marketing, Procurement, Transportation, and Warehousing.

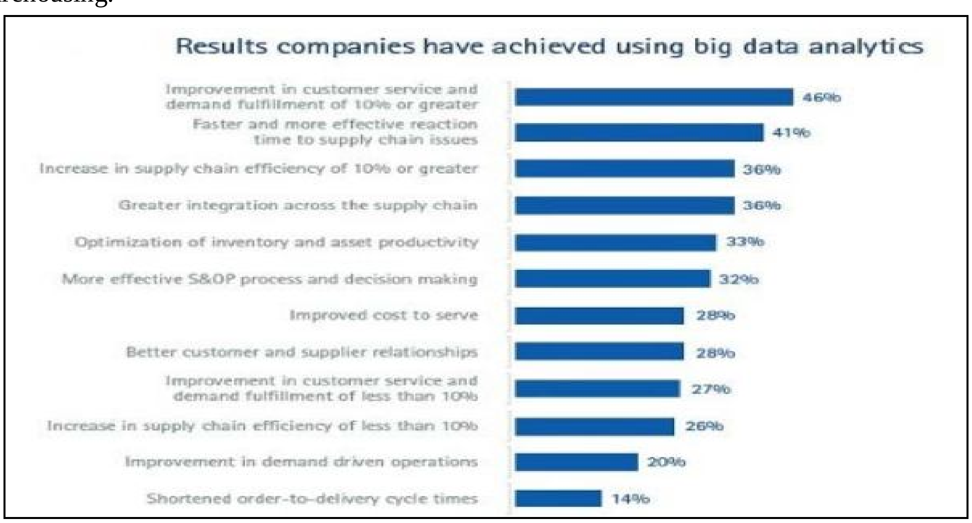

Fig. 3 Results achieved using Big Data (Miguel & Gómez, 2016)

A. Entry of Big Data in SCM

One of the main goals of using Big Data Analytics in Supply Chain is to tackle issues that cannot be handled using traditional methods. The complexity of the process and the unstructured data that results from it is one of the major problems that Big Data and Big Data Analytics confront in Supply Chain. A large physical flow connects Supply Chain organisations, including raw materials, work-in-process inventories, finished goods and returned items, information flows, and financial flows. Companies must manage the rising complexity of supply chains in order to compete more effectively in the global market. Material and information exchanges between Supply Chain organisations are related with Supply Chain complexity. Traditionally, these movements have been structured from supplier to consumer in a sequential order. Today, information does not move in a linear fashion. Information flows, especially through electronic interactions between all Supply Chain stakeholders, increasingly appear to be a contemporaneous interchange. A supply chain is made up of several different pieces or aspects that are related to each other either directly or indirectly. The importance of these many aspects and their interrelationships in the occurrence of complexity in a system cannot be overstated. To comprehend the influence of complexity, it is necessary to analyse its features. The following are the major features of Supply Chain Complexity:

B. Number of Supply Chain Entities

A Supply Chain's various entities must be evaluated. Computing data from a large number of such things may be difficult, since the amount of data collected grows in tandem with the number of entities evaluated.

C. Diverseness

The homogeneity or heterogeneity of a supply chain may be categorised.

D. Interdependency

The interconnection of things, products, and Supply Chain partners. The rise in interconnectedness leads to an increase in complexity.

E. Variety

It is a term that describes a system's dynamical behaviour.

F. Uncertainty

In a Supply Chain, uncertainty prevails owing to a lack of information about the whole system or any specific entity. As the level of uncertainty in a supply chain rises, so does its complexity.

V. APPLICATION

According to our findings, there is a substantial positive association between SCAC and business performance, as well as a mediating effect of supply chain agility on this relationship. These insights may help managers decide whether or not to invest in SCAC. In order to obtain a high-level sustained competitive advantage, they should also consider investing in complementary assets such as supply chain agility. Furthermore, businesses should invest in a SCAC-enabled business strategy (Hartmann, Zaki et al. 2016). It should be highlighted that this research identified the three primary subconstructs of supply chain analytics capability on which managers should focus when considering the adoption and application of big data analytics.

The study's findings can be utilised as a diagnostic tool to pinpoint big data analytics capacity deficiencies. For example, the model can assist managers in identifying any analytics sub-dimension that is underperforming and adds little to a specific dimension (i.e., talent, technology or, management). The findings of this study can also be used to determine the relative contribution of any particular dimension on agility and performance.

Machine-to-machine communication, or IoT, would be able to circumvent this obstacle. The BDA, which has already been used to plan and assess product lifecycles (Ma et al., 2014; Song et al., 2016), could be effective for anticipating product returns and measuring return quality. In a reverse logistics system, this is critical for capacity planning and remanufacturing scheduling.

Managing a CLSC has always been difficult because of the unknowns and potential conflicts between aims, such as profit vs. environment vs. social well-being. In this way, BD can help with understanding people's perceptions, developing multi-KPIs, monitoring operational processes, and taking appropriate measures.

VI. FUTURE RESEARCH PROSPECTS

The findings presented above offer some future areas for advancing BDA application research in the SCM setting.

More research on BDA's applicability at the SC function level. Each SC function has a lot of research gaps, according to the assessment. Quality control in manufacturing, dynamic vehicle routing and in-transit inventory management in logistics/transportation, order picking and inventory control systems in warehousing, demand shaping in SC and operational research, and procurement are just a few examples of areas that are currently under-researched

Functional alignment technique for BDA-driven SC horizontal integration All functions are interconnected in SCM, which is a multi-level process. As a result, focusing BDA adoption on only one or two functions will not provide a major or long-term competitive advantage. To avoid such disjointed attempts, the entire SC should be horizontally interconnected by properly aligning BDA apps in various roles. Production and logistics planning, for example, might be combined with real-time demand sensing to reduce costs and improve service levels. Indeed, alignment blurs the lines between functions.

Analytics at three levels should be assessed equally. Prescriptive analytics, rather than descriptive and predictive analytics, is the emphasis of contemporary research. Regardless, applying BDA to any subject, not just SCM, is always a linear process. Prescriptive analytics' performance would be significantly reliant on descriptive and predictive analytics' in this process, as they determine the value of crucial parameters in prescriptive models (Duan and Xiong, 2015). Future research should balance the focus across all three levels of analytics to catalyse the rapid evolution of BDA application in SCM.

Developing more complex and adaptive BDA models for DSS by combining multiple data analytic techniques A variety of BDA models typically used in SCM applications, as well as popular and diverse BDA methodologies to develop those models, were found in the literature review. As baseline methodologies for prescriptive analytics and DSS, dynamic optimization and simulation modelling should be researched further in the framework of BDA. Furthermore, despite the widespread use of visualisation techniques as a supplement to predictive and prescriptive models in the literature, little emphasis has been dedicated to enhancing data visualisation approaches. This type of study should be pursued in the future.

VII. CONCLUSION

Supply chain management is a fertile ground for the use of analytics approaches, as evidenced by the employment of operations research, notably linear programming and optimization, in the past. Inventory theory, for example, is more than 50 years old, and substantial advances to production planning were made in the 1980s. As a result, supply chain analytics is not a new concept. The integration of price analytics and supply chain management in the field of revenue management, where the problem revolves on managing demand in a setting with fixed and perishable capacity, is one of the more recent applications.

New opportunities emerge as a result of big data. I've heard consultants extol the benefits of using social media for supply chain management, such as recognising local demand trends and adjusting inventory and prices. Although many organisations still struggle to balance basic supply and demand in a world of growing product proliferation, competition, and globalisation, there is potential there (i.e., longer lead times). Big data has the ability, among other things, to improve demand forecasting methods, detect supply chain breakdowns, and improve communications across frequently worldwide supply chains.

To allow real-time BI enabled supply chain solutions, business transactions, consumer demographics, seasonal flows, supplier data, and inventory levels must all be meticulously synchronised. In this work, we discuss both real-time and classical BI. In supply chain analytics, the approach to real-time BI is outlined. The benefits of real-time business intelligence are also explored. We believe that adopting real-time BI in supply chain analytics would improve operational efficiency and KPIs for any SCM firm.

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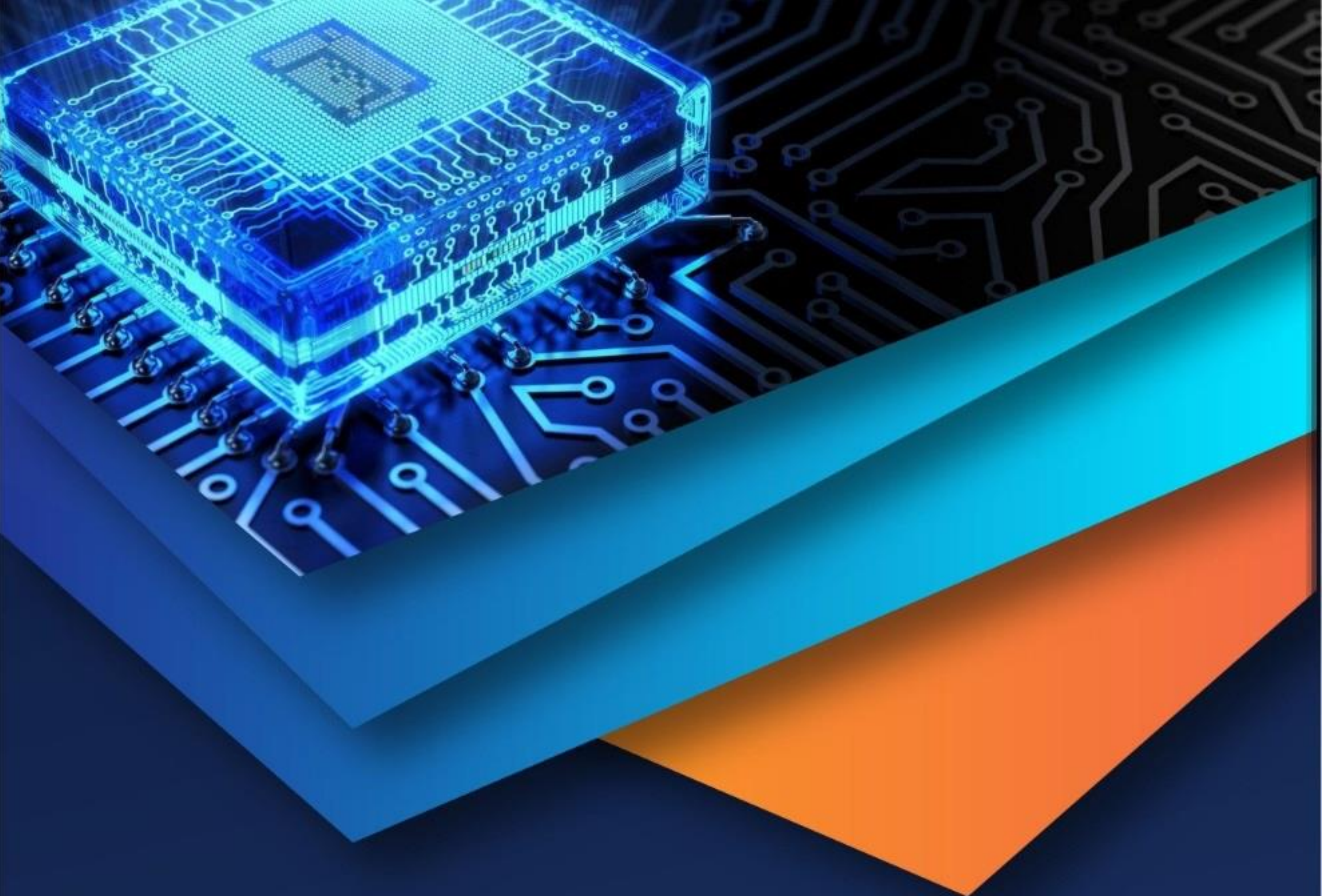

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