THE IMPACT OF SUPPLY CHAIN DIGITAL TRANSFORMATION ON SUPPLY CHAIN NETWORK INTEGRATION OF POWER AND ENERGY SECTOR IN PAKISTAN"

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Abstract

The he primary aim of this study is to assess the influence of contemporary supply chain digital transformation on the integration of supply chain networks within the Power and Energy Sector of Pakistan, specifically focused on the cities of Rawalpindi and Islamabad. This research investigates whether digital technology factors such as EDI, RFID, ERP, and MRP significantly impact supply chain integration. Four independent variables and one dependent variable were selected for analysis in this study. Quantitative research methodology was employed, utilizing a questionnaire to collect data from employees within the power and energy sector. A total of 152 respondents participated in this research. The collected data underwent analysis using SPSS software, employing descriptive analysis through tables and inferential analysis using regression methods to test hypotheses. These analytical methods aimed to provide a comprehensive understanding of the subject matter and validate the research's credibility. The findings indicate that the modern supply chain digital transformation positively impacts organizations within the power and energy sector, yielding favorable returns on investment. This research carries significance for businesses operating within this sector by identifying key factors and strategies that can enhance supply chain integration. It serves as a guide for implementing measures that effectively improve the integration of supply chains within the power and energy sector.

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I'm genuinely appreciative for the gifts gave to me by the Almighty Allah all through my life. It is through His will that I have arrived at this point, and I'm profoundly grateful for His direction. I might want to stretch out my ardent appreciation to my folks, whose relentless help has been vital to my excursion. Without their commitment and difficult work, I could not have possibly had the option to accomplish this achievement. The penances they made for me will continuously be recollected and loved. Moreover, I offer my thanks to my manager, Miss Asima Saleem, for her enduring devotion and amazing skill. Her direction, responsibility, and brief goal of our questions have been instrumental in my scholastic advancement and theory fruition. My sincere thanks additionally go to my companions for their help during testing times all through my scholastic process. Their help has been important in exploring troubles and obstacles. I'm likewise thankful to each educator who has bestowed information to me. Without the direction and backing of my educators and friends and family, arriving at this stage could never have been conceivable. By and by, I stretch out my ardent thanks to every one of you for your significant help and consolation.

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Chapter 1

Introduction

1.1 Background Study

In the past power companies who wanted to stand out amongst the competition and to win amongst them was the factor of low cost, so the trend of large scale production and economies of scale to lower the cost began to speed up to minimize the cost and to ultimately stabilize the economy, however, the dynamics of the market changed in the next 2 decades and they all started to increase the focus on quality because it became the main reason if the companies wanted to stand ahead in the competition(Rondeau & Literal, 2018). The main thing that mattered at that time was to check the ability of producers and suppliers to produce quality goods in a timely and at the right time to meet the wants of customers. (McKenna, 2016).

A vibrant and dynamic digital transformation will not only increase growth in the company but also can increase results quite drastically; however bad and vibrant technological system can have pretty bad effects on the performance of the organization, for example, the organization that resists change can prove to be quite detrimental for the organization (Allen and Boynton & Miloslav et al., 2019). The flexibility in digital transformation in the integration of power sector is not modern or new; however, it is considered as one of the forefathers to one kind of company or supply chain capabilities such as integration in the supply chain (Loukas et al., 2016).

The variability of digital transformation literature is influenced based on infrastructure variability which is also reinforced by the strong research of ours and by the work of renowned researchers (Kumar and Stylianou, 2020) Observed from a different point of view this whole view of research which seems to indicated the role of technology variability to enable the firms to get benefit and recapture or reconfigure the whole assets being used to perform different business activities to increase the gains through a different way of supply chain operations with integration. (Duncon, et al., 2021) The different flow of research with limited articles and research work finds out the new role of technology variability for the power organizations to adopt new ways and different ways of offerings

to the customers of the firm for the profits and strategic gains with the attention towards new technology technologies and executions of operations (Cheng et al., 2022).

The understanding is very clear in this literature that the ambidexterity is very important to stand ahead in the competition; For instance- the joined capability of new exploration and ambidexterity makes sure the viability in future as well as in current period, the joint use of new exploration and ambidexterity makes sure the surviving of the firm in long terms with the help of better money performance, innovative ideas and learning from the others ideas (Tushman, and Yang et al., 2014). However, the adjustment amongst ambidexterity and exploration has not yet been informed by instant variability in the literature of supply chain integration. Apart from that the ambidexterity in technological variability does not require to reside only in a single organization, rather it resides all over the supply chain. Variable links between information can allow an organization to manipulate its current cross-company operations.

In this way, the usage of digital transformation in the practices of power and energy sector businesses can present new businesses for organizations to stand ahead and compete in the high competition in the global market (Oghazi, 2019) The infrastructure of digital transformation allows the firms to manipulate their competitive advantage and contribute in the performance in market positively. (Hartono & Bardhan et al., 2016) In this regard, enterprise systems are regarded as one of the most important kinds of Information technology from the last two decades (Cotteleer, M.J., & and Bendoly, E., 2016). These are made up of hardware and software and they aim to do the standardization also the incorporation of all the processes in the businesses and all of the data which these infrastructures have collected for the betterment of the organization (Davenport, 2018). Organizations use digital transformation for achieving maximum efficiency (Oghazi, 2019). There is also the chance that they would use digital transformation because of any pressure from the external market (Oghazi, 2019). In this way, since the 20th century, State firms are investing heavily in the power and energy sector for the implementation of ES. (Oghazi, 2019).

The adoption of Enterprise Resource Planning (ERP) systems is a technology that unifies various divisions within an organization and is becoming increasingly widespread.

ERP is a type of software that has several functional areas, such as Marketing and Sales (M/S), Accounting & Finance (AF), Supply Chain Management (SCM), and Human Resources (HR). Because it is Open-source software and Open bravo, the ERP program is very useful for small and medium-sized businesses (R & J, 2015). The ERP is an important tool for organizations to control the flow of both the internal and external firm processes and the processes happening out of the firms. To satisfy the cooperation amongst all the departments and contractors of the organizations, the ERP software gives immense control of material and information by using the different methods and its important modules which include production, management of warehouses, quality, and managing the supply. (Parry, G. & Graves, A., 2018) As per the resource-based view (RBV), the bundling of resources with the combination of tangible and intangible resources gives more benefits than the resource is used singly. (Hult, Ketchen, Adams, & Mena, J, 2018).

To achieve better customer service, it needs the working of all the departments of the organization to integrate into one platform and work together, which in turn will provide better customer service in the supply chain's domain of marketing and transportation. (A.E. Ellinger, 2017).

1.2 Power and Energy Sector of Pakistan

Following the introduction of the Policy Framework and Package of Incentives for Private Sector Power Generation Projects in Pakistan, sometimes known as the "Power Policy 1994," the power and energy sectors in Pakistan witnessed substantial transformations. This policy made significant reforms, allowing for the unbundling and reorganization of companies in the electricity industry. Its primary objective was to delineate distinct responsibilities for energy sector policy, regulation, and operations. Under this policy framework, the Ministry of Water and Power (MoW&P) was entrusted with the task of formulating Pakistan's energy policy. Concurrently, a new regulatory authority, the National Electricity and Power Regulatory Authority (NEPRA), was conceived to oversee and regulate various aspects of power and energy sector operations, including transmission, distribution, and generation.

Prior to the 1994 policy, Pakistan's power industry was dominated by two integrated public utilities: the Water and Power Development Authority ("WAPDA") and

the Karachi Electric Supply Corporation ("KESC"). WAPDA, being a government-owned statutory corporation, was tasked with distributing electricity throughout the country. Meanwhile, KESC, operating as a public limited liability company with government control, was specifically responsible for delivering electricity to the metropolitan area of Karachi. Established in 1958, (Oghazi, 2019). WAPDA was initially tasked with a broad spectrum of responsibilities encompassing power generation, transmission, distribution, as well as duties related to irrigation, drainage, and flood control. However, following the implementation of the Power Policy 1994, WAPDA's distribution network underwent a restructuring phase. This led to the establishment of eight electric supply companies, replacing the former Area Electricity Boards (AEBs) that were previously under WAPDA's jurisdiction. The AEBs were primarily responsible for managing supply and distribution, along with overseeing the construction, expansion, and operation of the distribution system. Over time, these AEBs have evolved into eight distinct power entities referred to as distribution companies (DISCOs). Additionally, there are three generation companies (GENCOs) and the National Transmission and Dispatch Company (NTDC), collectively managed under the Pakistan Electric Power Company (PEPCO).

The National Transmission and Dispatch Company (NTDC) holds the transmission license and holds a pivotal position within the power market structure. Its primary responsibility involves transmitting electricity from the generation system to the distribution companies, following a structured three-phase approach. In the initial phase, before 2004, the system operated under the “Single Buyer concept”, where the Central Power Purchasing Authority Guarantee (CPPA-G) under NTDC had the exclusive authority to procure power for the shared power pool and subsequently distribute it to the DISCOs. From 2004 to 2009, a transition occurred termed as the “Single Buyer Plus concept”, granting the DISCOs increased autonomy. This allowed them to engage in direct bilateral contracts with power generators to meet their energy requirements. Since 2009, DISCOs have been visualized as competitive entities. They assess their energy needs and procure power either from the power pool or through direct supply contracts with generators. Operating as profitable businesses, they negotiate energy rates independently. However, they continue to function within the framework established by the CPPA Single Buyer policy preceding 2004. (Parry, G. & Graves, A., 2018)

Founded in 1913, the Karachi Electric Supply Corporation (KESC) had the mandate of overseeing the generation, transmission, and distribution of electricity within Karachi and its neighboring regions. Primarily catering to urban consumers, it served approximately 1.5 million customers. As part of Pakistan's reforms aimed at restructuring and liberalizing the electricity market, KESC underwent privatization in 2005, transitioning into an integrated utility under the oversight of the Privatization Commission. Subsequently, KESC rebranded itself as K-Electric Limited ("KE").

Furthermore, the policy delegated decision-making authority to the institutions executing the projects, enabling them to decide on aspects such as power plant scale, technology, energy origin, and site location. To encourage investments, the government offered power-grid connections and assured the supply of necessary primary energy sources. Additionally, independent power producers received exemptions from various taxes, which served as an added incentive for increased private investment within the power sector. Moreover, the inception of the Alternative Energy Development Board (AEDB) took place in May 2003. It played a pivotal role in advocating for renewable energy sources, particularly wind, solar, and mini/small hydropower generation, in remote regions across Pakistan. Concentrating on formulating enduring policies for renewable energy, the AEDB took the lead in introducing foreign technologies in the realm of alternative energies, thus fostering progress in this sector within the nation. A significant recent development occurred with the enactment of the Private Power and Infrastructure Board (Amendment) Act in 2023. According to this legislation, the AEDB merged with the Private Power and Infrastructure Board (PPIB), leading to the dissolution of the Alternative Energy Development Board Act of 2010. This amalgamation aims to streamline endeavors and improve efficacy in the pursuit of sustainable and diverse energy solutions for Pakistan's future. (Cotteleer, M.J. 2016).

1.3 Research Gap

The future lies in digitization, which needs to be customized to address deficiencies in electricity transmission infrastructure, ensuring affordable prices and accessibility for consumers. The power and energy sector are one of the largest industries in Pakistan, yet it is significantly neglected by the government. In the international market, players in the power and energy sector are heavily engaged in tools that enhance supply chain integration, making it more vibrant, efficient, and effective. However, this is not the case in Pakistan (Mobeen, 2023).

The traditional approach to managing the supply chain in the power and energy sector in Pakistan has led to significant challenges, including the bullwhip effect, shortages, mismanagement of resources, annual debts, and various bottlenecks. These issues result in lost sales, back-orders, and ultimately reduce profitability, impacting the economy (Sohaib, 2022). The power and energy sector has frequently mishandled technology and digital concepts, causing consumers to bear all associated costs and expenses, rendering affordability objectives ineffective. Highlighting the need for a consumer-centric power and energy sector and cost optimization, experts emphasize the importance of input from energy specialists for the efficient utilization of resources and ideas. Additionally, the suggestion of establishing a professional board to advise the government on planning initiatives is made (Afshana, 2021).

Ensuring a secure, swift, and dependable communication network remains a significant challenge, particularly in small cities, remote regions, farms, motorways, and highways. This requirement is crucial for the successful implementation of substantial digitization initiatives in Pakistan. Without uniform digital access throughout the country, attaining comprehensive, dependable, and timely on-ground information will be unattainable. Such information is crucial for making informed decisions at the highest levels.

Considering all these challenges faced by power and energy producers, they can utilize new tools of digital transformation such as RFID, ERP, MRP, and EDI to mitigate the problems of demand and supply prevailing in the market. Many prominent players in

the Pakistani power and energy sector are already using these tools to address persistent challenges and improve efficiency.

1.4 Problem Statement

This problem affects the supply chain of the power and energy sector who still follow the traditional way of controlling operations and other activities, However, if the problem is not solved the problems of the effect, lost backups and poor management which is pretty much fatal to power and energy business; This problem is occurring in the power and energy sector and it is important to be fixed because it will avoid all the major challenges in the sector and will help in avoiding major discrepancy in the digital transformation for integration in supply chain.

The goal of this study is to solve the major problems in a discrepancy of implementing digital transformation within the power sector and what is the outcome of this which are very hard to keep track of because of their nature of coming and going too fast; however, the main reason that digital transformation is not being used completely among the whole sector is that it requires investment and there is also the problem of lack of awareness amongst many systems and legislation, despite these limitations the tools of digital transformation technology like ERP, MRP, EDI and RFID cannot only meet the cost of installation pretty quick but also can increase the profitability of a business and it can also reduce the major problems of lost sales and backorders ultimately leading to immense growth and revenue of the companies.

1.5 Research Question

1) What is the impact of RFID on the Supply Chain Network integration?
2) What is the impact of ERP on the Supply Chain Network integration?
3) What is the impact of MRP on the Supply Chain Network integration?
4) What is the impact of EDI on the Supply Chain Network integration?

1.6 Research Objectives

1) To find the impact of RFID on the Supply Chain Network integration.
2) To find the impact of ERP on the Supply Chain Network integration.
3) To find the impact of MRP on the Supply Chain Network integration.
4) To find the impact of EDI on the Supply Chain Network integration.

1.7 Significance of Research

The integration of power and energy organizations within the supply chain is intricate and pivotal within the organizational structure. Strategic alignment with digital transformation holds significant importance in achieving maximal profits, a collective goal shared by all supply chain networks. Hence, leveraging technological tools in the supply chain plays a crucial role. Operationally, RFID enables tracking production and inventory throughout the supply chain, while ERP facilitates seamless transmission of this information across all departments. Additionally, ERP aids in transmitting sales data to suppliers, preventing the dissemination of inaccurate demand information that could disrupt the supply chain. Effective information sharing among departments ensures smoother forecasting, collaborative understanding of production needs, and risk mitigation. Technological supply chain tools, such as RFID, ERP, EDI, and MRP, facilitate seamless information exchange among supply chain members. These challenges underscore the complexities within the power and energy sector, especially in industries like power and energy. Addressing these concerns is crucial. Despite being a billion-dollar sector, the power and energy supply chain often operate in traditional, outdated ways, hindering its growth potential. Stagnant growth leads to reduced profits, subsequently impacting taxes and the economy adversely. Embracing technological supply chain tools can invigorate and

enhance efficiency within the power and energy supply chain, accelerating growth, and aligning supply with demand. This research aims to demonstrate how these tools can mitigate challenges, boost sales and revenue, fostering overall growth within the power and energy sector.

The integration of power and energy organizations within the supply chain is a complex aspect that requires scholarly attention. This research contributes to the existing literature on supply chain management by delving into the intricacies of the power and energy sector. The research sheds light on the importance of effective information sharing among departments within power and energy organizations. This contributes to the literature on collaborative decision-making, risk mitigation, and forecasting within supply chain networks. The integration of power and energy organizations within the supply chain is a complex aspect that requires scholarly attention. This research contributes to the existing literature on supply chain management by delving into the intricacies of the power and energy sector. Academia can contribute to the professional development of industry practitioners by offering insights into practical solutions. This research provides actionable recommendations for power and energy professionals, demonstrating the real-world applications of theoretical concepts.

Chapter 2

Literature Review

2.1 Introduction

The supply chain is a kind of matrix of different entities of different firms that are responsible to deliver the services and products from the upstream chain of activities to the downstream chain of activities, apart from that it must direct and control the exchange of information and different activities in it. (Motiwala & Thompson, 2019). The supply chain is quite the same as a different system with a set of functions which also includes planning, controlling, and directing the whole process in the matrix of the supply chain. The supply chain also contains multiple interactions amongst organizations and partners in difficult and unexpected conditions. (Sivadasan and Efstathiou, 2013).

The fundamental method of efficiently guiding and regulating the supply chain matrix is to govern the process of interaction between the network component of the supply chain network and the flow of the supply chain network (Anrerio 2018). The supply chain's various versions include financial information flows and product features (Granger, 2019). The item flow is the distribution of finished items through various channels, such as material exchanges or consumer purchases of products from enterprises, such as sales orders (Wagner & Winder, 2016). The flow of the information consists of the method of sharing of information amongst the members of the supply chain this information includes the material purchased by the companies such as purchase orders or the number of orders received by the company such as sales order, its time of delivery and the schedule of shipment (Nelson, 2018)

The flow of finances consists of the sharing of value or information of finances amongst members of the supply chain taking any type of money, such as financing the schedule of payments, cost of delivery (Benson, 2019) By establishing the efficient and more effective integration amongst all the members of the supply chain of all these flows, companies can effectively increase the functions of supply chain and can respond to the dynamics of market efficiently. To make all these processes efficient the digital flows can help a great deal in that aspect (Kimmy, 2017). According to the definition of information and communication technology, it is a willingness to make data and knowledge

strategically and tactically productive and competitive, such as forecasting, revenue, stocks, inventory swings, market, and business strategies (Chase, C. W. 2016).

Continuous change in the inner and outer climate of companies is one of the most important characteristics of the time in today's business world. In such a scenario, the business's performance is more dependent on gathering data and analyzing it. It is better to use it in accordance with business objectives than to rely on factors such as capital and labor force. Technological, economic, political, cultural, and environmental influences, as well as changes in market management, are the basic dynamics that require the use of technological factor in supply chain, which makes major contributions to companies in dealing with growing global competition (R. L. 2020). Under risk and uncertainty, information systems can include logistics, customer, price, and on-time delivery, as well as changes in business processes and functions (Tan, 2018).

The point of data and correspondence innovation the executives is to work on the quality and store network combination of the organization's inventory network and business organization, in this manner expanding the company's pay as well as the whole association's result at each level (Hong, 2018). At any level of the production network, information sharing, knowledge, and legitimate viable correspondence assume a basic part in helping organizations in gathering, gaining, and deciphering information to determine business challenges (Kache, F., and Seuring, S. 2017). Power and energy area organizations can now screen their exercises by utilizing innovation. This affects market interest. The necessity for all power and energy areas in different regions of the planet to introduce the Electronic Global positioning framework (ETS) was met with resistance from the outset.

Drivers, then again, have progressively acknowledged the ETS, which means to supplant the stock while following any issue on the way and giving constant data on the spot, and condition. Administrative experts in many regions of the planet are as of now carrying out the ETS to relieve various dangers, including significant income misfortune, burglary, and reinforcing administrative requirement. The utilization of new innovations, for example, scanner tags and RFID takes into consideration more exact stock subtleties to

be gotten to. The remote non-contact utilization of radio-recurrence electromagnetic fields to send information for the reasons for naturally distinguishing and following labels joined to objects is known as radiofrequency recognizable proof (RFID). One of the main advantages of radio-recurrence ID is that information dividing among labels and peruses is quick and programmed, requiring no immediate contact or view. This will take into consideration more point by point store network the board information to be gotten to. This naturally converts into expansion in functional proficiency of the organizations (Zephania, J. 2019). Information technologies that have evolved in the business world over time and are built on more practical bases and needs can now generate substantial revenue and allow companies to achieve promised supply chain network integration levels. With its open structure, low cost compared to value-added networks, usage without special rules, and global access function, the Internet plays a critical role in the spread of electronic processes among businesses. There are two key reasons for companies to use the Internet at this stage. One of them is the digital supply chain startup and application costs, which are due to its inherent characteristics. The other is that, because of its significant environmental influence, the Internet more efficiently increases opportunities arising from new cooperative relationships (Mouzadar, W. 2016).

According to Manavalan (2019), Time spent dealing with customer problems; timely delivery, organizational versatility, and consistent quality have all become essential in today's successful sector. The use of effective communication and information technology is critical to aligning a supply chain to achieve these goals. Correspondence between inventory network members necessitates the sharing of relevant information from the point of origin to the point of utilization. Huo ET, AL (2014) conducted data and communication research with sellers, clients, and manufacturers and discovered that data and correspondence had an impact on functional efficacy. The outer and inside universes are inextricably linked. Because of the complexities of the power and energy area inventory network, data and communication have a significant impact on functional execution, but not fundamentally (Huo, B. 2016).

Manavalan (2019) also noted that the successful interoperability between the different organizations managing the relevant information is directly correlated with the

efficient flow of information between processes, systems, and humans. Many upcoming challenges and opportunities characterize the future of information technology to logistic performance; the logistics market has also become more competitive and unpredictable (Nurmala, 2017). The ability of IT reception to manage information flow, operate with hierarchical cycles, and assist independent direction may be evaluated by looking at what specialized store network implies for operations productivity. According to Kochan (2018), the ability to innovate and share data has a direct influence on the store network reconciliation and production network system. Constant data sharing has the advantage of forming electronic groups that function with coordination and involvement across the production network. Temporarily, leaders use information to distribute and use available assets in an efficient and effective manner, hence increasing the reliability and appropriateness of standard strategy duties.

According to Wang (2018), Long-term, technological supply chain systems allow management to evaluate business data to help and enhance management decision-making across a wide range of business activities. Automation has also resulted in a seamless information flow, allowing staff, manufacturers, forwarders, transporters, and clients to communicate easily. It enables continuous information exchange and sharing throughout the whole production network to become feasible in terms of time and cost (Abbas, 2016). The use of Electronic Data Interchange (EDI) and the Internet enables inventory network executives to benefit from current and trustworthy information at all stages of the project with little resources and strategies (Christopher, 2016). Inventory networking perceivability may be improved further by increasing coordinated effort among store network members through continuing information exchange. Various gatherings in the production network will quickly decide on appropriate choices if they have enough knowledge and further expanded perceivability and interaction between various strategy duties and investors (Konzelman, M. 2018).

When an organization has more knowledge, the difficulties of information management are that it is difficult to effectively represent, evaluate, react, and ensure availability to those who need it. When authorities implement communication proper processes and information technology in the supply chain, they must always develop the

advantages and disadvantages of these methods and technologies, as well as build a control structure to maximize the benefits of information and technology (Hugos, M. H. 2018). Communication and knowledge are called oxygen for supply chain management because they allow you to see from one side of the pipe to the other (Christopher, 2016).

2.2 Technological Factors that influence Supply Chain Network integration.

The supply chain operations within the power and energy sector have undergone significant transformations due to various factors. Notably, alterations in physical formats, the emergence of demand-driven supply chains, and the outsourcing of operations to gain a competitive edge have reshaped the industry (Svetlana, 2018). Moreover, contemporary market trends such as globalization, shorter product life cycles, heightened cost pressures, and amplified demands for customized products have played a pivotal role in shaping the power and energy sector (Ellram, La, & Weber, 2019). This shift in customer preferences towards increased customization has considerably amplified the complexity of supply chain management in this sector (Sternbeck, 2020).

Addressing these complexities requires the power and energy sector to adapt to greater variability, visibility, and enhanced connectivity within their supply chains (Ebrahimi, 2017). Various available technologies offer solutions for these challenges. For instance, the implementation of Point-of-Sale (POS) systems can effectively track processes and manage operations (Jan3, 2018). Digitization, integrated with inventory levels in distribution centers, triggers automatic reorder requests through Electronic Data Interchange (EDI) systems once stock levels reach a certain point. Additionally, RFID tags enable the monitoring of shipment statuses (Kent & Mentzer, 2018).

Information technology tools play a crucial role throughout the power and energy sector's supply chain. The integration of new technologies facilitates smoother operations, ensuring the timely and cost-effective flow of goods, services, and information (Anand & Grover, 2015). Digital transformation tools offer enhanced visibility into the supply chain and aid in devising effective replenishment strategies (Kabir, 2018). IT solutions also enable seamless connectivity across departments within the supply chain, contributing to more accurate and timely information flow between the power and energy sector and its trading partners. This integration helps in minimizing discrepancies between supply and

demand (Waheed, 2018). Ultimately, the utilization of digitization tools has rendered the power and energy sector's supply chain more responsive and efficient. This transformation has led to reduced inventory levels, cutting holding costs, and enabling prompt fulfillment of customer demands. Moreover, these digital tools have empowered the power and energy sectors to establish a competitive edge in the market (Jillian, 2020)

2.3 Electronic Data Interchange (EDI)

Electronic Data Interchange (EDI) involves the exchange of information among various supply chain departments or between buyers and sellers electronically or via the internet. Its aim is to enhance efficiency in delivering goods and fostering long-term customer retention (Rain, 2020). This technology demonstrates the application of communication technology and brings forth numerous advantages, including reduced stationery and paperwork costs, enhanced efficiency, decreased errors, timely data entry, improved cash flow, and inventory level reductions (Abdullah, 2019). Implementing EDI can significantly amplify the benefits within an organization's supply chain to various extents, benefiting numerous practitioners (Dearing, 2017). Markus (2019) suggests that increased use of EDI could notably enhance on-time delivery performance, although empirical research on this matter remains limited. In customer-vendor relationships, EDI can greatly assist and contribute to improved customer services (Usman, 2018).

While there have been several studies examining the effectiveness of EDI, empirical research specifically on production facilities is relatively scarce (Agarwal, 2018). As production facilities significantly add value to products within the power and energy sector's supply chain, these facilities can be utilized as a measure of analysis to evaluate EDI's effectiveness in delivery performance. Organizations employing EDI may exhibit much higher delivery performance compared to those using it infrequently (Tiffany, 2018). EDI fosters integration among all supply chain departments by facilitating timely information sharing. Sharing patent information among these departments enhances responsiveness, enabling transacting organizations to share necessary information and react to market dynamics, reducing uncertainties, and improving delivery performance (Jable, 2018).

EDI's significance is growing as a vital business approach in industries such as power and energy, particularly in environments requiring swift responses to changes (Mukhopadhyay, 2013). To enhance supply chain efficiency, it must be flexible and responsive to market needs and changes (Raman, 2017). Producers can cater promptly to customer demands by utilizing measures like lead time and throughput time (Christopher, 2019). Jade (2015) emphasizes the criticality of time across the supply chain, aiming for shorter lead times, improved order control, and reduced demand and supply levels. Peters (2017) notes that EDI links facilitate the electronic exchange of various documents among trading partners, including purchase orders, shipping notices, invoices, and more. This exchange expedites transaction processing and on-time product delivery, crucial for enhancing customer service and satisfaction. According to a survey conducted by Vixen (2019) on the benefits of EDI in the power and energy sector, improved customer service stands out as the foremost advantage.

2.4 Enterprise Resource Planning (ERP)

When enterprises, including those in the power and energy sector, confront substantial volumes of information across their organizational departments, this accumulation poses significant challenges. Managing such a large amount of data becomes difficult, especially when transferring it across various formats (Oghazi, 2019). Often, crucial information within organizational departments remains untransmuted to other necessary departments due to data unavailability and reliance on manual data management methods, leading to operational faults (Kanzie, 2017). Consequently, many power and energy sector organizations opt to implement Enterprise Resource Planning (ERP) systems to ensure timely delivery of goods to customers, thereby reducing costs and enhancing satisfaction levels (Häkkinen & Hilmola, 2018).

ERP software serves as a platform through which the power and energy sector can transmit order information using web-service technology and a centralized website. This software handles both downstream and upstream data efficiently (Lo, Hong, & Jeng, 2018). It enables suppliers to access information compatible with their systems, fostering integration between the power and energy sector and vendors across multiple environments without adhering to a traditional standard (Pramatari K., 2017). Built on diverse modules,

ERP software connects information from various organizational departments such as finance, logistics, fulfillment, order processing, and manufacturing, showcasing specific organizational functions. This centralized system equips managers with an encompassing view to make informed decisions beneficial for the organization (Vikram, 2019).

Moreover, ERP facilitates the automation of business processes within the power and energy sector, enhancing process efficiency and cost reduction (Ismaili, 2018). Consequently, organizations must thoroughly evaluate their processes before ERP implementation. Automating ineffective or inefficient processes can perpetuate inefficiencies and pose challenges in reverting them to their original state (Sheikh, 2018). The deployment of ERP systems by producers and companies involved in the supply chain fosters an informational infrastructure for exchanging data among partners in the power and energy sector. Through ERP software, critical information on inventory levels, orders, and production rates can be efficiently shared among producers and suppliers at reduced costs when required (Levi & Kaminsky, 2018)

2.5 Radio Frequency Identification (RFID)

RFID, an acronym for Radio Frequency Identification, stands as an automatic identification and data capture technology with a primary objective to identify, track, and manage the movement of various items within the supply chain (Kamaladevi, 2018). This technology comprises three key components. Firstly, the transponder or tag with an embedded chip can be affixed to physical objects at different levels such as product, case, pallet, or container (Srivastava S. K., 2017). Secondly, the reader, equipped with antennas, communicates with the tag, and finally, the host server in the middleware app manages and directs these tags (Attaran M., 2018). RFID uses radio frequencies to transmit data from tags to readers, and subsequently, the middleware updates this information in the system (Khalid & Azali, 2016). Information within RFID is encapsulated via an Electronic Product Code (EPC), allowing for seamless information exchange across the supply chain, connecting objects, data, individuals, and computers (Burgess, & Hawking, 2017).

In various power and energy sector organizations, RFID technology serves as a tool for labeling and monitoring objects (Suriya, 2019). This technology utilizes specific identifiers that transmit signals from devices to readers via radio waves with distinctiveness

(Vekas, 2018). With a microprocessor containing specific information memory space, RFID becomes a pivotal tool in executing numerous functions (Angelina, 2017), proving crucial in the realm of supply chain management (Oghazi, 2019). RFID facilitates warehouse supply management, verifies product deliveries to intended destinations, helps prevent stock-outs at sales levels, enables production phase monitoring, reduces paperwork, increases production efficiency, streamlines product development processes, lowers labor costs, and significantly improves forecasting accuracy (Srivastava B., 2014). This technology's physical infrastructure allows for comprehensive product tracking across the supply chain (Rijha, 2019). Additionally, RFID enables different organizational departments to monitor products or goods in motion, given that tagged items carry necessary information and can be tracked across different locations (Haris, 2018).

RFID technology, categorized as an Information Communication Technology (ICT), gathers information at various Point-of-Sale (POS) points, contributing significantly to understanding genuine advertising trends (Asha, 2017). This technology aids customers in swiftly matching different products, enhancing service quality, and decreasing delivery times (Mike, 2017).

While RFID presents numerous benefits, it also comes with drawbacks that organizations must address, including privacy concerns about stored data (Nystrom, 2016). Studies indicate consumer reservations about RFID tags, with a substantial percentage preferring to remove them at checkout due to privacy concerns (Megan, 2018). Furthermore, the data stored in tags might not conform to conventional formats understood across different supply chain organizations, leading to potential discrepancies or false information within partner firm databases (Native, 2019). To mitigate these issues, RFID technology is recommended as a significant solution, aiming to eliminate problems, enhance service quality, and reduce delivery times.

2.6 Material Requirements Planning (MRP)

Kumar (2012) asserts that in various sectors, the Material Requirement Planning (MRP) software is integrated using the System Application Product (SAP) Materials Management (MM-Module). By implementing SAP (MM-Module) in sectors requiring Material Requirement Planning, goods can be monitored and received within a safety

timeframe. The power and energy sector classifies materials through analysis to prioritize the ordering of essential goods online. According to Karen et al. (2015), incorporating MRP tools in the power and energy sector significantly reduces supply process costs, enhances production process efficiency, and improves information accuracy. MRP implementation within any organization necessitates internal personnel and organizational changes (Santosh & Chi, 2015). To find the ideal lead time, the MRP system employs a mixed integrated programming model that operates under a set of integrated constraints. These restrictions dictate anticipated orders, like the actions of an MRP system, but taking capacity and component availability limits into account. Experiment findings from a DRAM manufacturer show that the suggested technique outperforms the generally used tech method for predicting projected lead time in MRP.

Gerhard (2019) explains that in a modern power and energy sector production system, when unique customer orders with specific processing requirements are received, they directly enter the make-to-order system. This system caters to products depending on the current estimated finishing time. The focus lies in a multi-product production environment without resource configuration know-how. For estimating lead times, simple iterative algorithms are employed. Panagiotis & Maro (2016) present findings from their research based on a Greek Manufacturing company. They highlight the strategic significance of adapting MRP, impacting the entire company, its methodologies, culture, and competitive abilities. In this context, MRP functions as an information technology software tool, facilitating data processing and priority planning but lacks integration with capacity planning functions.

2.7 Supply Chain Network Integration

The executives' view of supply chain network integration combination is upon building an appropriate inventory network system that aligns with the overall market plan (Trunkline and Ketaki, 2019). A business system encompasses the range of customer demands that an organization's labor and products are expected to meet (Delery and Roupy, 2017). Every organization in the power and energy sector strives to implement a certain key technique that aligns with its objectives, while also attempting to have the necessary talents and assets to achieve those objectives (Nestor, 2019). For instance, one company

may focus on delivering high-quality products at premium prices, while another pledges to offer a full range of reasonably good products at affordable rates. Yet another might concentrate on providing diverse products and services with a customer-centric focus on convenience, accessibility, and responsiveness, among other factors (Kips, 2017).

For a firm to advance, it must integrate its supply chain network into the executive's structure with its serious planning (Delery and Roupy, 2017). Initially, important fit related to the alignment of critical objectives with customer requirements to fulfil serious strategy (Chopra, 2017). Companies aim to instill flexibility within their supply chain through various tactics and tools. Wang ET. Al. (2019) developed flexibility-based supply chain models, while Gimenez, Al. (2020) examined earnings, production speed, and travel costs as metrics of success. Vanichchinchai (2019) analyzed operational flexibility, encompassing versatility, cost, connectivity, and responsiveness. Westbrook (2020) argued that streamlining non-value-added operations, reducing order variations, and accelerating inventory flows significantly impact organizational efficiency. Hult and ET. Al. (2020) suggested that innovation in technology and procedures could significantly enhance operational flexibility. Baird et al. (2019) emphasized the necessity of organizations understanding the trade-offs between customer experience and costs.

Organizations attempt to achieve a competitive edge by aligning their supply chain processes and structures with their company strategy (Saxicola and Olcay, 2018). According to Shah (2019), the supply chain structure should ensure that the value chain provides extraordinary value to end consumers. According to Zests et al. (2019), an organization's performance is significantly contingent on the flexibility of the supply chain in which it works. Wheelen and Hunger (2022) analyzed business methodologies and proposed that an organizational strategy focusing on fortifying core advantages, goods, and/or services plays a pivotal role. They went on to say that the supplier network's capabilities have a direct influence on business performance. According to Alam. ET. Al (2021), operational flexibility has a substantial impact on the total supply chain. According to Bowersox et al. (2022), using external correlation flexibility measures helps end-customer valuation success by encouraging collaboration across operational activities and direct connection with other chain management industry partners. Harrison The importance of operational flexibility indicators as a common operational measure that facilitates

internal and external interrelationships among organizations was emphasized by Harrison and New (2022). As adaptable assessment guidelines, Vaidya and Hudsucker (2021) suggested cost, client experience, effectiveness, resource the executives, consistency, time, creativity, scale, adaptability/versatility, cooperation abilities, provider profile, and showcasing conduct. They proposed that organizations use operational efficiency standards, combined with resilience measures, to achieve organizational efficiency, service quality, and considerable efficiency (Cao et al., 2019). The supply chain's operational effectiveness was measured using features such as flexibility, time (speed), supply chain integration, and costs, all of which were judged quite beneficial.

2.8 Theoretical Framework

Understanding, explaining, and managing difficulties within the supply chain and its various activities pose significant challenges across all sectors. These challenges in the supply chain network encompass complexities in the flow of activities and interconnected aspects (Bode & Wagner, 2015). The supply chain within the power and energy sector stands as a particularly intricate system due to the multitude of product varieties it encompasses. Given this diversity, maintaining a comprehensive digital record of the entire system becomes imperative. The objective of this study is to assess the influence of information technology on supply chain management within the power and energy sector. The study focuses on digital supply chain transformation, treating factors such as ERP, MRP, RFID, and EDI as independent variables believed to exert a significant impact on Supply Chain Network integration dependent variable.

2.8.1 Theory of Constraints

The (TOC) is known as the way of thinking of the board which was explained by (Goldratt E., 1990) which objective is to begin and carry out the upgrades through major areas of strength for the on a limitation which doesn't permit a framework to accomplish the elevated degree of execution. The worldview of TOC shows that each association comprises of somewhere around one limitation. (Goldratt and Cox, 1992) states that limitation as any issue or thing that doesn't permit the association to accomplish its objective for which it was lay out in any case. The top of an association appears to coordinate and lay out its objective. The fundamental objective of any business is to acquire

benefit since that makes it not the same as generous associations. Others who are straightforwardly or by implication associated with the business can lay out the significant circumstances that should be met to permit the association to proceed with its tasks. The hypothesis of requirements empowers supervisors to lay out and check what is the issue or limitation that is keeping them from accomplishing the objectives of the business and after recognizing it there is a need to track down answers for it. The issues on account of the power and energy area are the issue of item assortment, monitoring the interest and supply, benefits expenses and estimating, these all issues can be experienced with the assistance of Data innovation apparatuses. The parts of computerized production network can help an extraordinary arrangement in getting the subjective information during the time spent inventory network and elaborate it for spreading across the individuals from production network, mechanical devices assist in managing various issues like undertaking asset arranging carried out store network. Innovation shows and assists the entertainer with systems administration hypothesis (Hanseth, 2015).

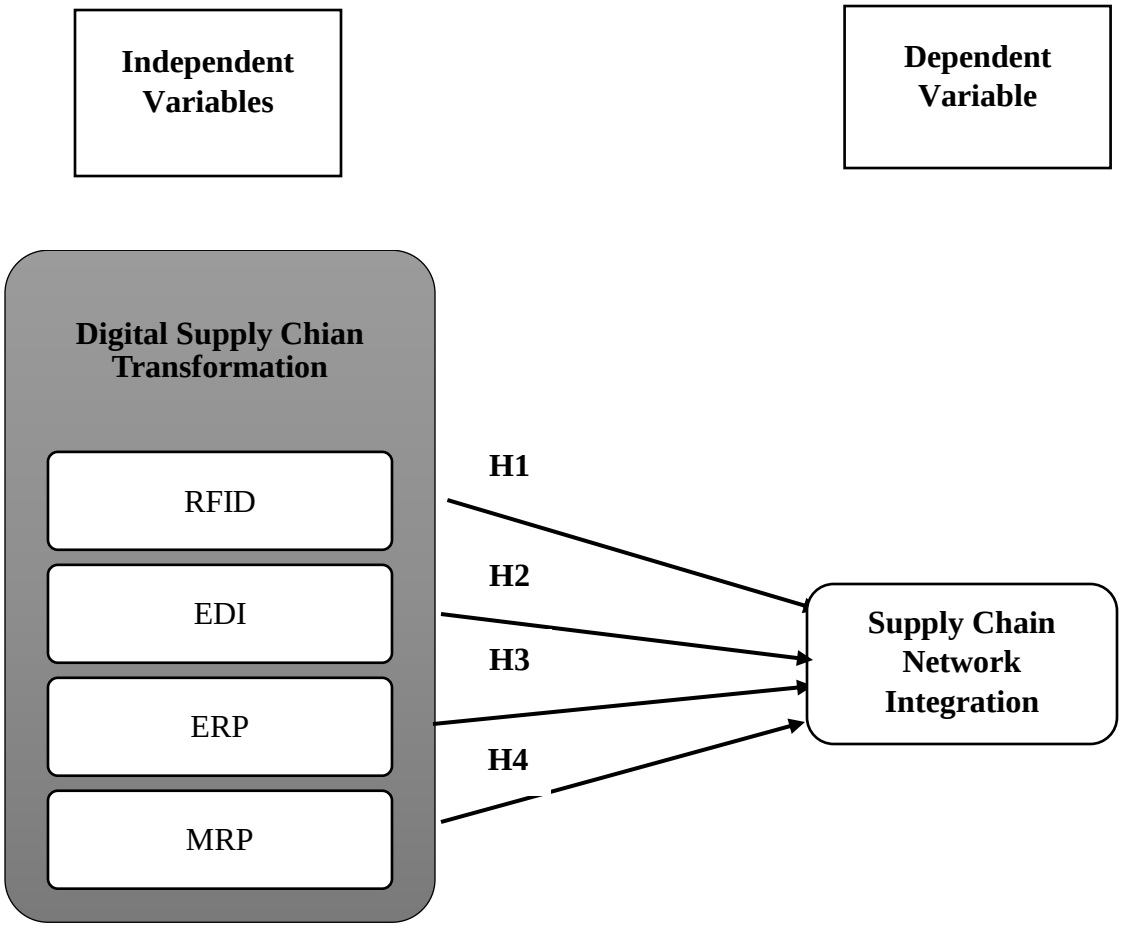
Apart from that, SCM activities with the blend of tool of technology jointly enforce the organizational information processing theory which helps in improving the information sharing and quality of information amongst all the members which are linked with the organization (Gunasekaran, & Blome, 2018). The relationship between the buyer and supplier in effected and evolved through the cost economics of the transaction (Ambrose, Marshall, & Lynch, 2010).

The improvement process in the constraints is based on five steps. The formal procedure of the focusing process is known as the five-step-focusing process (Goldratt E., 2018)

- The profitability of the current supply chain is determined by the problem or constraint which exists there.
- Then, the profitability of the company can be improved through the elimination of the constraints.
- The identified constraint when removed can increase the profitability of a company to a significant extent.

- The next step is to elevate the constraint by redesigning products to further delay in diversity points, where changing of needs of customers can be accomplished.
- last step is to avoid inaction from stopping the regular improvement in the processes.

2.9 Research Framework



2.10 Research Hypothesis

H1: RFID has a positive impact on supply chain network integration.

H2: EDI has a positive impact on supply chain network integration.

H3: ERP has a positive impact on supply chain network integration.

H4: MRP has a positive impact on supply chain network integration.

Chapter 3

Research Methodology

3.1 Introduction

This section discusses the overall approach to analysis that would have been adopted for the study, as well as the research methodologies and data sources that would have been applied. This also specifies how data will be processed, interpreted, and communicated as part of the data collecting process. Research technique refers to the methods used to acquire data and information to achieve research objectives. To address this issue, this section of the study will conduct research to assess the role and Impact of Modern Supply Chain Digital Transformation on Supply Chain Network integration of Power and Energy Sector of Pakistan.

3.2 Research Type

There are two basic research methodologies that we might employ for research: qualitative research and quantitative research. We have employed a quantitative data analysis methodology for our research. The quantitative technique in this study entails the statistical collecting of data, which is then applied to a detailed and analytical analysis of the data. In this study, quantitative research techniques are used to compare and objectively find the results regarding the impact of modern supply chain digital transformation on supply chain network integration of power and energy sector of Pakistan.

The advantage of using quantitative research methodology for this study is that we can reach a much larger sample group. In this quantitative investigation, systematic testing was used. In a quantitative method, the results can be digitized. The results and findings were acquired utilizing a quantitative research technique and closed ended survey-based questionnaire with a 5-point Likert scale, which was distributed among the respondents via Google Forms.

3.3 Research Approach

In addition, the deductive technique was used in a recent study that sought to address our research objectives. The deductive technique is the most utilized strategy for proving an existing hypothesis. After analyzing the problem description, the solutions to

the identified challenges are presented in the form of theory. The approach proceeded through the processes of data gathering and analysis to answer the research question.

3.4 Research Design

This study adopted the descriptive design for the research in obtaining the information of impact of modern supply chain digital transformation on supply chain network integration of power and energy sector of Pakistan. This kind of research is recommended because it allows the researcher to collect data to answer questions about the status of the subject under investigation. According to Karasti (2018), the goal of descriptive research is to establish how things are now, this aids in determining the current nature of a subject under investigation.

3.5 Research Technique

The research technique is the strategy used to collect data for study while keeping the margin of error in mind. When collecting data, researchers employ a variety of techniques. I created a Google Forms questionnaire and circulated it to the appropriate persons for responses. Our questionnaire was divided into parts. The first section deals with demographics, while the next sections deal with dependent and independent factors, respectively. To improve the quality of the data, respondents were asked to rate the extent to which the statements indicating variables applied to their businesses using a Likert scale. The research questionnaire employed a five-point Likert scale. The structured questions were utilized to make the analyzing process easier.

This allowed people to take a moment, think about it, and then respond in the most appropriate way. Respondents maintained their feelings, emotions, and thoughts confidential.

3.6 Target Population

Since this research is about the impact of modern supply chain techniques on supply chain network integration in the power generation business sector of Pakistan. But the target sample is the Power and energy sector of Pakistan. The target population for this study was 250 people (Power and energy sector employees). That population was preferred which were directly or indirectly linked with supply chain operations and activities.

3.7 Sampling Framework

A sample frame refers to the substance or system used in research to extract measurements. It represents a comprehensive list of individuals or entities within a population that can be sampled, including both people and organizations. In this study, the participants consisted of employees from three power generation, transmission, and distribution companies in Pakistan: Atlas Power Limited, Saif Power Limited, and Foundation Power Company Limited. sample frame.

3.8 Sample Size

In research, choosing the right sample size and making observations are critical. The sample size for this study is 152 individual respondents from Power sector of Pakistan. Data obtained without a sufficient sample size may not be reliable, and the conclusions drawn may not be generalizable. The sample size for this study was calculated using the formula and the Krejci and Morgan table from 1970.

3.9 Sampling Unit

A single person serves as the sampling unit. A single value in a group of samples is referred to as a sampling unit. The sampling unit for this study included Power and energy sector supply chain employees and other related persons who were referred to by friends, relatives, and coworkers. For this study, 152 individual respondents were chosen as the sample unit.

3.10 Sampling Technique

This research employed a random sampling technique (Shelton, 2018). Tests are collected from a basic collection to reach or touch in useful examinations. This technique is based on gathering information from members of the public who are interested and ready to participate in the evaluation. Sounders, Lewis, and Thornhill (2016) define this testing approach as "social event responders available whenever you need them." This strategy was chosen because it was the most appropriate given the circumstances and criteria for politeness.

3.11 Data Collection Procedure

Following the modification of the surveys, they were also altered for the benefit of respondents to obtain exact and dependable responses. Information was acquired by

distributing structured surveys to respondents working in Pakistani power and energy organizations. In this research conducted the overviews online using Google Docs. The survey data has been correctly synchronized to improve the review's sensible findings and conclusions. 152 surveys were collected over the course of 10 days. The responses were not rejected, and all the questionnaire received entire results. Legitimate responses were recorded and broken down in IBM SPSS measures.

3.12 Analysis

A poll was used to collect information for the review, which was done using quantitative information processing techniques. Measurable tools, such as relapse and connection evaluation, were used with the support of SPSS programming to determine the extent and duration of the relationship between ERP, MRP, RFID and EDI (independent variables) and supply chain network integration (dependent variable). Factual instruments (relapse and relationship) are often utilized for information evaluation all over the world and have proven to be extremely accurate and significant.

3.13 Research Instrument/Measurement/Scale Used

Utilized a standardized questionnaire to collect responses and gauge public attitudes concerning the variables relevant to my research. While there exist various methods to gather information and perform analysis, for this study, the quantitative analysis employed and utilized a questionnaire structured around the Likert scale method. The questionnaire used was already established and adapted from previous research papers, aligning with the past research work in this field. Specifically, the questionnaire on Radio Frequency Identification was adapted from Binh's research paper (2017). The Electronic Data Interchange (EDI) questionnaire was derived from Sheffield Hallam University, UK, authored by Fatorachian (2014). The Material Requirement Planning questionnaire was adapted from the University of Nairobi, authored by Millicent (2017). The Enterprise Resource Planning instrument was drawn from Lunds University, Sweden, authored by Rickard & Erik (2014). Lastly, the questionnaire measuring the dependent variable, supply chain network integration, was adapted from Naseer (20118).

Chapter 4

Results and Analysis

4.1 Introduction

The provided information outlines the methodology and focus of a study conducted within Pakistan's power sector, aimed at understanding the impact of modern supply chain techniques on supply chain network integration within the realm of the country's power and energy business sector. The data gathering approach entailed reaching out to many stakeholders in the electricity sector, including managers, supervisors, owners, and employees at all levels. The goal was to obtain various opinions and thoughts on supply chain operations in this specific business. The fundamental purpose of this research was to analyze and appreciate how current supply chain methodologies (such as ERP, MRP, RFID, and EDI) influence or effect supply chain network integration in Pakistan's power and energy industry. The variable of interest in this study was supply chain integration, which was deemed the dependent variable. ERP (Enterprise Resource Planning), MRP (Material Requirement Planning), RFID (Radio Frequency Identification), and EDI (Electronic Data Interchange) were among the independent variables included in the study. A questionnaire with a Likert scale and five rating alternatives was used to collect information. Along with replies on supply chain methods and integration, demographic data were gathered to better understand respondents' backgrounds and connections within the industry. The obtained data will be analyzed using statistical techniques and the SPSS program. To investigate and analyze the relationships between the variables and derive meaningful conclusions from the data, the researcher aims to use a range of analytical processes such as Reliability Tests, Correlation Analysis, Regression Analysis, Anova (Analysis of Variance), and Coefficients. The research intends to give significant insights into how the deployment of current supply chain techniques influences the integration of supply chains, especially within Pakistan's power and energy industry, by applying these methodology and analysis.

4.2 Demographic of the Respondents

A total of 180 surveys were distributed to the targeted population, with 152 precise respondents returning the completed survey. Information was received from respondents in Pakistan's electricity and energy sectors.

This study's investigator divided the obtained information into a few classes to make it easier to understand. The members were remembered for the examination since they answered the questions correctly.

4.2.1 Education Level

Under this section, education level was categorized into 5 sections which were namely Matriculation, Intermediate, Bachelors, Masters and PHD respectively.

4.2.2 Managerial Position

Employees' managerial positions were also classified into five categories: Front Line Manager, Executive, Supporting Staff, Middle Level Manager, and Senior Manager. We received 41 replies from upper-level managers, 67 from middle-level managers, and 42 from lower-level managers.

4.2.3 Respondents Experiences

Respondents' experiences were divided into five categories. One was for individuals with less than a year of experience, the second for those with 1-3 years of experience, the third for those with 4-6 years of experience, the fourth for those with 7-9 years of experience, and the fifth for those with more than 9 years of experience.

4.3 Reliability test

The constant standard test was used to determine the consistency and dependability of survey items for each review variable. According to Chang (2017), there are four levels of consistency in Cronbach alpha characteristics. Cronbach's alpha values of 0.9 or more indicate exceptional dependability, 0.70-0.9 indicates strong dependability, 0.50-0.70 indicates moderate dependability, while values less than 0.50 indicate low dependability. According to the results of the SPSS unshakable quality test, the five criteria used in this review have reasonable dependability.

Table 1
Cronbach's Alpha

Variables	Cronbach's Alpha	N of Items
Radio Frequency Identification (RFID)	.725	5
Electronic Data Interchange (EDI)	.639	5
Enterprise Resource Planning (ERP)	.754	5
Material Requirement Planning (MRP)	.760	5
Supply Chain Network Integration (SCNI)	.760	5

The beneficial effects of Cronbach's alpha demonstrated by consistent quality assessments are fundamentally appropriate for this review. The advantages of Cronbach's alpha have clearly indicated the higher level of unswerving quality and consistency pushed by the survey, primarily the examination directed inside the review. Cronbach's alpha is quite close to one, demonstrating the consistency of the survey used as well as significant areas of strength for the decisions made by the respondents; it is within the set range of 0.7-0.9. In any case, reliability is enough. According to this Cronbach alpha, the Likert scale is more consistent, and the floating survey for this quantitative inquiry is valid and clear.

4.4 Correlation Analysis

In statistical analysis, correlation is a metric used to analyze the relationship between two variables. It assesses the relationship between changes in one variable and changes in another. This connection might be favorable, negative, or non-existent. Pearson's correlation coefficient (abbreviated "r") is a statistic that quantifies the strength and direction of a linear relationship between two continuous variables. It is between -1 and +1. The correlation data given in the table most likely offer Pearson correlation coefficients (Pearson's r) demonstrating the strength and direction of correlations between certain independent variables and a dependent variable in the context of your study. These

coefficients aid in understanding how changes in one variable are related to changes in another, revealing the nature and extent of their relationship in your study environment.

Table 2

Correlations						
		RFID	**EDI**	**ERP**	**MRP**	**Supply Chain Network Integration**
RFID	**Pearson Correlation**	1	.			
EDI	**Pearson Correlation**	.755**	1			.
ERP	**Pearson Correlation**	.803**	.830**	1		
MRP	**Pearson Correlation**	.721**	.814**	.707**	1	
Supply chain network integration	**Pearson Correlation**	.794**	.818**	.776**	.818**	1
	Sig. (2-tailed)	<.001	<.001	<.001	<.001	
	N	152	152	152	152	152

**. Correlation is significant at the 0.01 level (2-tailed).

Using Pearson correlation coefficients, this material explores the links between supply chain network integration and several elements (RFID, EDI, ERP, and MRP).

The statement cites a significance level of 0.01, implying that the observed correlations are very reliable. A significance level of 0.01 implies a 1% chance that the observed associations happened by chance.

These coefficients, represented by numbers like.794,.818, and.776, reflect the degree and direction of the association between two variables. A near to 1 number implies a high positive connection, whereas a close to -1 value suggests a strong negative

correlation. A number close to 0 denotes a poor or non-existent linear connection between the variables.

In this context, the correlation values for RFID, EDI, ERP, and MRP in respect to supply chain network integration (.794,.818,.776) are all positive, indicating a direct and positive relationship between these elements and supply chain network integration. A correlation value of.818 between EDI and supply chain integration, for example, indicates a highly positive association between EDI use and supply chain integration.

These findings suggest that as RFID, EDI, ERP, and MRP values rise, so does the likelihood of improved supply chain network integration. The greater the positive correlation coefficients, the stronger the link between these factors, showing their reciprocal influence on supply chain integration.

4.5 Regression analysis

The assessment of regression determines whether a link exists, whereas regression analysis analyses the nature of the association. The table below is a standard way to offer a summary of the regression model.

Table 3

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.847	.717	.709	.3218

a. Predictors: (Constant), Radio Frequency Identification (RFID), Electronic Data Interchange (EDI), Enterprise Resource Planning (ERP), Material Requirement Planning (MRP)

The table above summarizes the regression analysis model. The value (R) represents the basic correlation. Notably, the R value is 0.847 (84.7%), indicating a strong relationship between the independent variables Radio Frequency Identification (RFID), Electronic Data Interchange (EDI), Enterprise Resource Planning (ERP), Material Requirement Planning (MRP), and Supply chain network integration (SCNI). Furthermore, R2 demonstrates how Radio Frequency Identification (RFID), Electronic Data Interchange (EDI), Enterprise Resource Planning (ERP), and Material Requirement Planning (MRP)

may help to clarify Supply chain network integration (SCNI). R2 in this study is 0.717 (71.7%), indicating a particularly high proportion. Adjusted R2, on the other hand, denotes the theoretical model's degree of fit. The Adjusted R2 in this study suggests a fit of 0.709 (70.9%), indicating a good fit of the model. R2 measures the "goodness of fit," or the effect of the independent factors on the dependent variable in the study.

4.6 ANOVA

Table 4

Model		Sum of Squares	DF	Mean Square	F	Sig.
1	**Regression**	60.467	4	12.117	28.57	<.001[b]
	Residual	15.476	144	.424		
	Total	75.943	148			

a. Dependent Variable: Supply chain network integration

b. Predictors: (Constant), Radio Frequency Identification (RFID), Electronic Data Interchange (EDI), Enterprise Resource Planning (ERP), Material Requirement Planning (MRP)

An ANOVA (Analysis of Variance) table is used in the analysis to assess the importance of a complete model connected to relapse. An F-test is frequently used in statistical analysis to examine whether the overall model has explanatory power and whether its coefficients are substantially different from zero. This statistic represents the model's explained variance divided by the unexplained variance. An F value larger than 4 (F>4) indicates that the model has a statistically significant overall effect. If the null hypothesis were true, this number reflects the likelihood that the observed findings (or more extreme) happened by chance. A p-value of less than 0.05 (p0.05) is frequently regarded as statistically significant, suggesting strong evidence against the null hypothesis.

The F value in the information presented is significantly high at 140.652, well above the criterion of 4. Concurrently, the p-value for this model is less than 0.05, indicating a high level of statistical significance. Since a result of these criteria, it is possible to infer that the complete relapse model significantly explains and predicts the observed data, since both the F value and the accompanying p-value fulfil the significance criterion.

4.7 Coefficient

Table 5

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	**(Constant)**	.670	.454		1.475	.142
	AVG RFID	.240	.093	.142	2.599	.001
	AVG EDI	.391	.045	.530	3.739	.001
	AVG ERP	.217	.043	.321	2.392	.001
	AVG MRP	.282	.050	.339	1.938	.001

a. Dependent Variable: Supply Chain Network Integration

At the 95 percent confidence level, all the components in the table above have a positive connection with supply chain integration. The importance of the link between the dependent and independent variables is explained by these coefficients. There is a significant link between the dependent and independent variables since all the t values are more than 2 (t > 2) and all of the p values are less than 0.05 (p0.05). The constant number (0.407) indicates that if all of the observed logistical operations were rated zero, (power sector) corporate supply chain network integration would be reduced by 0.407. A unit increase in RFID improves supply chain network integration by 0.240, a unit increase in EDI improves supply chain network integration by 0.391, a unit increase in ERP improves supply chain network integration by 0.217, and a unit increase in MRP improves supply chain network integration by 0.282.

4.8 Findings

Variables	Significance Level	Variable Impact	Result
Radio Frequency Identification	.001	Positive Impact on supply chain network integration	Hypothesis accepted
Electronic Data Interchange	.001	Positive Impact on supply chain network integration	Hypothesis accepted
Enterprise Resource Planning	.001	Positive Impact on supply chain network integration	Hypothesis accepted
Material Requirement Planning	.001	Positive Impact on supply chain network integration	Hypothesis accepted

Chapter 5

Discussion, Conclusion and Recommendations

5.1 Discussion

Supply chain networking encompasses the procurement, conversion of raw materials into finished products, and timely delivery to meet customer demand. It may also involve after-sale services in specific cases. The primary objective of the supply chain department is to streamline these operations, reduce costs, minimize lead times, and enhance efficiency to thrive in a highly competitive market. Supply chain management serves as a guide, advocating cost reduction and operational smoothness in these processes. This research paper highlights how the tools for digital supply chain transformation mentioned herein indicate a direct or positive correlation between efficient supply chain performance and modern supply chain techniques. The study conducted demonstrates that technology significantly impacts the supply chain network integration within Pakistan's power sector.

Given the diverse array of goods handled within these organizations, power and energy sector companies must identify crucial characteristics and determinants for achieving efficient supply chain network integration through digital transformation. The paper, along with empirical tests, reveals that IT tools such as RFID, EDI, ERP, and MRP positively influence the supply chain network integration in the power sector. To gain a competitive edge and establish enduring customer relationships, companies must move beyond traditional methodologies and consider embracing new technologies. Considering the wide product diversity within the power sector, the implementation of digital supply chain tools holds substantial importance for fostering productive supply chain integration. This discussion emphasizes the myriad challenges faced by power and energy sector companies and advocates the adoption of modern supply chain tools to overcome these challenges and reap the benefits of efficient supply chain integration, marked by reduced costs and shorter lead times.

5.2 Conclusion

Modern and technological supply chain transformation holds immense significance across various industries, particularly within the power sector where its importance becomes even more pronounced. The variables highlighted in this context play a pivotal role in shaping the supply chain network integration within the power sector. Given the extensive variety and diverse product range inherent in the power and energy sector, digitalization or the implementation of information technology tools becomes crucial to enhance the efficiency and effectiveness of the product supply chain. Information technology assumes a pivotal role in determining the supply chain network integration within the power sector. The findings of this research indicate that stakeholders involved in the power and energy sector possess a comprehensive understanding of the dimensions involved in measuring supply chain network integration and the pertinent technological tools.

The expansive nature of the supply chain within the power and energy sector, owing to product diversity and substantial volume, makes it challenging for companies to maintain an efficient and effective supply chain through manual means. In such scenarios, technological tools, such as RFID, EDI, MRP, and ERP, play a pivotal role in ensuring the efficient functioning of the supply chain within the power and energy sector. The operational aspect within the power and energy sector holds immense significance due to the sheer quantity and diverse range of products. Smooth operations within the supply chain are crucial for companies, especially in the power and energy domain. Therefore, ensuring the longevity and survival of these companies necessitates meticulous control over supply chain network integration, achievable through the aid of technological tools that are directly correlated with efficient supply chain integration.

The digital transformation tools or variables are pivotal in ensuring a smooth and efficient supply chain, primarily because supply chains inherently entail various risks such as inadequate quantity, the bullwhip effect, and errors due to manual processes. Leveraging technological tools like RFID, EDI, ERP, and MRP help mitigate these risks, reducing costs and enhancing overall profitability.

The multitude of risks involved can significantly impact organizations, escalating costs to considerable levels. Utilizing modern supply chain technology, as demonstrated above, can effectively mitigate these risks, cut down expenses, bolster supply chain integration, and ultimately improve overall efficiency in operations.

5.3 Recommendations

Upon comprehensive analysis of the entire research, it becomes abundantly evident that the power and energy sector in Pakistan currently faces numerous challenges due to its adherence to outdated and traditional practices. This inefficient approach incurs significant costs for companies as consumers increasingly gravitate toward competitors, resulting in lost sales, power supply shortages, and bottleneck effects. The prevalent issues encountered by these companies stem from the widespread reluctance among most power companies in our country to embrace new technologies. The challenges in Pakistan's power and energy sector extend beyond internal factors to encompass external influences. Notably, external factors such as political instability, fluctuations in economic policies, intricate supply chains, and socio-economic elements—like soaring food inflation, exorbitant transportation costs, and high tax rates pose severe threats to companies in the power and energy domain. Moreover, the diverse demands for electricity and energy due to the varied ethnic backgrounds of Pakistani citizens create hurdles in effectively managing and forecasting supply and demand, constituting additional external challenges.

In addition to external factors, internal elements within companies can also inflict significant harm. Factors such as the absence of digitization leading to erroneous demand estimation or forecasting, coupled with fluctuations in both demand and supply, exacerbate issues like supply shortages, reduced income, and prolonged lead times. Furthermore, companies in Pakistan encounter various problems related to fraud, mismanagement, and deceptive practices—for example, instances where imported products are manufactured locally and marketed as high-quality goods, resulting in customer dissatisfaction and subsequent loss of product sales.

For companies to survive and prosper, they must adapt to new technologies and digitize their infrastructure. Failure to implement these tools can distort supply and demand dynamics, lead to inaccurate forecasting, inflate costs, diminish sales, and elongate lead

times. It is imperative to address this process by embracing and appropriately managing the implementation of digital transformation tools.

There are some strategic recommendations for the power and energy sector of Pakistan as per the subject and objective of this research study:

- Implementation of digitized systems or automated tools can help in increasing the efficiency of the processes and can reduce the error of humans to a certain extent.
- Automated systems like digital transformation tools can be installed in companies for tracking materials and to meet certain deadlines.
- The use of data analytics with certain tools of digital supply chain can also help a great deal in supply chain network integration and increase the efficiency of the supply chain performance of the power and energy sector.
- The more integrated departments of the company there are the more efficient and smoother the supply chain is going to be.

So, the aim of this research has successfully been achieved with the connections of the power and energy sector and modern supply chain techniques. Apart from that, the management should investigate these factors to increase the profitability of the company and sustainability in the market. Apart from that, the researcher has also shown the recommendations for the increase in the integration of the departments across the supply chain to compete for long sustainable profits and to compete over a global market with the companies operating in the power and energy sector of Pakistan.

5.4 Research Implication

The study underscores the importance of digital supply chain transformation in boosting operational efficiency within the power and energy sector. The identified areas of focus, such as data sharing, strategic management, coordination and communication, administration, and scope quantification, provide actionable insights for improving overall supply chain performance. The research contributes to the development of awareness among supply chain executives in the power and energy sector regarding the critical role they play in enhancing efficiency through coordinated operations. This awareness is crucial for decision-makers to prioritize and invest in the necessary skills and technologies required for effective supply chain management. The study highlights the strategic

implications of supply chain network integration, emphasizing the need for informed decision-making. Executives in the power and energy sector can use these findings to shape their strategies related to data management, coordination, and other critical aspects, ultimately leading to more effective and responsive supply chain operations. The identified factors contributing to efficiency execution, such as data sharing and communication, serve as metrics for performance measurement and benchmarking. Organizations can use these insights to assess their current supply chain practices, identify areas for improvement, and benchmark their performance against industry best practices. Policymakers and regulatory bodies can leverage the research findings to formulate policies that encourage and support digital supply chain transformation within the power and energy sector. Creating an environment conducive to the adoption of advanced supply chain practices can have positive implications for the industry's overall competitiveness and sustainability. The study emphasizes the collaborative nature of supply chain operations, suggesting that stakeholders in the power and energy sector should engage in partnerships and collaborations. This can lead to the sharing of best practices, technologies, and expertise, fostering a more integrated and resilient supply chain network. This research not only provides practical insights for improving supply chain operations in the power and energy sector of Pakistan but also has broader implications for shaping strategic decisions, enhancing awareness, and influencing policy and regulatory frameworks in the industry.

5.4 Research Limitations

The research encountered several limitations that should be acknowledged to provide a more nuanced understanding of the study's scope and implications. One of the primary constraints was the restricted sample size, primarily due to time constraints. The research team faced challenges in gathering a larger and more diverse sample of respondents from the power and energy sector. This limitation may impact the generalizability of the findings to the entire industry, as the sample might not fully represent the diversity within the sector. The comprehensive literature review undertaken to explore the role of supply chain management in enhancing supply chain network integration demanded a considerable amount of time. The short deadline for the study further compounded this issue, restricting the depth and breadth of the research. As a result, the study might not have covered all relevant aspects and may have missed emerging trends

or recent developments. The study faced challenges in gathering responses from a broad spectrum of supply chain members in the power and energy sector within the specified timeframe. This limitation may introduce a potential bias in the data, as the responses obtained might not fully capture the perspectives of all relevant stakeholders. A more extended data collection period could have mitigated this limitation. The small sample size restricted the study from providing a comprehensive overview of the entire power and energy sector. The findings may be more applicable to specific sub-sectors or segments within the industry, and caution should be exercised when generalizing the results to the broader power and energy landscape.

To address these limitations and enhance the robustness of future research endeavors, it is imperative to allocate sufficient time for a more extensive and representative sample, employ diverse data collection methods, and consider a more extended research duration. Additionally, researchers should be mindful of the dynamic nature of the industry and strive to incorporate a broader range of perspectives to ensure a more holistic understanding of the complex dynamics at play in the power and energy supply chain.

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Appendix

The Impact of Modern Supply Chain Digital Transformation on Supply Chain Network integration of Power and Energy Sector of Pakistan

Research Questionnaire

This survey has been created with the sole intention of gathering information on the " The Impact of Modern Supply Chain Digital Transformation on Supply Chain Network integration of Power and Energy Sector of Pakistan. The information gathered will be treated with a high degree confidentiality and will only be used for academic purposes. You are kindly asked to fill out this questionnaire by circling appropriate answers.

Section A: General Information

Name: _____

Gender:

- Male
- Female

Email Address: _____

Age:

- 20-30
- 31-40
- 41-50
- Above 50

Education level:

- Matriculation/O-Level
- Intermediate/A-Level
- Bachelors
- Masters
- PhD

Organization: _____

Designation:

- Senior Manager
- Middle Level Manager
- Supporting Staff
- Executive
- Front Line Manager

Job Experience:

- Less than a year
- 1-3
- 4-6
- 7-9
- More

Section B: Independent Variables

Radio Frequency Identification	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
RFID offers better tracking and inventory control	**1**	**2**	**3**	**4**	**5**
RFID offers, less stock-outs and increase in sales	**1**	**2**	**3**	**4**	**5**
RFID offers labor cost reduction	**1**	**2**	**3**	**4**	**5**
RFID offers improve stacked lead time	**1**	**2**	**3**	**4**	**5**
RFID offers better warehouse management of goods	**1**	**2**	**3**	**4**	**5**
Electronic data interchange					
EDI helps to reduce the cost. (e.g. Accounting,	**1**	**2**	**3**	**4**	**5**

manufacturing, distribution, and finance)					
EDI helps in efficient flow of information.	**1**	**2**	**3**	**4**	**5**
EDI helps in improving the quality of products.	**1**	**2**	**3**	**4**	**5**
EDI helped our company in high turnover.	**1**	**2**	**3**	**4**	**5**
EDI improved competitiveness.	**1**	**2**	**3**	**4**	**5**
Enterprise Resource Planning					
The contract agreements will be easier to manage	**1**	**2**	**3**	**4**	**5**
The order lead-time will decrease	**1**	**2**	**3**	**4**	**5**
The costs in procurement will be reduced	**1**	**2**	**3**	**4**	**5**
The customers are more integrated in the new system	**1**	**2**	**3**	**4**	**5**
The suppliers are more integrated in the new system	**1**	**2**	**3**	**4**	**5**
Material Requirement Planning:					
Implementation of MRP has improved responsiveness	**1**	**2**	**3**	**4**	**5**
Implementation of MRP has reduced production cost.	**1**	**2**	**3**	**4**	**5**

Implementation of MRP has increased sales revenue.	**1**	**2**	**3**	**4**	**5**
Implementation of MRP has improved delivery time to customers.	**1**	**2**	**3**	**4**	**5**
Implementation of MRP has increase operational flexibility.	**1**	**2**	**3**	**4**	**5**

Section C: Supply Chain Integration

Supply Chain Network Integration	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Modern technologies system is inevitable to enhance capabilities of a firm.	**1**	**2**	**3**	**4**	**5**
Efficient technological process helps in cost reduction.	**1**	**2**	**3**	**4**	**5**
Technogym and innovation boost the responsiveness of the firm.	**1**	**2**	**3**	**4**	**5**
Implementing technologies helps in creating flexibility in firm in order processing.	**1**	**2**	**3**	**4**	**5**
Implementing technologies helps in improving the overall value chain.	**1**	**2**	**3**	**4**	**5**

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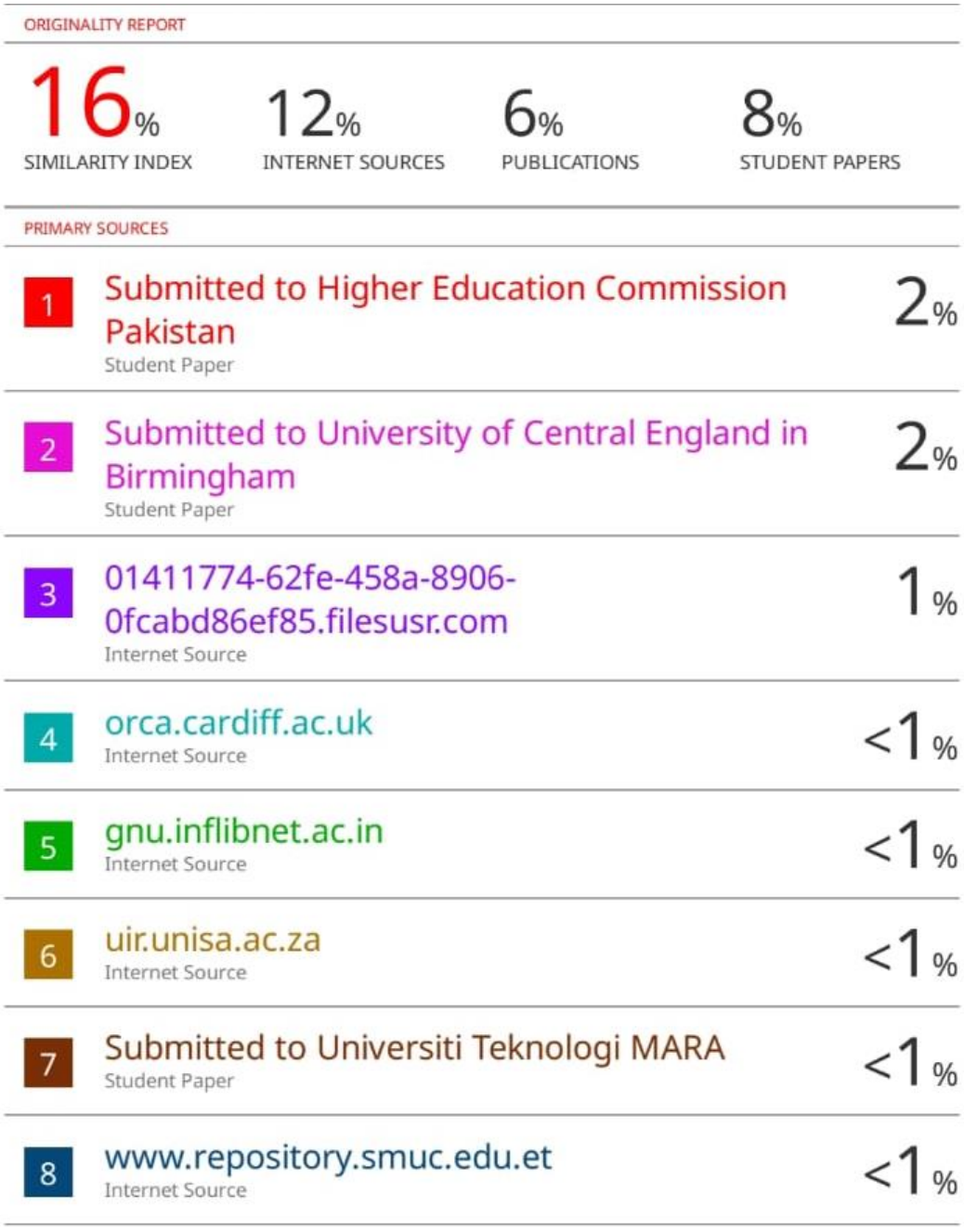

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RC-04

MBA/BBA

1st Half Semester Progress Report

Name of Student(s)	MUHAMMAD KASHIF
Enrollment No.	01-321221-015
Thesis/Project Title	The Impact of supply chain Digital Transformation on Supply chain networks integration of power and Energy sector in Pakistan

Supervisor Student Meeting Record

No.	Date	Place of Meeting	Topic Discussed	Signature of Student
1	7-Oct-2023	University	Topic, Model, Research Objectives Research Questions	Kashif
2	14-Oct-2023	Ma'am Office	Research Hypothesis, Research Gap, Contributions Past Thesis data	Kashif
3	5-Nov-2023	Whatsapp Calls Online	Analysis, Sampling, Data Collection How To ?	Kashif
4	25-Nov 2023	Ma'am Office	Sampling Techniques, framework Design and Sample Size	Kashif

Progress Satisfactory [✓] Progress Unsatisfactory [ ]

Remarks: The student put his effort hard to complete the thesis in time.

Signature of Supervisor: _____ Date: 8/1/24

Name: Asima Saleem

Note: **Students attach 1st & 2nd half progress report at the end of spiral copy.**

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RC-04

MBA/BBA

2nd Half Semester Progress Report & Thesis Approval Statement

Name of Student(s)	MUHAMMAD KASHIF
Enrollment No.	01-321221-015
Thesis/Project Title	The impact of Supply chain Digital Transformation on Supply chain network integration of power and Energy Sector in Pakistan

Supervisor Student Meeting Record

No.	Date	Place of Meeting	Topic Discussed	Signature of Student
5	9-Dec-2023	University	Conduction Analysis.	Kashif
6	17-Dec-2023	Malam office	Finding, Recomendations References.	Kashif
7	30-Dec 2023	Zoom meeting and online	Overall overview of Thesis Report.	Kashif

APPROVAL FOR EXAMINATION

Candidates' Name: Muhammad Kashif Enrollment No: 01-321221-015

Project/Thesis Title: The impact of Supply chain Digital Transformation on Supply chain network integration of power and Energy sector in Pakistan

I hereby certify that the above candidates' thesis/project has been completed to my satisfaction and, to my belief, its standard appropriate for submission for examination. I have also conducted plagiarism test of this thesis using HEC prescribed software and found similarity index at 16% that is within the permissible limit set by the HEC for thesis/ project MBA/BBA. I have also found the thesis/project in a format recognized by the department of Business Studies.

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Name: Asima Saleem