



Research Article

IT in Improving Integrity and Productivity in Supply Chain Management

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ARTICLE INFO

Article history:

03 Jul 2024 (Received)

07 Aug 2024 (Accepted)

15 Aug 2024 (Published Online)

Keywords:

Information Technology, Supply Chain Management, Business Management, Digital Help, Business Processes.

ABSTRACT

Supply Chain Management is a crucial field that involves the flow of information, materials, and finance within a network of suppliers, manufacturers, distributors, and customers. It has revolutionized the role of management in enhancing supply chain operations and addressing the knowledge-intensive nature of economies. Information Technology has significantly influenced this shift, making new product development more complex and competitive in dynamic market environments. This has led to the need for more accurate knowledge and information to satisfy customers' changing needs. The role of IT in supply chain management is crucial, as it helps manage e-risks and enhance the efficiency and efficacy of supply chain processes. The study examines how technology is changing supply chain management, highlighting its role in enhancing business operations and addressing the ever-changing needs of customers.

DOI: <https://doi.org/10.103/xxx> @ 2024 Transactions on Banking, Finance, and Leadership Informatics (TBFLI), C5K Research Publication

1. Introduction

Supply Chain Management's evolution has been marked by significant changes and breakthroughs throughout its history. In the 1900s, the supply chain was localized due to transport constraints or limited transport options. The advent of railroads in the 1950s solved transportation problems and facilitated the creation of interconnected supply chain networks. By the 1950s, global supply chains expanded, leading to increased logistics and mechanization. In the 1960s, companies centralized procurement procedures and implemented information systems to gain efficiency and integration (Daneshvar Kakhki & Gargeya, 2019). This allowed for more flexible and effective business even with fewer suppliers. Inventory management became more effective in the 1970s and 1980s, as businesses carefully balanced consumer demands and prevented surplus stocks. The 1990s through 2000s saw a focus on the need for stronger partnerships among supply chain partners, leading to the development of several important procedures to improve the supply chain management system (Daneshvar Kakhki & Gargeya, 2019; Mehmeti, 2016; Ross & Ross, 2015).

Technological advancements in supply chain management have gone a step higher, offering numerous options for companies to choose the best technology for their business. Companies design and

redesign their functions to harmonize with new technologies and optimize efficiency. Organizations evaluate systems based on their compatibility, efficiency, and effectiveness in their activities. One of the main goals is to make business activities more seamless and maximize returns (Maqbool et al., 2014). The past decades have witnessed changes in supply chain management that have significantly improved sourcing, transportation, and delivery of goods. Paper-based communication and transactions are no longer preferred in supply chain networks due to their negative impact on information flow and error-proneness. Technological advancements today enable organizations to acquire easily the necessary information and integrate technology into their supply chain networks. This integration allows for better inventory management, ensuring goods are available in the right quality and quantity when needed without unnecessary holding expenses (Fischer-Preßler et al., 2020).

Supply Chain Management (SCM) is the management of a network of interconnected businesses involved in the ultimate provision of product and service packages required by end customers. The sharing of information among supply chain networks allows the supply chain drivers to work together with the goal of integrated and coordinated supply chains for effective SCM. Information enhances performance and reduces risks of supply chains by providing processes executed

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Barna Biswas (2024). IT in Improving Integrity and Productivity in Supply Chain Management. *Transactions on Banking, Finance, and Leadership Informatics*, 1(1), pp. 1-7.

transactions and creating opportunities for decision-makers when they need it and in the format they need it. This is where IT comes into a role, consisting of hardware and software applications. IT plays an important role in integrating suppliers, manufacturers, distributors, and customers to satisfy the quantity and quality of products.

The functional roles of IT in SCM have been outlined as Transaction Execution, Collaboration and Coordination, and Decision Support. IT systems such as data integrity, real-time availability, visibility, processing capability of information, and standardization of business processes are expected to facilitate better matching of supply and demand between supply chain members and create an excellent backdrop for embarking on integration with external partners in the supply chain. The rigorous use of information technology in the supply chain is considered a critical prerequisite for managing supply chains. The exponential growth of information technology in supply chain networks has significantly changed paper-based communication to e-communication, which is a serious threat of cybercrime (e-risk) by unauthorized or illegal access using physical or virtual intrusion to a computer or computer system or computer network. Criminals may commit illegal access to confidential data, theft of data, manipulation of data, and denial of access to the system of supply chain networks (Varma & Khan, 2014).

Barcodes are cost-effective and time-saving tools that eliminate human error and reduce paperwork to improve customer service. Improved data integrity allows decisions to be made with real-time, accurate data, improving product and category management decisions. Bar code technology also facilitates the use of automated replenishment or vendor-managed inventory so the right product is always at the right store at the right time. Recently, organizations from both government and corporate sectors have mandated to implement of radio frequency identification (RFID) technology for their suppliers (Varma & Khan, 2014). The global standard for RFID such as the Electronic Product Code (EPC) offers insight into the coexistence of barcodes and RFID, increasing their importance to curb e-risks. ERP software vendors claim their software solutions are complete and designed to be industry-specific, but in practice, these packages do not support many business processes and require frequent upgrades. Many organizations are forced to leave some processes unautomated and a few legacy systems in place. Implementation of IT in SCM appears to have modest roles in decision-making and reducing e-risks by supply chain management (Fischer-Preßler et al., 2020; Varma & Khan, 2014).

The evolution of high-performance and cloud computing systems has started appearing in the domain of SCM, helping to provide transparency and visibility in supply chains. The next generation Internet connects heterogeneous computing devices to create network

traffic generated by automated objects from public sectors to the day-to-day life of people rather than human intervention. IT systems with service-oriented architecture and web service standards, expected to come in the future, may facilitate better supply chain management (De Barros et al., 2015).

The rapid growth of IT in supply chain management (SCM) is crucial for optimizing decisions, improving service levels, reducing inventory and costs, and reducing electronic risks. It is essential for effective information sharing and integration across organizations. Rapid changes in technology and IT applications, such as Electronic Data Exchange, Radio Frequency Identification, Bar Code, Electronic Commerce, Decision Support systems, and Enterprise Resource Planning packages, drive organizations toward a virtual supply chain. IT is also easily applicable in curbing e-risks, revolutionizing supply chain management, and enhancing organizational competitiveness. This paper explores the transformative role of technology in supply chain management, emphasizing its role in managing e-risks and improving the efficiency and effectiveness of supply chain operations.

2. Literature review

Information technology plays a crucial role in a business-level strategy, as it directly affects the mechanisms through which they create and capture value to earn a profit. However, much research on IT's role in strategy needs to be more accurate, suggesting a need for rethinking its complex relationship with profit generation. IT activities are integral to a firm's functional-level strategies but also play significant roles in business strategy, with substantial performance implications. IT affects industry structure, strategic alternatives, and value-creation opportunities, enhancing the firm's current capabilities and enabling new ones. These digitally attributable capabilities determine how much value can be captured by the firm and how much will be dissipated through competition or value chain partners (Drnevich & Croson, 2013). A study investigates the impact of information technology (IT) on business productivity, addressing the "IT paradox" and the lack of empirical research on IT benefits. It uses survey data to examine how IT adoption in supply chain communication systems influences market performance. The research finds that a firm's coordination mediates the influence of IT adoption on market performance only when the partner is critical to its success. If the partner is not critical, IT benefits can only be realized through enhanced coordination activities. The study aims to clarify the inconsistent benefits of IT in supply chain relationships (Kim et al., 2005).

Artificial intelligence (AI) has the potential to significantly enhance supply chain management (SCM) in four SCM fields: logistics, marketing, supply chain,

and production. This study aims to identify the most prevalent AI techniques in SCM, potential AI techniques for employment, current AI-improved subfields, and high-potential subfields that can be enhanced by AI. By addressing gaps in existing literature and examining papers from these fields, AI can provide valuable insights and improve the overall supply chain management process (Toorajipour et al., 2021). Another study explores the impact of technology on supply chain management (SCM) and its impact on marketing performance, financial performance, and customer satisfaction. The fuzzy DEMATEL method is used to analyze the interrelationships among these criteria. Advanced IT is found to be the key factor influencing marketing performance and customer satisfaction. The implications for the Vietnam textile industry are discussed, along with limitations and directions for future research (Tseng et al., 2011).

The relationship between a manufacturer's use of IT, particularly electronic procurement, and the number of suppliers in their supply chain is examined. A sample of 150 U.S. manufacturers found no direct relationship between e-procurement and the number of suppliers at the aggregate level. However, the use of electronic procurement is associated with buying from more suppliers for custom goods, but from fewer suppliers for standard goods. The positive relationship between the number of suppliers and electronic procurement for custom goods is negatively moderated by deeper buyer-supplier system integration, suggesting an alternative to increasing supplier numbers (Dedrick et al., 2008). The supply chain is a critical component of a business's success, with accurate inventory projections offering a competitive advantage. It is influenced by internal factors like product introductions and distribution network expansion, as well as external factors like weather and customer perception. Artificial Intelligence (AI) has emerged as an extension of our brain, allowing us to unleash our strategic and creative potential. AI has been integrated into various sectors, reducing costs, increasing revenue, and enhancing asset utilization. It helps businesses forecast customer demand, optimize R&D, increase manufacturing, promote products, and provide a better customer experience. Supply chain leaders use AI-powered technologies to create efficient designs, real-time monitoring, and lower process cycle times, thereby bringing innovation faster to the market (Dash et al., 2019).

The tourism industry in Thailand is crucial for the country's GDP and is incorporating artificial intelligence and robotic awareness in its hotel employees to improve performance across all dimensions. Supply chain agility is also being considered in this study. Data was collected from Thai hotel sector managers using a structured instrument and analyzed through confirmatory factor analysis and structural equation modeling. Results showed that robotic awareness significantly impacts all three dimensions of performance, and supply chain agility

significantly mediates these relationships in a positive direction. This study is unique in testing supply chain agility as a mediator in robotic awareness and performance linkage, and considering operational performance as another dimension of performance. Implications, limitations, and future research indications are also provided (Panichayakorn & Jernsittiparsert, 2019). The rise of the internet and electronic communications has revolutionized customer service, but it has also influenced strategic alliance and partnership structures. To succeed in this new market, leaders must navigate the evolving organizational structures and the changing nature of alliances and partnerships. This article explores the impact of traditional supply chain management (SCM) and electronic supply chain management (eSCM) on strategic alliances and partnerships, and discusses the new type of leader most likely to thrive in this dynamic and adaptable structure (Williams et al., 2002).

The papers describe the definition and meaning of information technology, and describe the role of IT in daily life as well as in business. The role of IT in supply chain management for business is quite crucial. The current study examines how technology is changing supply chain management, with a focus on how it might manage e-risks and boost the efficacy and efficiency of supply chain processes.

3. Methodology

This exploratory study explores the application of IT in Supply Chain Management (SCM) using multiple perceptions of multiple sources. The research aims to provide a better understanding of the subject, units of analysis, and practical validity of the constructs selected in the literature. The study uses a comparative analysis of scientific articles published since 2012, contrasting and comparing phenomena observed and analyzed by academia in different contexts and methods.

Three phases comprised the study's execution displayed in Fig. 1:

- i. Article search;
- ii. Article selection;
- iii. Categorization and analysis of the chosen articles.

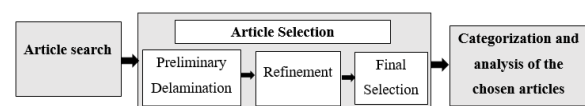


Fig. 1. Phase processing of sample collection.

SCM is a critical field of research, requiring a thorough literature review to identify relevant articles. A study was selected from scientific articles published in relevant journals and electronic journals for IT and SCM fields, published over five years since 2012. The

research context was chosen from databases like CAPES Journal Portal, including Emerald, Springer, ScienceDirect, DOAJ, Wiley Online, World Scientific Journals, Scielo, and Cengage Learning. The searches, conducted in October 2014, considered keywords like "supply chain management" and "technology information" in any language, resulting in 200 articles. This systematic approach ensures a comprehensive understanding of SCM and its applications in various industries.

The selection process for SCM involved delimitation, refinement, and preliminary reading, and final selection of articles. The selection process involved filtering search engines to include "supply chain management" and "technology information" topics, excluding biomedical journals, and peer-reviewed journals. After refinement, 160 selected articles were selected for their compatibility with the subject of analysis, IT application in SCM. Documentary research was used to highlight information obtained from various sources.

The articles' information was then consolidated and classified in a Microsoft Excel spreadsheet, considering processes benefiting from the SCOR model (Planning, Sourcing, Production, Delivery, and Returns), GSCF model (Customer Relationship Management, Customer Service Management, Demand Management, Order Fulfillment, Production Flow Management, Supplier Relationship Management, Product Development and Marketing, and Returns Management), and benefits in supply chain management (Cost reduction, Operational Efficiency, Quality, Integration, and Differentiation of Products/Services).

Following the described classification, a quantitative and qualitative analysis of the database derived from the articles was conducted, with an emphasis on identifying the gaps and patterns as detailed in the part that precedes the result.

4. Results and Discussions

By using the framework to to cross-check the research published in the publications, it was possible to determine how the relevant business activities and, consequently, the processes that benefited from this technique, were related. Fig. 2 illustrates that all of the chosen publications discussed the planning process. It also shows that sourcing or supply procedures received more attention (89%), while delivery or distribution received less attention (76%), and producing goods was the least mentioned (61%) to be helped by IT management for running Supply chain in medium and small size businesses.

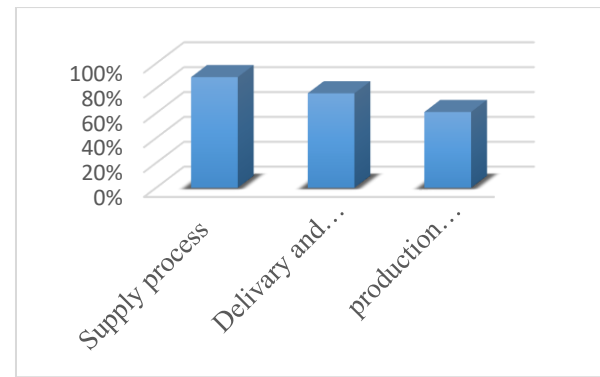


Fig. 2. Use of IT in SCM for running business.

Regarding the conceptual model and the evaluation of the advantages of implementing IT in supply chain management, the analysis's findings indicate that IT helps with supply chain management, particularly in the areas of quality, accuracy, and reliability of information (26 articles), operational efficiency and process improvement (25 articles), and integration and collaboration (23 articles). Fig. 3 illustrates this, adhering to the process analyses that were previously presented. Additionally, there is a chance for IT advancements when it comes to cost reduction and product or service differentiation, with references to such topics appearing in just 10 and 15 articles, respectively.

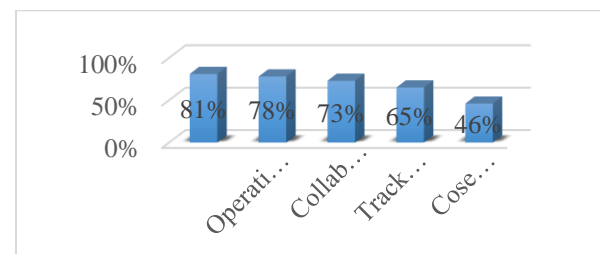


Fig. 3. Benefit of IT in SCM.

From the articles studied, there are several popular technologies used for the business including the advantages (shown in Fig. 4) and problems related to IT.

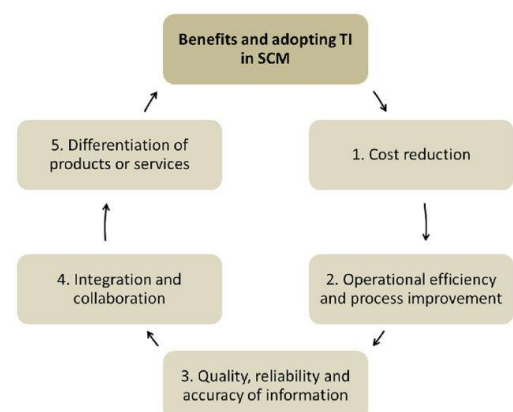


Fig. 4. Benefits of IT in SCM (Lopes et al., 2017).

4.1. Enhancing Efficiency with IT

The dynamic world of supply chain management that exists now has brought forth ground-breaking developments and continues to hold out hope for better things to come. This section aims to examine the leading supply chain technology developments and their potential to improve efficiency amidst the ongoing industry revolution. In the past, businesses only had access to antiquated technologies, and they had to cope with their inherent inefficiencies. Organizations in a variety of industries may now select from a wide range of innovative technology. These are a few of them.

4.2. Automation and Robotics

Supply chains have undergone a radical transformation as a result of logistics automation. Errors are decreased, procedures are streamlined, and overall efficiency is increased with automation. Enhanced productivity also contributes to lower expenses and more income for companies. The way that jobs are carried out or finished has changed dramatically as a result of new technology like autonomous cars and warehouse robots.

Operations including order fulfillment, last-mile delivery, and inventory management are being revolutionized by robots. These are devices that, when used as intended, simplify tasks, increase precision, and impart a little bit of perfection. A supply chain that is more flexible and effective is facilitated by these technologies.

4.3. Predictive Analytics

With the use of big data analytics at its core, supply chain experts' decision-making has seen a significant revolution. Businesses are using analytics to pinpoint areas in need of process optimization, optimize inventories, and enhance demand forecasts.

Nowadays, companies may confidently forecast consumer desires or market trends and make the necessary preparations to successfully satisfy those demands. To learn more about their organizations, they employ sophisticated analytics techniques to examine vast amounts of unstructured and organized historical data. Predictive analytics, a type of information technology, also aids in mitigating losses that could result from erroneous or unsuccessful market trend forecasts.

4.5. Internet of Things (IoT)

Technology has greatly benefited the supply chain, and the Internet of Things has significantly changed how some operations are carried out. The way its gadgets are integrated keeps changing how supply chain visibility is seen. Companies can now track shipments, fleets of vehicles, and warehouse conditions in real-time. As a result, the Internet of Things facilitates faster decision-making and lessens delays. Businesses can easily obtain useful data to optimize routes, cut lead times, and

enhance the overall performance of their supply chains by utilizing IoT-enabled devices and sensors.

4.6. Cloud Computing

Supply Chain Management, exploring the world of cloud-based solutions, greatly benefits from cloud computing. The new techniques aid in understanding how data administration is simplified. Businesses may improve cooperation and scalability in the SC processes by utilizing cloud-based tools.

Supply chain partners' connections have generally been synchronized by IT, which has strengthened their bonds and maximized their contributions to the overall SC goals. This has given the supply chain partners a competitive edge over other supply chains. It is also a useful solution since it is a system that is easily compatible with different approaches, both old and modern.

4.7. Artificial Intelligence and Machine Learning

Artificial Intelligence and Machine Learning are rapidly transforming the business world, offering numerous benefits in areas like inventory management, intelligent sourcing, and logistical route planning. Cobots are revolutionizing warehouse efficiency by picking, packing, and moving heavy objects.

AI's computer vision supports object recognition and defect detection, while augmented reality enhances maintenance and quality control. Machine Learning, a subset of AI, enables computers to learn without explicit programming, helping businesses make decisions and predict important aspects like quality control, demand forecasting, and new product development.

4.8. Improving Transparency with IT

Organizations nowadays embrace the use of novel technology to secure a competitive edge and maintain a lead in business transactions and administration. Technology advancements in recent years have made it easier for organizations to obtain information that improves transparency. Robust supply chain connections are based on trust, which is fostered by transparency between parties.

As a result, IT has greatly helped these kinds of interactions; yet, trust is essential to the success of supply chains and even of individual companies.

4.9. Blockchain Technology

Businesses utilise this distributed ledger technology to make safe, transparent records of every transaction inside a SC. The supply chain has significantly improved since blockchain was introduced. It enhances transaction security, traceability, and transparency.

Similarly, it has offered strategies to reduce the possibility of fraud and mistakes in SC. Business use of blockchain is growing as a result of its efficiency and

reliability. It simplifies the movement of completed goods from the manufacturer to the consumer plus boosting accountability. Whatever the extent of their network, any firm in the twenty-first century would suffer without this technology.

4.10. Real-time Data Sharing

In the supply chain, exchanging real-time data is essential for making well-informed decisions. By improving their teamwork via precise and timely data exchange, SC partners may maximize their income. It functions in tandem with sophisticated monitoring technology, IoT devices, and analytical tools that allow businesses to follow every facet of the SC in real-time.

Real-time data sharing increases visibility, which among many other advantages, improves response, lessens the effect of disruptions, increases efficiency and dependability, and shortens lead times. Supply chains and their partners have to make every effort to fully use this concept, as it presents several advantages that have the potential to propel any enterprise to unprecedented heights.

4.11. Enhanced Collaboration Platforms

In modern times, cooperation is crucial to supply chain management. Nowadays, it is nearly hard for firms to exist without developing strategic alliances. In order to pool resources, knowledge, and insights for the benefit of all partners and the supply chain as a whole, they also establish cooperative networks. Developing agility is one of the advantages of this cooperative approach.

In other words, it makes it possible for businesses to react quickly to shifts in consumer preferences and market conditions. All parties anticipate significant benefits when technology improves cooperation or offers a feasible platform for productive collaboration to occur. These technological advancements foster some components of cooperation, such transparency and trust.

4.12. Digital Twins

These are digital copies of real-world resources including manufacturing facilities, transportation hubs, and warehouses. Businesses may use it to model and optimize supply chain operations. Similarly, it assists companies in anticipating hazards, avoiding them, responding appropriately, and strengthening their resilience. Companies that have been using these technologies have overcome preventable obstacles and survived in the face of ever-growing, increasingly complicated issues.

4.13. IT Difficulties and Solutions for Supply Chain Management

Technological changes within an organization can be challenging due to internal changes and the need for a strong leader to champion these changes. Incompatible systems can lead to inefficiency or ineffectiveness, and

partners may be uneasy sharing information. To solve this, businesses should form partnerships with companies with clean track records and trustworthiness. Loyalty can also help choose the right supply chain partners. Disconnected enterprise systems can cause data redundancies, errors, and costly inefficiencies. Poor coordination between systems can lead to flawed production plans, poor customer service, and increased supply chain pressure.

To address these issues, businesses are now opting for new systems that are compatible with their methods. Data protection and cyber security threats are also challenges that need to be addressed. Experts can help the supply chain merge new with existing systems and provide businesses with necessary insights through training to optimize the successful application of new methods. Ultimately, the introduction of new technologies can bring numerous challenges, but with the right leadership and support, these challenges can be overcome and successful implementation can be achieved.

5. Future Directions for Supply Chain Management and IT

Better technology is being brought into corporate operations regularly, which indicates that supply chain management is going to see better times in the future. The supply chain has been heavily emphasized, to the point that new technologies are being invested in to build the most lucrative version of it.

5.1. Emerging Technologies

Numerous jobs that were formerly completed by humans have been replaced by automation and robots. Emerging technology has the potential to replace people in even more activities. Industries utilizing robotics are developing further, intending to surpass current state-of-the-art robotic process automation (RPA) and related technology. In addition to the introduction of new technologies, several already existing ones are undergoing modifications.

Future developments in supply chain management are anticipated to bring about new advantages through autonomous drones. They analyze their surroundings using actuators, sensors, and a centralized computer to automate the flying process. Businesses still anticipate a period when drones will be adapted to perform more sophisticated duties and bring greater benefits to the supply chain, even if they are now being used to monitor and collect products from warehouses. Drones will have minimal human intervention to fly independently.

A new technology called intelligent transport systems (ITSs) promises to make commuting safe and easy for users. The goal of the Vehicular and Hoc Networks (VANETs) is to promote cooperative driving applications by offering a new networking paradigm using wireless communication networks. The VANETs,

another novel technology, offer a unique platform for car-to-vehicle communication.

6. Conclusion

Information technology's entry into the corporate world and supply chain management's technical breakthroughs have improved company procedures. The growing number of business owners are cognizant of the influence technology has on organizations. This article's thorough descriptions make it simple to comprehend the significance of information technology in supply chain management. SCM (Supply Chain Management) has seen a significant increase in the adoption of IT, particularly in the planning macro-process. This has led to process improvements, improved information quality, and enhanced management processes. The main benefits of IT in SCM are emphasized on the quality of information, process improvements, and collaboration between actors. The study suggests that IT advances in SCM, particularly in production processes and product development, present a window of opportunity for IT advances. However, the study was limited to the CAPES Journal Portal databases and a specific analysis horizon. Future research should consider new research databases, a wider range of search terms, and an extension of the analysis horizon.

Supply chain management is one area where IT is still transforming enterprises, and more and better technologies are on the horizon. Everyone is attempting to outperform their competitors and provide quality to their clients. In a market that might be fiercely competitive and complicated, they aim to expand their base and control the desired market segments.

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