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EXPLORING THE IMPORTANCE OF BIG DATA FOR EXPORTERS IN BANGLADESH'S READY MADE GARMENTS SECTOR

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Abstract

The RMG industry of Bangladesh is one of the major sectors of the country's domestic economy and foreign currency earner. Increasing technological advancements and innovations are likely to accelerate the progress of this sector further. Consequently, the need for big data in the RMG industry is increasing significantly. This research paper mainly highlighted the importance of big data and its need in Bangladesh's ready-made garment industry. The study's primary purpose was to explore the importance of big data in the ready-made garments industry in Bangladesh. The focus was mainly on those RMG manufacturers to identify the benefits and necessity of data-driven decision-making processes in the RMG industry in Bangladesh. The qualitative study collected data from RMG exporters in Bangladesh for three months. A total of four ready-made garments exporters and manufacturers were engaged through semi-structured interviews in the qualitative method. The study's main findings revealed that big data applications are essential antecedents to RMG manufacturing and export collaboration; hence data-driven RMG operation plays a significant role in attracting buyers and helps RMG exporters to operate a business efficiently. The main themes that emerged include forecasting, revenue growth and supply chain efficiency. The results highlighted that application of big data in the RMG industry in Bangladesh provides several. The benefits associated with the adoption of data-driven garment manufacturing. The key benefits include forecasting, decision-making, supply chain efficiency, and revenue generation. Businesses in the RMG industry should adopt big data to improve efficiency and remain competitive.

Keywords: *RMG, Big data, Supply chain, Production Tracking, Operation management*

1.0 Introduction

The ready-made garments (RMG) manufacturing sector plays a significant role in Bangladesh's economic development and prosperity. The industry has played a pivotal role in the country's economic prosperity for 50 years since independence. With the help of globalization, Bangladesh can make a significant mark on the world stage (Islam et al., 2016). Bangladesh ranks second in the world in garment manufacturing and export (Mirdha, 2020). In the 30 years from 1990 to 2020, the garment industry has been the country's primary source of foreign exchange earnings (Swazan & Das, 2022). The role of digitalization and the Fourth Industrial Revolution in accelerating the continuous progress of the garment industry in Bangladesh is undeniable (Rumi et al., 2021).

The ready-made garments sector plays a vital role in developing the country's overall economy. Obtaining economic benefits in export earnings might give Bangladesh's Garment sector more competitiveness and aid its growth. Bangladesh has maintained consistent productivity expansion because of sustained expansion in the international fashion market. (Mosley, 2020) The continual growth of this sector is progressing the national economy steadily. The Bangladeshi garment sector's pay scale is one of the main reasons its region is regarded as a worldwide apparel-sourcing powerhouse, as the current income basic income is approximately 97 Dollars (Majumder & Ferdaus, 2020). Conversely, China's current pay varies between 162 Dollars and 358 dollars (Zhang, 2022). As a consequence, Bangladesh's cheaper pay encourages overseas purchasers, resulting in a USD 33.07 billion in garments total export in 2020 (BGMEA, 2021). Besides, Europe and the United States of America (USA) are the country's top distribution and collection, accounting for 80% of overall manufacturing output in 2019. Bangladesh's clothing exporters to the European Union (EU) reached USD 20.42 billion in 2019 and USD 6.02 billion in the United States (BGMEA, 2021).

To stay competitive, the firms in the RMG sector need to be efficient. To compete with other RMG manufacturing countries like China and Vietnam, there is no substitute for building the overall structure in the garment industry to rely on information to sustain its current position and organize the industry in big data management, which plays a significant role in buyers' decision-making in the global market (Tareque & Islam, 2020). Big data and big data analytics have grown in size and importance. It can be seen that the width and depth of Big Data have grown over time, mostly as a result of a growth in the volume and size of data as well as better processing hardware. Past studies have shown that big data and predictive analytics can be used in many ways by different companies to carve out a niche for themselves in a crowded market (Akter & Wamba, 2016). Additionally, Big data provides crucial business insights by providing solid statistical backing for interdisciplinary studies that might aid in business growth (Dubey et al., 2018). Additionally, according to recent studies, BDPA can provide business firms with more insights by turning complicated and unstructured data into actionable knowledge (Shamim et al., 2019). According to some studies, big data is an organizational skill that firms use to achieve a competitive edge in a fast-paced setting (Wamba et al., 2017). Firms in the RMG sector in Bangladesh can gain a better competitive advantage by building strategic frameworks using big data analytics and other current technologies, such as machine learning (Akter & Wamba, 2016).

However, there is a dearth of studies that have explored the role of Bigdata in performance and, more specifically, in the RMG sector in Bangladesh. Earlier studies have focused more on the performance or competitive advantage of firms. In addition, most past studies were done in

countries that are developed and technologically advanced. The study, therefore, aims to answer the following research questions: What role does big data analytics play in enhancing the performance of firms in the RMG sector in Bangladesh?

2.0 Literature Review

2.1 RMG industry Bangladesh

Many countries, particularly Bangladesh, perceive the growth of the garment industry to be a major priority in their economic growth. With both the cultural changes, aspiring entrepreneurs are involved in a variety of small and medium-scale clothing industries, which include commodities such as shorts, trousers, shirts, sweaters, blouses, skirts, tee-shirts, jackets, sportswear, and many more informal and trendy items. (Chowdhury, 2014). However, according to another researcher (Carlson & Bitsch), despite the many challenges the industry has experienced in recent years, it has maintained to demonstrate strong performance, competitive edge, and, perhaps most importantly, social obligation. RMG's economic contribution to Bangladesh is well-known, well-appreciated, and well-respected. Nevertheless, the size of its great impact and consequences will frequently validate the administration's assistance for this industry in recent years, as well as the assistance it is requesting now.

As stated in the report by McKinsey, this economic success story's backbone or the mainstay is the ready-made clothing (RMG) sector: Currently, RMG accounts for 84 per cent of Bangladesh's exports, making it one of the top exporters of clothing in the world. This is the result of the industry's explosive development and modernization over the past ten years, as well as the progress it has achieved in enhancing working conditions for the nation's four million or more garment employees (Berg et al., 2021). Bangladesh has become a manufacturing powerhouse for garments in recent years. The low cost of labour and large workforce is the nation's strengths. Many significant international retail companies have been drawn to Bangladesh by the country's advanced technology and high-quality goods. With a GDP of 38.73 billion dollars, the nation is a major exporter of textiles. Additionally, Bangladesh's vertical capacities support international brands in ensuring greater coordination and transparency throughout their supply chains. With the large volume of value-added commodities that major international companies are ordering, Bangladesh's textile sector is expanding quickly (Fibre2Fashion, 2018). Over the next 50 years, the country is thought to have the ability to provide faster development (Islam et al., 2014).

Hence, monitoring consumer purchasing behaviour and involvement has so become critical. Rather than forcing supplies towards the consumer, business is becoming demand-driven, which means that customer needs are first considered, as well as the item is then created, built, and marketed (Ericsson & Sundström). Changing customer behaviour and consumption habits has emphasized the need for a company to flourish their supply chain management to respond to client requests quickly and handle the overall complexities of both the product design process (Okur & Sarcasm). This shows a transition in distribution networks from "supplier-driven" to "demand-driven," with manufacturing becoming even more responsive to consumer demands (Thomassey & Zeng, 2021). The design and production procedure in what seems like a demand-driven distribution chain is centred on the consumer's wants as well as requirements (Thomassey & Zeng, 2021).

2.2 RMG Products of Bangladesh

Woven and knit garments are the two types of ready-to-wear clothing produced in Bangladesh. The primary woven items are shirts, T-shirts, and trousers, while the main knit products are undergarments, socks, stockings, T-shirts, sweaters, and other casual and soft clothes. Woven garments continue to dominate the country's garment export revenues (Haider, 2007). Hence, product diversification is the cornerstone of a successful business in a globalized and successful fashion industry. As a result, the RMG industry must expand its brand portfolio beyond low-cost, low-value things to high-end high-value ones (Islam et al., 2016). According to the research of Masum (2016), since companies in Bangladesh manufacture clothes depending on customer orders, an examination of the demand side of the garment sector is essential. These are well-branded merchants as well as wholesalers from throughout the world. Such branded merchants are all in charge of sales forecasts as well as Bangladeshi distribution channels. Bangladeshi companies make apparel with little understanding of the tastes of the end buyers. As a result, a detailed examination of the demand side is required. The product portfolio and supply chain management could be tailored to the specific needs of various market segments. The garment industry, which involves multiple players doing numerous procedures to make the fashion apparel commodity altogether, is investigated throughout this research.

2.3 RMG Supply Chain in Bangladesh

The ready-made clothing industry's supply chain in Bangladesh is a well-organized and crucial component of the industry. The marketing, order-taking, design, sampling, sourcing of raw materials, knitting and dying quality control, and logistics processes are all part of the clothing supply chain. According to a study by (Islam et al., 2012), the industry distinguishes the garment distribution network from others based on several factors. The development stage of its products is influenced by seasonality or fashion demands. Businesses obtain a huge competitive edge by utilizing the supply chain capabilities within their operation. As a result, Supply Chain Management ideas and methods are now widely used in global corporate management around the globe. Large local corporate giants and MNCs from around the world have embraced supply chain management principles in Bangladesh (BSCMS, n.d.).

The product descriptions also contain information like the category, a prototype of garments, technical requirements, sizes, and colourways wherein the garment must be manufactured, and the kinds of fabric used are determined by the design professionals staffed by the vendors. (Jain, 2020). In communicating directly with both the client and the marketing merchandisers of the RMG industry, implement those directions to develop samples. Following the approval of the garment's samples, the production executives begin planning and developing directions for designing, trimming, stitching, assembling, finishing, inspections, and shipping (Hossain & Roy, 2016). Finally, wholesalers or logistics suppliers transport the manufactured goods to various locations regionally and abroad, per the plans devised by the vendor company's management (Nuruzzaman, Haque, & Azad, 2010).

Bangladesh's supply system is vulnerable and liable to interruptions and disruptions. According to Christopher & Peck (2004), supply chain vulnerability is the risk of experiencing a significant disruption due to risks both inside and outside of the supply chain. The RMG sector supply chain

network is more susceptible to higher disruption risks for its worldwide supply chain networks in this period of vulnerability (Chowdhury et al., 2019). The supply chain's vulnerability is increased by customer dependence, supplier dependence, supplier concentration, single sourcing, and global sourcing (Wagner & Bode, 2006). The factors that define a supply chain's susceptibility and vulnerability are concerns with the customer side, supplier side, and supply chain design (Wagner & Bode, 2006). The most significant hazard in the supply chain is disruption risk, which affects things like product quality, transportation, and cost (Roehrich et al., 2014). This fluctuation impacts the apparel market. Inventory costs and shortages are impacted by disruptions (Ali et al., 2018). The complexity of the supply chain and recent widespread disruption have made effective supply chain management complicated. Big data analytics and the accessibility of data may be one of the answers to reducing the effects of supply chain interruptions.

As previously said, the garment supply chain is constantly evolving into a demand-driven supply chain, which necessitates the use of digitalization to deliver products to consumers. Nevertheless, senior leadership has yet to recognize the growing popularity of big data management platforms for developing such data-driven initiatives. Another researcher (Akhtar et al., 2018) highlighted that, for garment industry leaders to fully understand and implement demand-driven strategies in terms of big data management, they must diversify their ecosystems and realize the potential of big data to satisfy customers at the highest level of good business performance. Trying to implement demand-driven strategies is difficult because it requires knowledge of the proper application. To be flexible, users need to manage and analyze a lot of different data about clothing demand and market analysis. However, based on the research (Labrinidis & Jagadish, 2012), to enhance the way business is done now, people need to know about the methods as well as the problems that come with them, including bad data reliability, a lack of analytical abilities, facilities to retail outlet and organize the information, and data security. Therefore, taking into consideration, this research explored the concept of RMG Exporters in Bangladesh to enhance their company's operations by using big data.

2.4 Big Data

The phrase 'big data' refers to the vast amount of information that may be gathered as well as used with the help of proper technology (Wamba, 2017). According to Davis, Patterson, and others, "large data are data that are too big to be processed and evaluated by typical database protocols such as SQL" (Emani et al., 2015) are two definitions for big data. Big data is similarly described by Manyika et al. (2011) as a data set that is larger than what can be captured by standard database software technologies. These authors concur that data size is the single element that distinguishes big data. Because the data is too large, moves too quickly, or does not adhere to the limitations of database structures, big data is multidimensional (Emani et al., 2015). According to Hadi et al. (2015), the five dimensions of big data include volume, variety, velocity, value and veracity. Big data's impact is upending the fields of industry (Koutsomitropoulos et al., 2017), science, and society, prompting people to seriously consider adopting new, more effective practices for business plans and governmental policies, particularly in crucial industries like energy, health, transportation, and so forth.

The three-V model of big data is highlighted in the definition of big data (Emani et al., 2015). The three Vs in this model are volume, velocity, and variety of the data. Because of the volume, the data

can be obtained from a wide variety of different sources. Compared to structured data, the amount of unstructured data that originates from social networks, websites, sensors, and mobile networks are substantial; nevertheless, the proportion of structured data that contains usable information is inverted, favouring the conclusion (Russom, 2011). However, the biggest technology needed to perform tasks with Big Data is Artificial Intelligence. More specifically, artificial intelligence is like an engine where big data act like fuel. In addition, the accuracy of provided data makes the AI process smoothest in terms of data-driven business operations (O'Leary, 2013).

A report by McKinsey (2016) highlighted one of his reports that the importance of big data in inventing new knowledge through the aggregation of information from different sources is immense. According to his findings, it can also play an important role in determining the future needs of the garment industry and getting information on the customer's design needs, which could not normally be obtained using the old data management method. As such, Big Data Management is a significant tool for providing important solutions to the questions of what consumers are buying, what kind of designs they are choosing, what garments are in high demand in the region and what kind of quality buyers are paying attention to (Aktas, and Meng 2017).

2.5 Big Data Management in Manufacturing and Supply chain

In the context of improving business operations, "big data management" refers to the process of gathering, organizing, maintaining, and making use of large amounts of data through the application of advanced analytics (Rossi & Hirama, 2022). The data is the most important component to consider while managing a large volume of data. The garment distribution network, much the same as most sectors in existence today, is connected to a massive amount of data in a wide range of formats. Data from the service and manufacturing sectors is increasing sharply and lifts a growing enthusiasm for the notion of Big Data (Zhong et al., 2016). Supply chain management has been undergoing digitalization for several years. Since supply chain management is associated with several activities in the supply chain, the performance and efficiency are significant, which has driven the initialization of Big Data (Eichengreen & Gupta, 2013). Supply chain management is leveraging big Data to ensure better decision-making mechanisms. Big Data brings a new source of competitive advantages for logistics providers to carry out supply chain management. This enables enhanced visibility, the ability to adjust under demand and capacity fluctuations on a real-time basis, as well as insights into customer behaviours and patterns to achieve smarter pricing and better products (Swaminathan, 2012).

The manufacturing sector uses large amounts of data nowadays since various sensors, electronic devices, and digital machines are used in production lines, shop floors, and factories (Zhong et al., 2015). A report by IDC stated that over the next several years, manufacturers increasingly plan to use service as a competitive differentiator along with Big Data analytics for profitable long-term revenue (Spotfire, 2013). Executives at leading-edge manufacturing enterprises are leveraging Big Data to optimize operations and work out strategic decisions on a real-time basis (Khatri, 2013). Some of the manufacturers using big data include Merck and Raytheon Corporation. Merck produces vaccines and uses Big Data analytics to optimize its manufacturing (Henschen, 2014). Raytheon Corp. uses big data to enable smart factories, which are based on the powerful capacity to manage information from various sources of data (Noor, 2013).

2.6 Benefits of Big Data

There are several benefits of big data. With today's technology, it is possible to analyze data and get answers from it almost immediately – an effort that's slower and less efficient with more traditional business intelligence solutions (SAS, 2022). Firstly, big data is useful for decision-making. There is a connection between the data that may be obtained, saved, and managed to make informed decisions that can assist business leaders in developing a competitive advantage for their companies (Dong, 2020). As reported by Forbes, innovations in technology have changed the rules when it comes to big data. Advanced software systems greatly reduce analytics time, giving companies the ability to make speedy decisions that help increase revenue, reduce costs and stimulate growth. This offers a competitive advantage to brands that can work faster and target their consumers more effectively (Mills, 2019).

By using big data, companies can pinpoint what customers are looking for. Businesses can use big data to deliver tailored products to their targeted market by using big data. Big data has been instrumental in developing new risk management solutions. Big data continues to help companies update existing products while innovating new ones. By collecting large amounts of data, companies can distinguish what fits their customer base. By using big data, companies offer supplier networks, otherwise known as B2B communities, with greater precision and insights (Mills, 2019). According to a report from SAS (2022), one of the key benefits is reducing costs. Big data technologies can significantly reduce costs when it comes to storing large amounts of data. Big data also supports making faster and better decisions. The speed and the ability to analyze new sources of data help businesses analyze information immediately and make fast, informed decisions. Big data is also beneficial in developing and marketing new products and services. With big data analytics, more companies have an opportunity to develop innovative new products to meet customers' changing needs (SaS, 2022).

3.0 Methodology

This qualitative study collected data in voice and words from the participants. This was based on the interpretivism philosophy, and the objective was to interpret the meaning (Merriam & Tisdell, 2016). A major goal of this study was to demonstrate the importance and benefits of big data in Bangladesh's ready-to-wear industry. For that reason, the study discussed in this study interviewed four exporters and manufacturers of Bangladeshi garments. A qualitative descriptive research methodology was used for the following research design to understand the subject matter from several industry experts in the RMG sector in Bangladesh. Data was collected from these participants between July 2022 and August 2022 through semi-structured interviews. With their consent, four virtual semi-structured interviews were held via google meet and recorded. The interviews averaged 30 minutes in length.

The managers of firms in the RMG sector were the study's target population. Because only cases that matched the inclusion criteria were chosen for the interview, purposeful sampling was more suitable for this study (Saunders et al., 2016). To continue collecting data until the saturation point is achieved, the sample size complied with the criterion (Babchuk, 2016). The proposed target sample size for this study's homogeneous participant population was 4–12 people (Saunders et al., 2016). Five participants in this study came from a homogeneous background.

A discussion guide was created based on the literature research, and a pilot study involving just one participant was run to ensure the questions were appropriate. The final interview was performed online using the Google Meet meeting platform with the participant's consent. The next step was to submit the discussion guide and a written reflection on the interview for peer review to examine the questions' relevance and validity, look for researcher bias, and ascertain whether any crucial questions had been left out. The discussion guide was slightly modified, and data collection got started. Each of the four interviews was analyzed using the MAXQDA 11 software tool. Using thematic analysis as a data analysis strategy, we analyzed our data. This resulted in the development of a coding system that was used in the subsequent qualitative analysis.

The four standards of trustworthiness listed by (Lincoln, Guba, & Pilotta, 1985) were referred to assess the data's reliability. Lincoln, Guba, & Pilotta (1985) listed credibility, transferability, dependability, and confirmability as the four standards for trustworthiness. Credibility relates to the research's primary objective. It is assurance in the data's ability to address the intended focus (Polit & Beck, 2012). In this study, member checking was used to address credibility. In this study, member validation received much attention. The raw data transcript was sent to the participants for confirmation. They were asked to review and comment, and all remarks and modifications were recorded (Saunders et al., 2016). Dependability is the ability of data to remain accurate over time and in many environments. To address the dependability of data, all records and changes were saved and maintained. An audit trail strictly complied with (Koch, 1994).

4.0 Results and Findings

The research interview scripts identify three main themes related to big data and its importance in the ready-made garments sector in Bangladesh. These are (1) Forecast, (2) Revenue, and (3) Supply chain. The following discussion will focus on these three primary themes and the subthemes connected to them. The report will present illustrative quotations from participants for each primary and secondary theme.

Table 1: List of participants

Participant of the interview

Participant No	Transcript No	Position	Year of experience	Business type
Participant - 1	1	Founder & CEO	09	Implementing RMG's ERP
Participant - 2	2	Managing Director	23	RMG Exporter & Manufacturer
Participant - 3	3	Founder & CEO	10	RMG e-supply chain platform
Participant - 4	4	Managing Director	20	RMG Exporter & Manufacturer

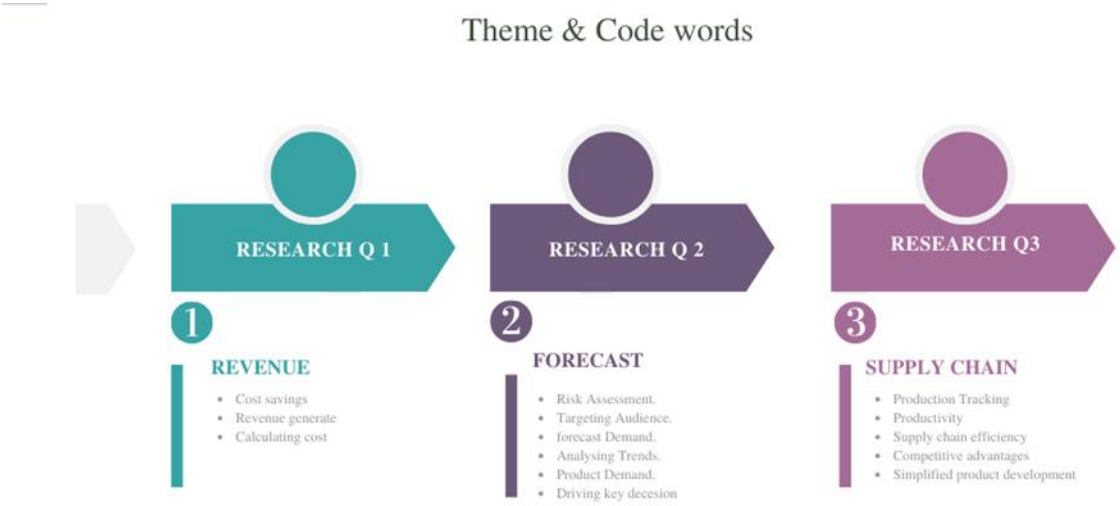

Figure 1: Coding Concept Map Generated by MAXQDA Software

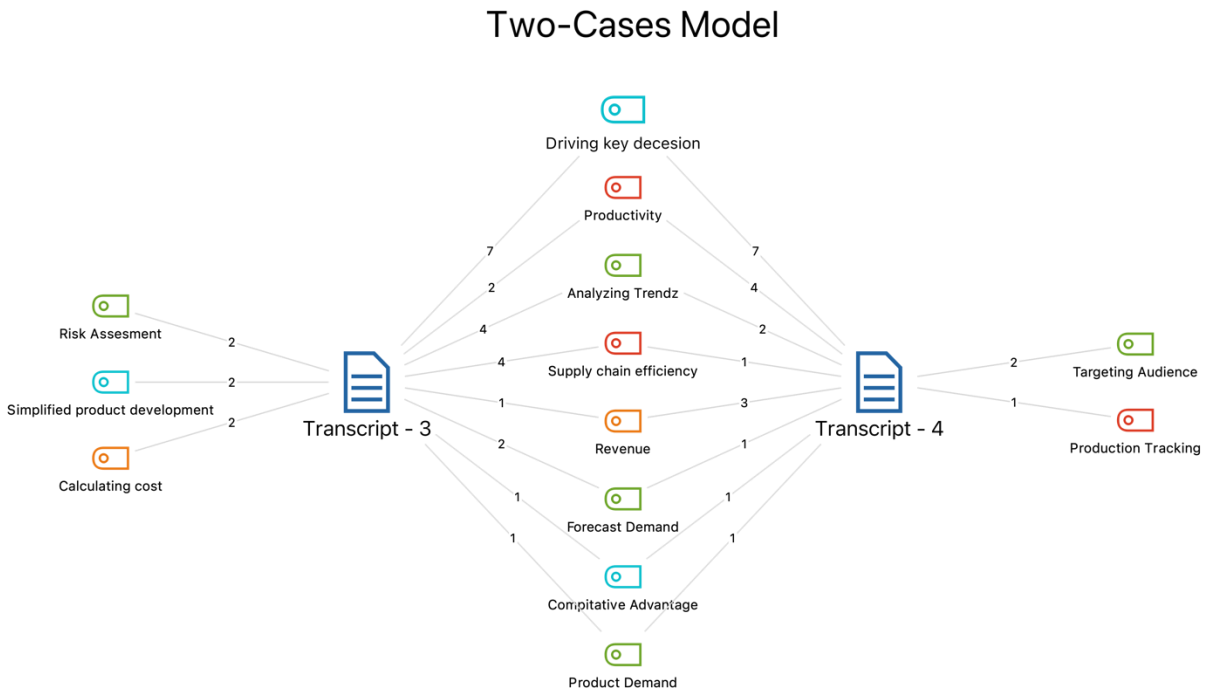

Figure 2: Two-Case Model

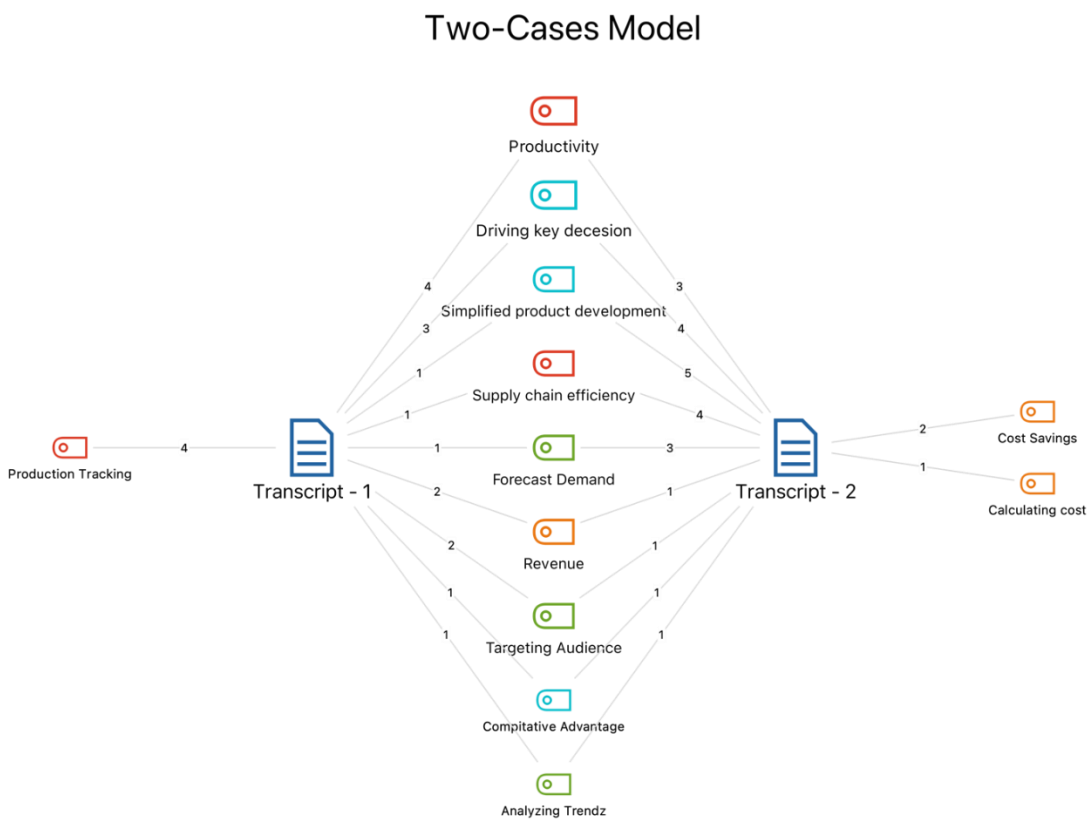

Figure 3: Two-Case Model

The following themes were identified based on the thematic analysis.

1. Revenue generation and growth
2. Forecasting and decision making
3. Supply chain efficiency

There were sub-themes under each main theme.

4.1 Revenue Generation and Growth

Turnover is one of the most important areas for any business. In the RMG sector in Bangladesh, exporters can increase their business revenue through Big Data analytics. In the following topic, some code words have been generated to identify the revenue stream of RMG exporters in Bangladesh and highlight the importance of Big Data in this sector.

Cost Savings

The advantage gained from taking steps to lower a company's core expenditure on resources, which has a powerful effect on its bottom line, is known as cost savings. Cost-saving measures include increasing productivity and obtaining reduced supply purchasing costs. The participant from the interview felt that big data helps the RMG manufacturers to save costs.

The use of big data in RMG manufacturing eliminates the need for an absurdly high number of samples since automated information-based technical packs are inherently more accurate than the samples made using more conventional methods.
(Cost Savings (Transcript - 2, Pos. 32) (Weight score: 30))

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(Cost Savings (Transcript - 2, Pos. 32) (Weight score: 30)

Most participants highlighted that cost savings is necessary for the RMG business; however, data-driven decision-making allows them to cut unnecessary costs from the operation, inventory and so on. Big data technologies can significantly reduce costs when it comes to storing large amounts of data.

Higher Revenue
RMG businesses could develop innovative products in response to client wants and preferences courtesy of big data analytics. Organizations use big data analytics because these elements make it feasible to increase revenue. Businesses that use big data analytics might see a 5-20% revenue boost. The participant addressed that because they are so readily available now, big data analytics are being used by a growing number of businesses to cut down on the expenses of production and sampling while at the same time producing a product that is of higher quality.
(Revenue (Transcript - 2, Pos. 34) (Weight score: 0))

Garments employ big data in their internal systems to improve operations, give better customer service, generate more targeted marketing campaigns, and take other steps that, eventually, can raise revenue and profitability.
(Revenue (Transcript - 4, Pos. 30) (Weight score: 0))

Revenue generating is essential for every business. The RMG industry is not out of this. The participants highlighted that data-driven RMG management allows exporters to generate more revenue for their business by cutting down operational costs.

Cost minimalization
Additionally, businesses that were capable of quantifying the benefits of big data analysis showed an overall 8% increase in earnings and a 10% decrease in costs by calculating the accurate manufacturing and operational cost (BARC, 2021). However, the interviewee emphasized that,

In this sector, the most vital role is to predict product demand, analyze trends, calculate cost, and forecast product demand. (Calculating cost
(Transcript - 3, Pos. 26) (Weight score: 0))

Hence, most participants addressed that data-driven operation allows the RMG exporters to calculate the accurate external and internal business cost that helps the management make a proper financial decision to earn more revenue.

4.2 Forecasting And Risk Management

From the analysis, the interviewee highlighted more on forecasting. According to the author, A market analysis should always include a market forecast as one of its primary components. Risk management is essential for a business to sustain and thrive in high-risk environments. Big data has been instrumental in developing new risk management solutions. Big data can improve the effectiveness of risk management models and create smarter strategies (Mills, 2019).

Risk Assessment

Risk assessment is very important for any business, and the RMG sector is not exempt. The analysis of the potential risk plays a crucial role in the success of the business and the achievement of its potential ROI. In the RMG sector, the analysis of potential risk is very important for the effectiveness of the business, and Big Data plays a crucial role in the analysis of this risk assessment. One of the interviewees emphasized that,

"Companies of today are prospering in high-risk surroundings; however, these habitats demand risk management systems. Big data has been an integral part of the development of innovative solutions for risk management, and these surroundings necessitate risk management processes. The utilization of large amounts of data can enhance the performance of risk mitigation systems as well as a result in the development of more astute tactics."
(Risk Assessment (Transcript - 3, Pos. 28) (Weight score: 0))

The Participants highlighted that by using big data in RMG company, the exporters could determine the business risk by analyzing the market data. While the majority of participants also addressed the importance of risk assessment for their RMG business.

Targeting customers and clients

According to the author, big data enables businesses to better understand their clients to enhance customer experience and marketing efforts. Big data offers essential information on business clients, especially their characteristics, geography, and legitimate interactions within the business. In addition, for the RMG exporters, targeting the audience is highly necessary to make a good and essential marketing plan. The interviewees emphasized that,

"They may be based on content-based filtering, where the system matches items based on user profiles, or collaborative filtering, where the system makes recommendations based on the preferences of a group of users."
(Targeting Audience (Transcript - 2, Pos. 17) (Weight score: 0))

"While researching RMG marketing, we concluded that "our total efficiency in running companies is likewise low compared to the global benchmark." This is something that we believe to be true." (Targeting Audience (Transcript - 4, Pos. 21) (Weight score: 0))

"Big data provide all the necessary information, and this is highly necessitated for RMG exporters to compete for global market nowadays." (Targeting Audience (Transcript - 4, Pos. 34) (Weight score: 0))

According to the participants' statements, targeting the right customers is very effective for marketing, especially for the B2B model in the RMG industry. Hence, the majority of the participants highlighted the importance of big data analysis in the RMG industry for targeting the right customers. Analyzing customer needs and satisfaction through analytics empowers businesses to give customers what they want when they want it.

Future Demand

The Ready-Made Garments process depends heavily on being able to estimate demands adequately. Failure to do so can be expensive as the business runs the danger of buying too much inventory, which could result in the company having a significant number of unused commodities. Participants indicated the big data for forecasting RMG demands.

"If we review in depth, it can undoubtedly be said that big data plays an immense role in the growing development in the apparel industry, especially by accelerating the pace of business through holistic market management and information-based marketing, including product diversification."
(Forecast Demand (Transcript - 3, Pos. 20) (Weight score: 0))

"For instance, big data can provide useful insights regarding overseas clothes shoppers, which businesses can use to improve their marketing, advertising, and promotional strategies in order to boost the percentage of customers who engage with those strategies and go on to make a purchase."
(Forecast Demand (Transcript - 4, Pos. 31) (Weight score: 0))

"In this sector, the most vital role is to predict product demand, analyze trends, cost calculating as well as forecasting the product demand". (Forecast Demand (Transcript - 3, Pos. 26) (Weight score: 0))

Consequently, most participants pointed out that forecasting the apparel demand is highly necessary for the RMG exporters to make their business effective. Hence, the use of big data is needed to forecast market demand. In addition, data-driven RMG management allows the company to predict product demand and helps to avoid unnecessary costs and risks for the business.

Analyzing Trends

According to the author (Masterclass, 2021), anticipating the future of a market is the focus of the study of fashion trends. Every sector employs trend analysts who use information from previous sales to predict possibilities in the future. Thus, the area of the fashion industry known as fashion forecasting is concerned with foreseeing new fashion trends, including colours, decorating approaches, material qualities, and much more, which will excite customer desire. However, big data is playing a significant role by providing wide tools in big data management for analyzing those fashion trends. According to respondent quotations,

"RMG Manufacturers are currently using web data (obtained from sales, market research, and social media feedback and purchasing analytics) to acquire data on particular categories. Among these is the choice of fabric, which is closely connected to a variety of factors, including feelings, preferences about structure and texture, and the passage of time."
(Analyzing Trendz (Transcript - 3, Pos. 20-21) (Weight score: 0))

"So yeah, to motivate in something different way, and if it can be based on technology, that will be more beneficial. So, to motivate a buyer to receive a new order from a different customer to promote your business to satisfy your customer."
(Analyzing Trendz (Transcript - 1, Pos. 33) (Weight score: 0))

Furthermore, all four participants strongly highlighted that, to analyze fashion trends accurately, big data analysis can provide the necessary information about the trends.

Driving key decisions
According to the research article published by (Jeble et al., 2018), RMG organizations now face challenges from high consumer expectations, intense rivalry, increasing labour plus raw material costs, and faster production cycle times. The borders between countries are becoming hazier due to globalization. Geography, as well as proximity to marketplaces, are no more obstacles to entering the market. RMG manufacturers must constantly look for dangers and possibilities within such a turbulent climate and act swiftly to make decisions about their businesses based on the information at hand. In addition, big data management and adaption in the RMG industry in Bangladesh may allow the exporters to take effective business decisions based on the analyzed data. However, several participants emphasized that.

Big data plays an essential role in the RMG industry's efforts to improve its traditional decision-making process, as well as its efforts to develop business intelligence solutions and intelligent factory management tools and to skill up its marketing expertise.
(Driving key decision (Transcript - 4, Pos. 19) (Weight score: 0))

If we review it in depth, it can undoubtedly be said that big data plays an immense role in the growing development of the apparel industry, especially by accelerating the pace of business through holistic market management and information-based marketing, including product diversification.
(Driving key decision (Transcript - 3, Pos. 20) (Weight score: 0))

The four-participant highlighted that driving the key decision is very important for RMG business. Hence big data plays a vital role in their business and drives the key decision. The speed of analytics combined with the ability to analyze new sources of data helps businesses analyze information immediately and make fast, informed decisions.

4.3 Supply Chain Efficiency

Big data gives inventory managers guidelines on how much to anticipate by combining historical sales patterns plus prediction technologies. The distribution network may acquire just enough inventory to fill the stores. As a result, reducing the risk of purchasing too much and squandering raw commodities (Raman et al., 2018). Not only that, but by using big data, RMG exporters can track their production, increase productivity as well as make the supply chain process more efficient than the traditional model. The participants specifically highlighted several areas of the supply chain where big data plays a significant role in RMG manufacturing and provides benefits to its stakeholders and exporters.

Logistics tracking
Production tracking is an approach used by businesses in the production company to gauge, evaluate, and enhance visibility throughout the whole process of manufacturing, from raw materials to final goods. In addition to the ready-made garments industry, tracking production is highly important. Participants emphasized that,

Then the customer will. See, they are using technology. They are more advanced,
(Production Tracking (Transcript - 1, Pos. 33) (Weight score: 0))
Our query was, given that garments create a significant amount of data on a daily basis, why are we unable to use this data in our decision-making? Then we came to the conclusion that in order to create a data driven RMG industry, we require infrastructure.
(Production Tracking (Transcript - 4, Pos. 24) (Weight score: 0))

All four participants strongly addressed that production tracking is very important for the RMG industry. They also highlighted that big data makes the production tracking process very efficient.

Increased productivity
According to the research article by (Sreekumar et al., 2018), productivity is the greatest and most difficult task any firm is currently facing. It is a measurement of the overall effectiveness, or integrative effectiveness, of workers, machinery, and other tools, the type of raw materials used, the company's effectiveness, and the effectiveness of the entire manufacturing system. By implementing big data in the RMG industry, exporters can operate their operations more productively. The participants underlined the subject:

Big data plays an essential role in the RMG industry's efforts to improve its traditional decision-making process, as well as its efforts to develop business intelligence solutions and intelligent factory management tools and to skill up its marketing expertise.
(Productivity (Transcript - 4, Pos. 19) (Weight score: 0))

Suppose you just received a new order from a new Buyer. You have to produce 1 million orders in just one month. But you have to analyze how you will produce within this time period.
(Productivity (Transcript - 1, Pos. 29) (Weight score: 0))

Is this line good? These few lines will be more productive for this kind of production.
(Productivity (Transcript - 1, Pos. 29) (Weight score: 0))

The participant addressed that the data-driven ready-made garments industry is very productive compared to the traditional operation process. All four participants addressed that big data is very important for making productive RMG exports.

Supply chain responsiveness
Internal procedures of the supply chain are the primary priority of supply chain responsiveness and efficiency. With better supply chain responsiveness, organizations have the ability to react quickly to sudden changes in the environment that affect their logistics processes. It has to do with making the optimum use of the available resources, such as financial, administrative, technical, etc., to

match consumer demands efficiently. In order to relate to this, big data plays a significant role in making an efficient supply chain in RMG manufacturing. However, the participant address that:

In order to address this, the RMG industry underwent a transition from mass production to mass customization, which is essentially customization done with the efficiency of mass production.
(Supply chain efficiency (Transcript - 2, Pos. 14) (Weight score: 0))

Secondly, companies are able to offer supplier networks, also known as B2B marketplaces, with increased precision and knowledge as a result of their utilization of big data.
(Supply chain efficiency (Transcript - 3, Pos. 31) (Weight score: 0))

Hence, as supported by participant information, big data allows the RMG exporters to make the supply chain process efficient. Additionally, all the four respondents highlighted that data-driven supply chain efficiency is highly necessary for RMG business.

Sustaining Competitive Advantage
Big data allows RMG companies to simulate a variety of decisions before implementing merely those that performed well in a scenario, providing them with a competitive edge. An initial product release might be a huge advantage for exporters. Owing to this, the RMG exporters will get extra benefits to the global market compared to another competitive country. The patriciates have raised several points on how big data provides them to gain a competitive advantage.

Our marketing needs to be scaled up, especially when considering the competition coming from Vietnam and other developing countries.
(Competitive Advantage (Transcript - 4, Pos. 20) (Weight score: 0))

In order to adjust the production process, there are many difficulties, though, since complexity rises with the level of customization. The fact that most customers lack expert design knowledge and are unaware of their wants is another issue with mass customization.
(Competitive Advantage (Transcript - 2, Pos. 15) (Weight score: 0))

But I will say big data can help business to reshape and strengthen global competition.
(Competitive Advantage (Transcript - 3, Pos. 26) (Weight score: 0))

The four participants strongly addressed that data-driven operation in the ready-made garments industry allows the exporters to get competitive advantages from the other competitive market. The majority of the participants also pointed out that in order to reach global customers, big data management plays a vital role, and it reshapes the RMG business and gives opportunity to exporters.

The participants highlighted that product development is very important for the RMG business. The majority of the participants strongly addressed that big data and data driven RMG operation simplified the product development process, which is very important for the RMG exporters to provide customized service to overseas buyers.

To summarise the analysis, the following study was conducted to explore the importance of big data in the ready-made garments industry in Bangladesh. The primary research question discovered

the importance of big data for the RMG industry and how the RMG exporters can benefit from the data-driven operation process. Through an inductive approach, the collected data was analysed based on the themes and information collected from the four participants. All the participants provided information based on their professional experience as well as from the industrial perspective.

5.0 Practical Implications

The information presented in this study is for those garment exporters who are interested in increasing their exports and sustaining their businesses by using big data. This research provided some more depth and insights into the benefits of adopting big data. The findings can contribute to the organisation's decision-making, revenue generation and supply chain efficiency. More specifically, the result of this study enables practitioners to better comprehend the key benefits of the use of big data. Organization leaders and managers should recognize the important benefits associated with successful big data adoption in RMG enterprises to put these research findings to use. In addition, big data service providers should consider the key benefits of big data technology to enterprises and support the enterprises.

From the theoretical perspective, there were also some implications. Firstly, the study provided answers to the research question and the gap in this study. This study provided some new insights such as supply chain efficiency and decision-making. The parties in the supply chain should work together and support the RMG sector in Bangladesh. In addition, this study also has some academic implications. Future researchers should extend the results of this study to gather more information.

5.1 Limitations and Recommendations for Future research

Firstly, this study collected data from businesses in the RMG sector in Bangladesh. It is suggested that data can be collected from other industries and countries. It may help gain better results. Secondly, this study focused on the role of big data. A combination of technologies such as big data and artificial intelligence may give better insights. Future studies should consider the impact of a combination of technologies as there may be some level of interdependence. Thirdly, this study was qualitative and further probing into the responses was not undertaken. For future studies, a mixed method of research is recommended. For instance, a sequential exploratory study can enable the research to confirm the results through a quantitative study.

6.0 Conclusion

In RMG operations, big data can play an increasingly important role. In our work, we explored how Big Data can be used to support RMG sector in various aspects. As well as providing new insights into the significance of big data in RMG Bangladesh, this study also highlighted the benefits the RMG sector can derive from the adoption of big data. The insights gained from this exploratory study have aligned the propositions of our theories by answering the research questions. The three main themes that emerged were revenue generation, forecasting and supply chain efficiency. The implications explain the various possibilities of adopting big data to remain competitive and sustain businesses. The businesses in RMG sector in Bangladesh should invest in big data to continue to

grow. This new technology is becoming available to more organizations than ever before. Using data, businesses are expected to make better decisions and sustain their competitive advantage.

7.0 References

Akhtar, P., Khan, Z., Tarba, S., & Jayawickrama, U. (2018). The Internet of Things, dynamic data and information processing capabilities, and operational agility. *Technological Forecasting and Social Change*, 136, 307–316.

Akter, S., & Wamba, S. F. (2016). Big data analytics in E-commerce: a systematic review and agenda for future research. *Electronic Markets*, *26*(2), 173-194.

Aktas, E., & Meng, Y. (2017). An exploration of big data practices in the retail sector. *Logistics*, *1*(2), 12.

Ali, S. M., Arafin, A., Moktadir, M. A., Rahman, T., & Zahan, N. (2018). Barriers to Reverse Logistics in the Computer Supply Chain Using Interpretive Structural Model. Global *Journal of Flexible Systems Management*, 19(1), 53–68. https://doi. org/10.1007/s40171-017-0176-2

Babchuk, W. A. (2016). Book review: *Qualitative research: A guide to design and Implementation* (4th ed.), by S. B. Merriam and E. J. Tisdell. *Adult Education Quarterly*, *67*(1), 71-73.

BARC. (2021, May 7). *Benefits of Big Data Analytics: Increased Revenues and Reduced Costs*. From BI-Survey.com: https://bi-survey.com/big-data-benefits

BCMS (n.d.). Bangladesh Supply Chain Management Society. https://www.bscms.com.bd/

Berg, A., Chhaparia, H., Hedrich, S and Magnus, K. H. What's next for Bangladesh's garment industry, after a decade of growth? McKinsey https://www.mckinsey.com/industries/retail/our-insights/whats-next-for-bangladeshs-garment-industry-after-a-decade-of-growth

Berry, T. (2022, May 10). *What Is a Market Forecast?* From Business Plan: https://articles.bplans.com/what-is-a-market-forecast/

BGMEA. (2021, June 15). *Comparative Statement on Export of RMG & Total Export of Bangladesh*. From Bangladesh Garments Manufacturing Association. https://www.bgmea.com.bd/page/Export_Performance

Chowdhury, N. A., Ali, S. M., Mahtab, Z., Rahman, T., Kabir, G., & Paul, S. K. (2019). A structural model for investigating the driving and dependence power of supply chain risks in the ready-made garment industry. *Journal of Retailing and Consumer Services*, 51, 102–113. https://doi.org/10.1016/j.jretconser.2019.05.024

Chowdhury, M., Ahmed, R., & Yasmin, M. (2014). Prospects and Problems of RMG Industry: A study on Bangladesh. *Prospects*, *5*(7), 103-118.

Carlson, L. A., & Bitsch, V. (2018). Social sustainability in the ready-made-garment sector in Bangladesh: an institutional approach to supply chains. *International Food and Agribusiness Management Review*, *21*(2), 269-292.

Dong, M., Zeng, X., Koehl, L., & Zhang, J. (2020). An interactive knowledge-based recommender system for fashion product design in the big data environment. *Information Sciences*, *540*, 469-488.

Dubey, R., Gunasekaran, A., Childe, S. J., Luo, Z., Wamba, S. F., Roubaud, D., & Foropon, C. (2018). Examining the role of big data and predictive analytics on collaborative performance in context to sustainable consumption and production behaviour. *Journal of Cleaner Production*, *196*, 1508-1521.

Ericsson, D., & Sundström, M. (2012). Value innovation and demand chain management: Keys to future success in the fashion industry. *Nordic Textile Journal*, *1*, 83-90.

Emani, C. K., Cullot, N., & Nicolle, C. (2015). Understandable big data: a survey. *Computer Science review*, *17*, 70-81.

Emel Aktas, Y. M. (2017, December 12). An Exploration of Big Data Practices in Retail Sector. *Logistics*, *1*(2), 01-28.

Eichengreen, B., & Gupta, P. (2013). The two waves of service-sector growth. *Oxford Economic Papers*, *65*(1), 96-123.

Fibre2Fashion (2018). Top 10 Exporting Countries of Textile and Apparel Industry https://www.fibre2fashion.com/industry-article/8471/top-10-exporting-countries-of-textile-and-apparel-industry

Hadi, H. J., Shin, A. H., Hadishaheed, S., & Ahmad, A. H. (2015). Big data and five V's characteristics. *International Journal of Advances in Electronics and Computer Science*, *2*(1), 16-23.

Haider, M. Z. (2007). Competitiveness of the Bangladesh ready-made garment industry in major international markets. *Asia-Pacific Trade and Investment Review*, *3*(1), 3-27.

Hossain, M. U., & Roy, I. (2016). Supply chain management for sustainable RMG growth in Bangladesh. *International Journal of Science and Research*, *5*(4), 1242-1248.

Henschen, D. (2014). Merck Optimizes Manufacturing with Big Data Analytics. InformationWeek Connecting the Business Technology Community, http://www.informationweek.com/strategic-cio/executive-insights-andinnovation/merck-optimizes-manufacturing-with-big-data-analytics/d/d-id/1127901.

Islam, M. S., Rakib, M. A., & Adnan, A. T. M. (2016). Ready-made garments sector of Bangladesh: Its contribution and challenges towards development. *Stud*, *5*(2), 02-12.

Islam, M., Begum, M., & Rashed, C. (2012). Operational Disturbances and Their Impact on

the Manufacturing Business- An Empirical Study in the RMG Sector of Bangladesh. *International Journal of Research in Management & Technology*, 2(2), 184–191. http://iracst.org/ijrmt/papers/Vol2no22012/10vol2no2.pdf

Islam, M. M., Islam, M. M., Azim, A. Y. M. A., Anwar, M. R., & Uddin, M. M. (2014). Customer perceptions in buying decision towards branded Bangladeshi local apparel products. *European Scientific Journal, 10*(7).

Jain, S. (2020). Big data management using artificial intelligence in the apparel supply chain: opportunities and challenges (Doctoral dissertation, Högskolan i Borås).

Jain, S., Bruniaux, J., Zeng, X., & Bruniaux, P. (2017, October). Big data in fashion industry. In *IOP Conference Series: Materials Science and Engineering* (Vol. 254, No. 15, p. 152005). IOP Publishing.

Jeble, S., Kumari, S., & Patil, Y. (2017). Role of big data in decision making. *Operations and Supply Chain Management: An International Journal*, *11*(1), 36-44.

Koch, T. (1994). Establishing rigour in qualitative research: the decision trail. *Journal of advance Nursing, 19*(5), 976-986

Koutsomitropoulos, D. A., & Kalou, A. K. (2017). A standards-based ontology and support for Big Data Analytics in the insurance industry. *At Express*, *3*(2), 57-61.

Khatri, H. (2013). Trends in Manufacturing Operations: Leveraging Big Data across the Value Chain. PROFIT ORACLE Technology Powered. Business Driven. http://www.oracle.com/us/corporate/profit/archives/opinion/011813-hkhatri1899121.htm

Labrinidis, A and Jagadish, H.V. (2012). Challenges and Opportunities with Big Data. *Proc. VLDB Endow*, 2012, 5 (12), 2032–2033.

Lincoln, Y. S., Guba, E. G., & Pilotta, J. J. (1985). Naturalistic inquiry. *International Journal of Intercultural Relations*, *9*(4), 438-439.

Masum, M. (2016, September 01). *The Bangladesh Textile-Clothing Industry: A Demand-Supply Review.* https://ritsumei.repo.nii.ac.jp/?action=repository_action_common_download&item_id

Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C., & Hung Byers, A. (2011). Big data: The next frontier for innovation, competition, and productivity. McKinsey Global Institute.

Masterclass. (2021, June 7). Fashion Trend Forecasting: How Brands Predict New Styles. https://www.masterclass.com/articles/fashion-trend-forecasting-guide

McKinsey (2016). The age of analytics: competing in a data-driven world. *McKinsey Global Institute Research*. https://www.mckinsey.com/capabilities/quantumblack/our-insights/the-age-of-analytics-competing-in-a-data-driven-world

Mills T. (2019). Five Benefits Of Big Data Analytics And How Companies Can Get Started. Forbes. https://www.forbes.com/sites/forbestechcouncil/2019/11/06/five-benefits-of-big-data-analytics-and-how-companies-can-get-started/?sh=8d94fbb17e4d

Merriam, S. B. & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation*, 4th ed. San Francisco: Jossey Bass.

Mirdha, R. U. (2020, August 25). *Bangladesh still in second spot in global apparel trade*. The Daily Star: https://www.thedailystar.net/business/news/bangladesh-still-second-spot-global-apparel-trade-1950597

Mosley, J. S. (2020). Firm participation in voluntary regulatory initiatives: The Accord, Alliance, and US garment importers from Bangladesh. *Springer Link*, 1-5.

Majumder, S. C., & Ferdaus, J. (2020). Contribution of ready-made garments industry on the economic development of Bangladesh: an empirical analysis. *The Economics and Finance Letters*, *7*(2), 295-307.

Noor, A. (2013). Putting Big Data to Work. ASME Mechanical Engineering: 32-37.

Nuruzzaman, Haque, A., & Azad, R. (2010, April 01). Is Bangladeshi RMG Sector Fit in the Global Apparel Business? Analyses the Supply Chain Management. *The South East Asian Journal of Management, 4*(1), 53-72.

Okur, N., & Saricam, C. (2019). The impact of knowledge on consumer behaviour towards sustainable apparel consumption. In *Consumer behaviour and sustainable fashion consumption* (pp. 69-96). Springer, Singapore.

O'Leary, D. E. (2013, June 27). Artificial Intelligence and Big Data. *IEEE Xplore*, *28*(2), 96-99.

Polit, D. F., Beck, C. T. (2012). *Nursing research: Principles and methods*. Philadelphia, PA: Lippincott Williams & Wilkins.

Raman, S., Patwa, N., Niranjan, I., Ranjan, U., Moorthy, K., & Mehta, A. (2018). Impact of big data on supply chain management. *International Journal of Logistics Research and Applications*, *21*(6), 579-596.

Russom, P. (2011). Big data analytics. *TDWI best practices report, fourth quarter*, *19*(4), 1-34.

Rossi, R., & Hirama, K. (2022). Analytical Engineering for Data Stream. *Journal of Computer and Communications*, *10*(7), 13-34.

Roehrich, J. K., Grosvold, J., & Hoejmose, S. U. (2014). Reputational risks and sustainable supply chain management: Decision making under bounded rationality. *International Journal of Operations and Production Management*, 34(5), 695–719. https://doi.org/10.1108/IJOPM-10-2012-0449

Rumi, M. H., Bala, S., Shah, A. M., Sayem, M. A., & Abedin, M. M. (2021). Future Tradeoff

under Fourth Industrial Revolution in Bangladesh: A Study on RMG Sector. *International Journal of Social, Political and Economic Research*, *8*(1), 198-215.

SAS (2022). With today's technology, it's possible to analyze your data and get answers from it almost immediately – an effort that's slower and less efficient with more traditional business intelligence solutions. https://www.sas.com/en_us/insights/analytics/big-data-analytics.html

Saunders, M., Lewis, P and Thornbill, A. (2016). Research *methods for business students,* Pearson, Essex.

Shamim, S., Zeng, J., Shariq, S. M., & Khan, Z. (2019). Role of big data management in enhancing big data decision-making capability and quality among Chinese firms: A dynamic capabilities view. *Information & Management*, *56*(6), 103135.

Spotfire (2013). Big Data in Manufacturing: Rise of the Machine. TIBCO Spotfire's Trends and Outliers Blog, http://spotfire.tibco.com/blog/?p=20446

Sreekumar, M. D., Chhabra, M., & Yadav, R. (2018). Productivity in manufacturing industries. *International Journal of Innovative Science and Research Technology*, 3(10), 634-639.

Swazan, I. S., & Das, D. (2022). Bangladesh's Emergence as a Ready-Made Garment Export Leader: An Examination of the Competitive Advantages of the Garment Industry. *International Journal of Global Business and Competitiveness*, 1(13), 162-164.

Swaminathan, J. M. (2018). Big data analytics for rapid, impactful, sustained, and efficient (RISE) humanitarian operations. *Production and Operations Management*, *27*(9), 1696-1700.

Tareque, A., & Islam, N. (2020). Leading in the digital age: the perspectives of the ready-made garments sector of Bangladesh. *Int. J. Business Management*, *3*(12), 01-13.

Thomassey, S., & Zeng, X. (2021, September). FBD_Bmodel Digital Platform: A Web-Based Application for Demand Driven Fashion Supply Chain. In *IFIP International Conference on Advances in Production Management Systems* (pp. 21-30). Springer, Cham.

Wamba, S. F., Ngai, E. W., Riggins, F., & Akter, S. (2017). Transforming operations and production management using big data and business analytics: future research directions. *International Journal of Operations & Production Management*, *37*(1), 2-9.

Wagner, S. M., & Bode, C. (2006). An empirical investigation into supply chain vulnerability. Journal of Purchasing and Supply Management. https://doi.org/10.1016/j.pursup.2007.01.004

Zhang, Q. Z. (2022, April 11). *A Guide to Minimum Wages in China in 2022 (Last Updated on April 11, 2022)*. China Briefing: https://www.china-briefing.com/news/minimum-wages-china-2022/

Zhong, R. Y., Newman, S. T., Huang, G. Q., & Lan, S. (2016). Big Data for supply chain

management in the service and manufacturing sectors: Challenges, opportunities, and future perspectives. *Computers & Industrial Engineering*, *101*, 572-591.

Zhong R.Y., Li Z., Pang L.Y., Pan Y, Qu T, Huang G.Q. (2013). RFID-enabled real-time

advanced planning and scheduling shell for production decision making. Int J Comp Integ M 26(7):649–62.