Integrating Apparel Mill Sustainability into Primary Education: The Role of Intangible Resources and Capabilities

Dr. Asif Khan
Textile Institute of Pakistan, Department of Management, Member of the Financial Assistance Committee.
muhammad.asif@tip.edu.pk

Dr. Ahras Rashid
Institute of Business Management Sciences, University of Agriculture, Faisalabad, Pakistan
ahrasrashid@hotmail.com

Dr. Sherbaz Khan
Associate Professor, Head of Department of Business Administration, Jinnah University for Women, Karachi, Pakistan
analyzeus@gmail.com

Dr. Adeel Shah
Assistant Professor, Head of Department of Supply Chain, Institute of Business Management, Karachi, Pakistan
adeel.shah@iobm.edu.pk

Hafiza Noor ul Ain
Lecturer, Jinnah University for Women Karachi.
noorhanif70@gmail.com

Abstract

The main focus of the current study is to investigate the impact of advanced manufacturing technology (AMT), supplier responsiveness, logistic responsiveness, and resilience on sustainability. Sustainability not only depends upon the raw materials there are multiple other factors in an apparel firm, so we choose some of the factors in order to explore whether these contribute in or not. Sustainability is an important concept in contemporary business and organizations are now more concerned about sustainability because it provides them with multiple benefits. This research also generates focus towards these factors of an apparel firm. The current research study includes a mixed-method design. Data was being collected from the respondents of apparel units through questionnaires and interviews. This study concludes that advanced manufacturing technology (AMT), supplier responsiveness, logistic responsiveness, and resilience are significant contributions to sustainability. This research would be carried out using primary data as mentioned in the literature review as well as primary data that we would be collecting from a local brand's practicing EM. Where we will conduct interviews and questionnaires by handing them out to the consumers of the brand. This questionnaire would objectively probe questions that would draw a difference between the sales from traditional and sales from experiential marketing. This research study also includes discussion, practical/managerial implications, limitations, and direction for future research. Relationships of these variables are analyzed by using the Regression analysis. All the hypotheses resulted in support. Hence, we proved that Advanced Manufacturing Technology, Supplier responsiveness, Logistic responsiveness and resilience has a significant impact on Sustainability.

Keywords: *Advanced manufacturing technology (AMT), supplier responsiveness, logistic responsiveness, resilience, Sustainability.*

Introduction

Sustainability is an important concept in the 21st century. It is also one of the most used buzzwords of the last 20 years. There appears to be nothing that can't be labeled as "sustainable" - everything can be hyphenated or coupled with it. Cities, economies, resource management, business, livelihoods - and, of course, sustainable development – are all examples of sustainable development. Sustainability has become the epitome of what Gieryn (1999) refers to as a "border word" - a term that encompasses both science and politics. Building epistemic communities of shared knowledge and common commitment to connecting environmental and economic development problems have become a key priority throughout the globe as part of the 'boundary work' surrounding sustainability. In the previous two decades, various actors have created networks, as well as alliances, have been forged; institutions and organizations have been established, projects have been developed, and money has been spent in increasingly huge sums in the name of sustainability. Boundary work takes place at this complicated confluence of science and politics and words, with sometimes ambiguous and contested interpretations, have a significant political role in policymaking and development processes.

Background of the study

The term supportability as different trendy expressions, has a set of experiences. It didn't generally have such significant implications. The expression was at first instituted by a German forester, Hans Carl von Carlowitz, in his 1712 work Sylvicultura Oeconomica, to portray how woods ought to be kept up with over time. In any case, it wasn't until the 1980s that the expression "manageability" acquired broad use. With the rise of cutting-edge ecological development in the last part of the 1960s and 1970s and conversations over development restrictions, hippies were anxious to exhibit how natural worries may be associated with standard improvement troubles. During the 1980s, the commission-driven by previous Norwegian Prime Minister Gro Brundtland turned into the point of convergence for this conversation finishing in the noteworthy report "Our Common Future" in 1987. Coming up next is the now-standard contemporary idea of manageable turn of events:

"Feasible improvement is characterized as an advancement that fulfills current requests without endangering people in the future's ability to meet their own (WCED, 1987)."

The ideas "supportability" and "reasonable turn of events," specifically, started extensive philosophical questions across disciplines. As the words were projected into the Center phase of strategy conversations globally, outstandingly in the approach the World Conference on Environment and Development in Rio in 1992, there was a blast of academic discussion on these issues starting during the 1980s.

Scientists had for some time been keen on how environments reacted to shocks and stressors and numerical nature had sprouted during the 1970s and 1980s with significant work on the solidness and flexibility characteristics of both model and genuine organic frameworks from individuals like Buzz Holling and Bob May (Holling, 1973). Accordingly, manageability might be characterized as a framework's capacity to recuperate from such shocks and stressors and return to stable states. To characterize (powerless) supportability, neoclassical financial analysts utilized thoughts of substitutable capital. What’re more contentions, seethed inside financial matters concerning whether such a "frail" meaning of maintainability was adequate or then again assuming that a more grounded definition focusing on the non-substitutability of "fundamental regular capital" was required (cf. Pearce and Atkinson, 1993). In the interim, biological financial aspects set up more straightforward linkages with normal frameworks, producing regions, for example, life cycle examination, environmental impression appraisal and elective public bookkeeping frameworks (Common and Stagl, 2005). Components of these discussions were gotten by the business local area, bringing about the development of ideas like the 'triple primary concern,' where maintainability was viewed as one of a lot more customary business goals, bringing about a huge number of new bookkeeping and reviewing measures that brought manageability worries into business arranging and bookkeeping practice (Elkington, 1997).

The World Business Council for Sustainable Development (Schmidheiny and Timberlake, 1992) was shaped with the extensive ruckus in Rio, welcoming on board some significant business heavyweights. Political researchers like Dobson (1999) characterized political speculations that depended on more extensive public political worries about the connections between environment, prosperity, and civil rights developments, for example, laid out political hypotheses that incorporated a "green" governmental issues viewpoint and put supportability issues at the focal point of a regulating vision of social and political change. Others introduced coordinated combinations that connected the monetary, ecological, and socio-political components of

manageability into what Bob Kates and associates named a "supportability science" (Kates *et al*., 2001).

Problem Statement

Sustainability has become a challenge for the contemporary organization; therefore, this study tends to focus on the fact that what are the factors through which an apparel manufacturing unit can produce sustainable products. In the literature, it is the most discussed topic, but that topic gets less attention in the Pakistani context, so this research study focuses to identify factors that lead towards the production of sustainable products. This study tends to explore whether advanced manufacturing technology, supplier responsiveness, logistic responsiveness, and resilience lead the production of sustainable clothes or not?

Research questions

Following are the research questions of the current study.

- How does advanced manufacturing technology affect sustainability?
- How does supplier responsiveness affect sustainability?
- How does logistic responsiveness affect sustainability?
- How does resilience affect sustainability?

Literature Review

Sustainability

The latest 20 years have seen a surge in discussions around 'sustainability,' to the extent that 'sustainability science' is now often recognized as a distinct field. However, despite this, 'sustainability' remains an open concept with varied interpretations and context-specific applications. One particularly common portrayal of 'sustainability' involves three interconnected pillars or legs—economic, social, and environmental components or goals. It should be noted here that these terms are often used interchangeably, and our preference for 'pillars' is largely arbitrary. This tripartite depiction is frequently, but not universally, presented as three intersecting circles of society, environment, and economy, with sustainability positioned at the center.

This paper aims to shed light on the origins of the 'three pillars' concept by tracing the historical development of the idea of 'sustainability' from its diverse early roots to the emergence of

'sustainable development' during the 1970s and 1980s. This is followed by a literature review examining the early evolution of these ideas with the intention of exploring the origins of the three pillars before 2001 when the three-circle diagram was first described as a 'common view' (Giddings et al., 2002). In the final discussion, we find that the development of the three-pillar perspective, with minimal theoretical foundation, is largely the result of the specific origins of 'sustainability' as a concept, influenced in part by the contributions of various actors who helped shape its early history (Nazir et al., 2023).

The modern understanding around the language of sustainability from a global perspective did not emerge until the late 20th century. The Club of Rome's 'Limits to Growth' argued for a "world system… that is sustainable" (Glades et al., 1972); this, claims Grober (2012), marks the first modern appearance of the term in a broadly global context. That same year, in 'A Blueprint for Survival,' which draws on the unpublished work for 'Limits to Growth,' the editors of The Ecologist presented their proposals for the creation of a 'sustainable society' (The Ecologist, 1972). Whatever the specific origins of the language, it is from the mid-1970s that the idea gained momentum; the World Council of Churches' commission on 'The Future of Man and Society' in 1974 considered the concept of a 'sustainable society' more refined than the language of limits (Grober, 2012). The Ecology Party (later to become the British Green Party) adopted their 'Manifesto for a Sustainable Society' in 1975 (The Ecology Party, 1975), and a series of books was published increasingly featuring the language of sustainability. In the interests of brevity, we leave much of the earlier discussion to authors previously mentioned. Instead, we pick up the narrative at the cusp of the 1960s environmental movements, choosing to focus on the strand of 'development' and how its study contributed to the rise of 'sustainable development' during the 1980s. The World Commission on Environment and Development (WCED) (1987) defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." To be relevant, the term "sustainability" should not only relate to conserving, renewing, or repairing something specific (Sutton, 1999), but also to the ethical component of a fair compromise between present economic demands and future environmental requirements. Therefore, the papers in this issue address all of these dimensions, reinforcing the view that "sustainability is becoming a key business imperative as the eternal quest for mastery over nature is replaced by the challenge of achieving ecological balance" (Clarke and Clegg, 2000).

Although environmental standards and their interpretation have been harmonized to remove obstacles to global competitiveness (Brack, 1998; Faucheux & Cheorge, 1998), different nations have followed various paths in the pursuit of environmental leadership due to their governments' specific policies and relationships with business. In Germany, for example, strict regulations have spurred private sector innovation, such as the search for new uses for waste materials previously destined for landfills; in Japan, however, the concept of collaboration between industry and government has resulted in a more integrated process (Russo, 1995). Subsidies to R&D activities in this field are available. Unlike these two countries, the United States has shown strong resistance to policies that interfere with energy industry activities (Moore & Miller, 1999), despite the fact that past American government policies have resulted in significant reductions in sulfur dioxide emissions from the power generation sector (Hill, 1999). Governments, on the other hand, cannot address the world's major environmental issues if the economic environment is unsupportive. Former centrally planned economies' governments were heavily criticized for a lack of political will and a failure to use economic incentives to reduce industrial pollution (Peterson, 1993; Whitefield, 1993).

Governments, on the other hand, are losing control over private companies, particularly large multinational corporations with global reach. Governance institutions have not kept pace with the global economy, resulting in negative consequences for people and the environment, necessitating the development of sustainable standards, harmonization, and regulatory frameworks (Sherbaz Khan, Imran Zaman, et al., 2022). Although there is evidence of some multinational corporations introducing processes that are superior to the demands of some national standards to standardize corporate policies on a global scale, there is more scope for large companies to face up to their responsibilities as creators of demand and consumers of resources and to play a role in collaborative efforts.

Advanced Manufacturing Technology

Advanced manufacturing technology (AMT) has different definitions depending on the context; however, it can be broadly defined as "an automated production system of people, machines, and tools for the planning and control of the manufacturing process, including the procurement of raw materials, parts, and components, as well as the shipment and service of finished products" (Pennings, 1987). AMT is a collection of computer-based technologies that includes CAD,

robotics, group technology, flexible manufacturing systems, automated materials handling systems, computer numerically controlled machine tools, and barcoding or other automated identification techniques (Zairi, 1992; Zammuto & O'Connor, 1992; Sambasivarao & Deshmukh, 1995).

AMTs can provide numerous benefits on various scales. The ability of AMT to offer end-users a combination of flexibility and efficiency is its most distinctive feature. This blend of capabilities challenges the old paradigm of operations management and industrial strategy. Traditional thinking suggests that efficiency can only be achieved by mass-producing standardized items in vast quantities, while customization is inevitably associated with higher costs. AMT adoption can frequently bring advantages to the organization at the organizational level through improvements in areas such as workflows and communication, in addition to these operational benefits, such as efficiency and flexibility (Zairi, 1992).

In the United States, the use of AMT has become widespread among industrial companies. The AMT promise might be described as the manufacturing industry's "Holy Grail": the ability to produce customized goods while maintaining the efficiency of mass production, along with a host of other benefits. However, in the harsh reality of the shop floor, the promise of AMT does not always align with reality, and users of these technologies are often dissatisfied with their implementation. AMT adoption often requires organizational and managerial practices that differ from those found in more traditional settings (Zammuto & O'Connor, 1992).

H1: Advanced manufacturing technology has a significant positive association with sustainability

Supplier responsiveness

Organizations can no longer rely solely on internal expertise; strategic partnerships between buyers and suppliers are becoming increasingly crucial. Suppliers are now viewed as value-added resources, essential for maintaining a competitive position (Cannon & Homburg, 2001). Supplier responsiveness, defined as the ability of suppliers to accommodate changes in demand, whether in volume or mix (Christopher & Peck, 2004; Choi & Hartley, 1996), is critical to organizational success. A lack of responsiveness from suppliers can negatively impact organizational performance (Holweg et al., 2005). Today, supplier management aims to secure the best material and service quality at competitive prices with flexible lead times. Developing

strong, long-term relationships with suppliers is a key strategy for improving operational performance (Abdullah & Hamdan, 2014; Rashed, Azeem & Halim, 2013).

The concept of supplier relationship management involves integrating diverse knowledge, expertise, and competence into the business on a partnership basis to enhance performance capabilities (Kähkönen & Lintukangas, 2011). Strategic partnerships between buyers and suppliers can significantly improve organizational performance, shifting from a competitive to a collaborative approach (Loppacher et al., 2011). Strong cooperation with key supply partners helps organizations manage external changes effectively (Su, 2013). A buyer-supplier partnership is an ongoing relationship aimed at mutual advantages and support in critical areas such as material, technology, equipment, and market strategies (Thatte et al., 2009).

H2: Supplier responsiveness has a significant contribution towards sustainability

Logistic responsiveness

Logistics is typically viewed within a single organization, but it also manages flows between the organization, its suppliers, and customers. Supply chain management encompasses logistics flows, customer demand management, production processes, and the information flows needed to monitor activities at all supply chain nodes (Lummus et al., 2001). Logistics responsiveness is defined as a firm's ability to adjust its outbound transportation, distribution, and warehousing systems to meet changes in customer demand (Thatte et al., 2013). Responsiveness in logistics processes is a crucial element in achieving a responsive supply chain strategy (Khan & Sajjad, 2013). Logistics and delivery management involve transporting goods from suppliers to manufacturers, then to distribution centers, and finally to the end consumer (Lummus et al., 2003). This includes warehousing, packaging, transportation planning and management, inventory management, reverse logistics, and order tracking and delivery (Christopher, 2016). Logistics must be responsive to serve the varying needs of customers (Thomopoulos, 2016).

Responsive logistics involve flexible warehouse capacity, handling a wide range of products, utilizing various transportation carriers, and efficiently packing customized products to enhance supply chain responsiveness and sustainability (Khan, Rashid, et al., 2023). While there is no significant link between supply logistics integration and sustainability, logistics service capability is positively related to sustainability. Therefore, the following research hypothesis can be proposed.

H3: Logistic responsiveness has a significant positive association with sustainability

Resilience

Resilience is defined as the ability to adapt positively or to maintain or restore mental health despite adversity (Wald et al., 2006). As scientific knowledge has expanded, so have the definitions of resilience. Researchers from various fields, including psychology, psychiatry, sociology, and more recently, biological sciences such as genetics, epigenetics, and endocrinology, have studied resilience. However, there is no consensus on a practical definition. The central question is how certain individuals manage to persevere through adversity without suffering detrimental physical or mental health consequences.

A key distinction lies between viewing resilience as an individual trait and seeing it as a dynamic process. Resilience has been defined as a human quality that functions after a single, short-term stressor from a narrow perspective (Bonanno & Loss, 2004; Klohnen, 2006). Early studies on resilience focused on specific traits or assets that helped individuals overcome adversity, such as intellectual functioning. Initial research, which was the subject of groundbreaking studies (Sherbaz Khan et al., 2022), found that the definition of adversity has evolved to include unpleasant experiences statistically linked to adjustment issues or future mental disorders. Examples include poor parenting, poverty, homelessness, traumatic experiences, natural disasters, violence, war, and physical illness.

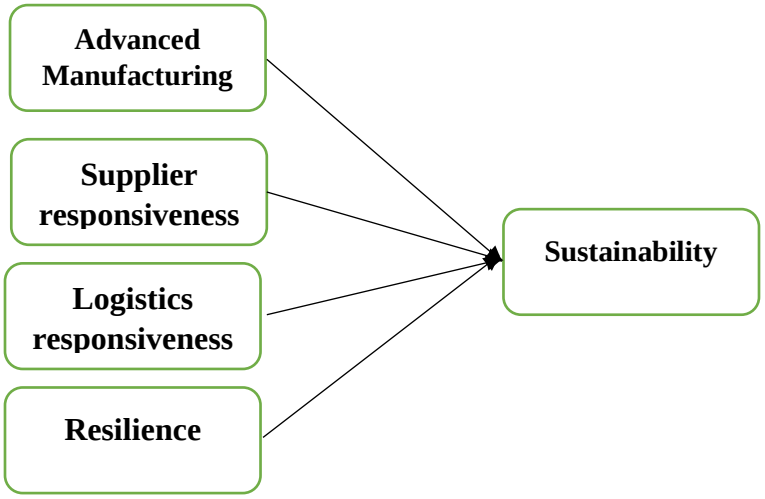
Subsequently, researchers explored how systems (families, services, groups, and communities) could help individuals cope with adversity. Resilience and resilience interventions were redefined as "protective and vulnerability factors at various levels of influence—culture, community, family, and the individual" (Cicchetti, 2010). Other researchers defined resilience as "the protective factors, processes, or mechanisms that lead to positive outcomes despite exposure to stressors that have been shown to increase the likelihood of developing psychopathology" (Hjemdal et al., 2006) or as "an interactive concept relating to relative resistance to environmental hazards or the ability to overcome stress or adversity" (Rutter, 2006) or as "a dynamic process of adaptive recovery in the face of significant adversity," characterized as "a multi-dimensional trait that varies with context, time, age, gender, and cultural origin, as well as within an individual exposed to a variety of life situations" (Connor & Davidson, 2003). These definitions agree on two points: multiple factors and systems contribute to an interactive

dynamic process that develops resilience in the face of adversity, and resilience is context- and time-specific, not universally present across all life domains (Khan, Qabool, et al., 2023). Consequently, there are several sources and pathways to resilience, including biological, psychological, and dispositional traits, as well as social support and other social system characteristics (family, school, peers, and community), all of which interact frequently (Luthar & Cicchetti, 2000; Friborg et al., 2003; Masten, 2001). Despite the lack of consensus on a practical definition of resilience, most definitions use similar domains to demonstrate resilience (Walsh et al., 2010). Therefore, resilience is also linked to sustainability, leading to the hypothesis that is:

H4: Resilience has significant positive association with sustainability

Research Model

Figure 1



Research Methodology

Research Philosophy

In this research project, a positivist (scientific paradigm) or quantitative approach is used. The study uses a deductive strategy to analyze data and an inductive strategy to interpret results. The major data-gathering instrument is a questionnaire survey. The research involves primary data collection from a local brand's practicing EM, including interviews and questionnaires handed out to consumers. The study employs a T-test for statistical analysis and will conclude with discussions, recommendations, and limitations.

Variables of the study

This current research study is based upon the sustainability of apparel manufacturing units which is dependent variable of this study. The sustainability is being affected by the advanced manufacturing technology, supplier responsiveness, logistic responsiveness and resilience. The sustainability of apparel manufacturing units is affected by advanced manufacturing technology, supplier responsiveness, logistic responsiveness and resilience.

Target Population

The target population for the present research study was the private textile and garments sector of Karachi. The motivation to choose the textile sector was because of good reputation and known stakeholders are trustworthy because of their good practice related to internal and external customers. We measured the impact of advanced manufacturing technology, supplier responsiveness, logistic responsiveness and resilience on the sustainability so the textile and garment sector best suit for this kind of research study.

Sample Size, Sampling Technique

The study's sample size consists of 100 customers employed in the textile and garment sectors. Both quantitative and qualitative data were collected to understand customer perceptions comprehensively. Quantitative data, gathered through surveys, focused on customer experiences, preferences, and satisfaction with specific brands, allowing for statistical analysis of behavior and trends. Qualitative data was also collected, exploring deeper insights into customer perceptions of advanced manufacturing technology, supplier responsiveness, logistics responsiveness, resilience, and sustainability. This dual approach provided a holistic view of factors influencing customer perceptions. Nonprobability sampling, specifically convenience sampling, was used to collect responses due to the accessibility of the target population. While this method has limitations in generalizability, it was suitable for the study's exploratory nature. The combined data collection methods offered a thorough examination of how various factors impact customer satisfaction and brand perception in the textile and garment sectors.

Instrument development

We gathered raw facts by structuring a Questionnaire using 5 points which were given as a Likert scale (Strongly disagree 1, Disagree 2, Neutral 3, Agree 4 and Strongly Agree 5). This questionnaire is consistent with the well-thought Questions, with a total of 40 items sliced into 5 parts:

- Part 1 consists of advanced manufacturing technology.
- Part 2 considering the supplier responsiveness.
- Part 3 focused on logistic responsiveness.
- Part 4 focused on resilience.
- Part 5 consists of sustainability.

Data Analysis

Quantitative Data Analysis

The questionnaire for data analysis regarding this study consist of two parts. First part contain question that are close ended, and it is analyzed using SPSS. In the second part, consists of qualitative questions and it will be analyzed using NVIVO in the second part of this chapter. In this section, we will study and analyze in detail about the quantitative questionnaire.

Table 1
Reliability Analysis

Variable	Cronbach's Alpha	No. of Items
Advanced Manufacturing Technology	0.882	14
Supplier Responsiveness	0.805	06
Logistic Responsiveness	0.790	05
Resilience	0.871	11
Sustainability	0.766	04

The reliability analysis of the study variables, as presented in the table, demonstrates strong internal consistency across all measured constructs, as indicated by their respective Cronbach's Alpha values, all of which exceed the acceptable threshold of 0.7. Advanced Manufacturing Technology, measured with a 14-item scale, shows a high reliability with a Cronbach's Alpha of 0.882, suggesting that the items consistently capture the concept. Supplier Responsiveness, assessed with a 6-item scale, has a Cronbach's Alpha of 0.805, indicating good internal consistency. Similarly, Logistics Responsiveness, measured with a 5-item scale, exhibits a reliability coefficient of 0.790, confirming that the items effectively measure the responsiveness of logistics processes. The Resilience scale, comprising 11 items, also demonstrates strong reliability with a Cronbach's Alpha of 0.871, reflecting consistency in measuring resilience

among respondents. Lastly, the Sustainability variable, though measured with a smaller 4-item scale, shows a Cronbach's Alpha of 0.766, which still indicates reliable measurement. These reliability results confirm that all variables are measured consistently, allowing for confident progression to further statistical analyses in the study.

Correlation Analysis

Table 2
Correlation Analysis

Variables	1	2	3	4	5
Advanced Manufacturing Technology	1				
Supplier Responsiveness	.558**	1			
Logistic Responsiveness	.564**	.733**	1		
Resilience	.306**	.392**	.437**	1	
Sustainability	.587**	.564**	.523**	.373**	1

Table 2 illustrates the correlation analysis for the study variables, revealing that all examined variables are significantly positively associated with each other. Advanced Manufacturing Technology (AMT) shows a robust positive correlation with Supplier Responsiveness ($r = 0.558$, $p < 0.01$), indicating that advancements in manufacturing technology are closely linked to improved responsiveness from suppliers. Similarly, AMT is positively correlated with Logistic Responsiveness ($r = 0.564$, $p < 0.01$), suggesting that better manufacturing technology enhances logistical efficiency. The correlation between AMT and Resilience is also positive but weaker ($r = 0.306$, $p < 0.01$), reflecting that while AMT contributes to organizational resilience, the effect is less pronounced compared to other associations. Furthermore, AMT demonstrates a strong positive correlation with Sustainability ($r = 0.587$, $p < 0.01$), highlighting that advancements in manufacturing technology are associated with improved sustainability outcomes.
Supplier Responsiveness is significantly positively correlated with Logistic Responsiveness ($r = 0.733$, $p < 0.01$), indicating a strong relationship between responsive suppliers and efficient logistics. It also shows a positive correlation with Resilience ($r = 0.392$, $p < 0.01$) and Sustainability ($r = 0.564$, $p < 0.01$), suggesting that suppliers who are more responsive contribute positively to organizational resilience and sustainability. Logistic Responsiveness is positively

correlated with both Resilience (r = 0.437, p < 0.01) and Sustainability (r = 0.523, p < 0.01), showing that efficient logistical operations are linked to higher resilience and better sustainability performance. Lastly, Resilience is positively correlated with Sustainability (r = 0.373, p < 0.01), indicating that organizations with greater resilience tend to achieve better sustainability outcomes. Overall, these positive correlations underscore the interconnected nature of AMT, supplier responsiveness, logistic responsiveness, resilience, and sustainability, suggesting that improvements in one area are likely to benefit the others.

Regression Analysis

Table 3
Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.667	0.444	0.421	0.54800

Table 3 shows the model summary of the hypothesized research model. Table shows that R square of the model is .66 which shows that 66% change in sustainability is due to advanced manufacturing technology, supplier responsiveness, logistic responsiveness and resilience.

Table 4
Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.199	0.433		0.460	0.646
Advanced Manufacturing Technology	0.287	0.080	0.250	3.584	0.000
Supplier Responsiveness	0.233	0.065	0.235	3.511	0.029
Logistic Responsiveness	0.184	0.065	0.206	2.820	0.045
Resilience	0.138	0.061	0.158	2.284	0.013

Table 4 shows the regression coefficients of the hypothesized research model. Table shows that t statistics for all the variables is above the standard of 2, this shows the good fit. Table shows that advanced manufacturing technology is significant (p<.01) and positive (B=.287) relation with sustainability. So H1 of the study that advanced manufacturing technology is significant positive associated with sustainability is being supported by the data of this study. Table shows that supplier responsiveness is significant (p<.01) and positive (B=.233) relation with sustainability. So H2 of the study that supplier responsiveness is significant positive relation with sustainability is being supported by the data of this study. Logistic responsiveness is significant (p<.01) and

positive (B=.184) relation with sustainability. So H3 of the study that logistic responsiveness is significant positive associated with sustainability is being supported by the data of this study. Resilience is significant (p<.05) and positive (B=.138) relation with sustainability. So H4 of the study that resilience is significant positive associated with sustainability is being supported by the data of this study.

Hypotheses Summary

Table 5

Hypothesis	Supported/ Not Supported
H1: Advanced manufacturing technology has a significant positive relationship with sustainability.	Supported
H2: Supplier responsiveness has a significant positive relationship with sustainability.	Supported
H3: Logistic responsiveness has a significant positive relationship with sustainability.	Supported
H4: Resilience has a significant positive relationship with sustainability.	Supported

Discussion And Conclusion

This research project is conducted to investigate the impact of advanced manufacturing technology, supplier responsiveness, logistic responsiveness, and resilience on the sustainability of apparel manufacturing units in Pakistan. Sustainability is an important element that is considered to be critical for each organization and industry as well. The success of an organization purely depends upon its sustainable products. Therefore, this specific study is conducted to explore the role of advanced manufacturing technology, supplier responsiveness, logistic responsiveness, and resilience to produce sustainable products. These four are the key factors to produce sustainable products. This research study includes 40 quantitative and 5 qualitative questions. 40 items of the quantitative study were analyzed by using the Statistical Package for social sciences (SPSS) and quantitative questions are analyzed using NVIVO. The results of the current study indicate that advanced manufacturing technology, supplier responsiveness, logistic responsiveness, and resilience are significant positive associated with sustainability.

Discussion

The results of this study indicate that advanced manufacturing technology, supplier responsiveness, logistic responsiveness, and resilience are all significantly and positively associated with sustainability. The analysis shows that these factors account for 66% of the variation in sustainability, highlighting their critical role.

Advanced manufacturing technology, with its use of cutting-edge techniques, reduces waste and enhances the production of sustainable products. Supplier responsiveness also plays a key role, as high responsiveness from suppliers supports the creation of sustainable products. Similarly, responsive logistics contribute to sustainability by ensuring efficient supply chain operations. Resilience within organizations helps maintain flexibility, much like individual resilience, which is crucial for sustaining effective production practices in apparel manufacturing. Overall, these findings underscore the importance of these factors in driving sustainability in the textile and garment sectors.

Theoretical Contribution

This research study has many theoretical contributions as this study explores the role of advanced manufacturing technology, supplier responsiveness, logistic responsiveness, and resilience on sustainability (Khan et al., 2022). Sustainability is the most discussed topic in the world nowadays and most organizations are entirely shifting their trends to produce sustainable products in Pakistan there is little research, but that study provides a comprehensive platform for the researchers, especially for apparel manufacturing units of Pakistan. The study elaborates that advanced manufacturing technology, supplier responsiveness, logistic responsiveness, and resilience are important contributors to the production of sustainable products in Pakistan. In theory that will advance the literature and open a new dimension to disclose other variables like mediators and moderators in the current framework.

Practical Implications

The results of the current study also have important practical implications as the managers and owners of the textile and garments firms can focus on the advanced manufacturing technology, supplier responsiveness, logistic responsiveness, and resilience to produce sustainable products. That will improve their sales and so due to an increase in sales the resources of the organization can be best utilized to gain maximum benefits out of that. Sustainability has become a challenge so all the apparel and textile manufacturing brands must focus on the fact that the demand for

their products in local and international markets depends upon the production of sustainable products. Therefore, the current research tends to explore the factors that will defiantly help organizations to produce sustainable apparel and textile products. The current study explores that textile and apparel manufacturing brands must consider AMT, supplier responsiveness, logistic responsiveness, and resilience because this research study investigated that AMT, supplier responsiveness, logistic responsiveness, and resilience are the important indicators to produce sustainable products. So, this is an important practical implication for the managers of textile and apparel manufacturing units to look into AMT, supplier responsiveness, logistic responsiveness, and resilience in order to produce sustainable apparel and textile products.

Limitation and Future Directions

Like all research, this study has limitations that should be acknowledged so that future researchers can address and mitigate them. The primary limitation of this study is the small sample size, consisting of 100 quantitative respondents and 8 qualitative participants. This limited sample size restricts the ability to generalize the findings to a broader population. Future research should aim to include larger sample sizes to enhance the generalizability of the results. Another limitation is the study's cross-sectional design, where data were collected at a single point in time. This approach does not account for changes over time, which could influence respondents' answers. Future studies should consider using a longitudinal design to examine how responses evolve over different time periods, as situational factors can impact the data. Additionally, the study's focus on a single industry limits its applicability to other sectors. Future research could replicate this model in different industries, such as telecommunications, banking, or education, to see if the findings hold true across various contexts. Finally, the study faced challenges related to the respondents' comprehension of the survey questions. Many participants struggled to understand the questions due to educational limitations, requiring verbal translations. To address this issue, future research should consider translating the questionnaire into Urdu or other relevant languages to ensure all respondents can fully comprehend and accurately answer the questions.

By addressing these limitations, future research can build on the findings of this study and contribute to a more robust understanding of the topic.

References

Al-Abdallah, G. M., Abdallah, A. B., Hamdan, K. B., & Bany Hamdan, K. (2014). The Impact of Supplier Relationship Management on Competitive Performance of Manufacturing Firms. *International Journal of Business and Management*, *9*(2), 192–202.

Bonanno, G. A. (2004). Loss trauma and human resilience: have we underestimated the human capacity to thrive after extremely aversive events? Am Psychol, 50(1), 20–28.

Brack, D. (Ed) (1998), Trade and Environment: Conflict or Compatibility, The Royal Institute of International Affairs, London.

Cannon, J. P., & Homburg, C. (2001). Buyer-Supplier Relationships and Customer Firm Costs. *Journal of Marketing*, 65(1), 29–43.

Carr, A. S., & Smeltzer, L. R. (2000). An Empirical Study of the Relationships among Purchasing Skills and Strategic Purchasing, Financial Performance, and Supplier Responsiveness. *Journal of Supply Chain Management*, 36(2), 40–54.

Choi, T. Y., & Hartley, J. L. (1996). An exploration of supplier selection practices across the supply chain. *Journal of Operations Management*, 14(4), 333–343.

Christopher, M. (2016). Logistics & supply chain management. Pearson Uk.

Christopher, M., & Peck, H. (2004). Building the resilient supply chain.

Cicchetti, D. (2010). Resilience under conditions of extreme stress: a multilevel perspective. World Psychiatry, 9, 145–154.

Clarke, T., & Clegg, S. (2000). Management paradigms for the new millennium. *International Journal of Management Reviews*, 2(1), 45-64.

Common, M., & Stagl, S. (2005). *Ecological economics: an introduction*. Cambridge University Press.

Connor, K. M., Davidson, J. R. T. (2003). Development of a new resilience scale: the Connor-Davidson Resilience Scale (CD-RISC) Depress Anxiety, 18(2), 76-82.

Dailly, H and Cobb J.B. (1994). For the Common Good, 2nd ed, Beacon Boston, M.A.

Dobson, A. (1999). Fairness and futurity: essays on environmental sustainability and social justice.

Dunphy, D. C., & Griffiths, A. (1998). *The sustainable corporation: organizational renewal in Australia*. Allen & Unwin.

Elkington, J. (1997). The triple bottom line. *Environmental management: Readings and cases*, *2*.

Faucheux, S. And Gheroge, A. (1998), "Foreword: International Journal of Sustainable Development, Vol 1 No. 1, pp.1-8

Friborg, O., Hjemdal, O., Rosenvinge, J. H. (2003). A new rating scale for adult resilience: what are the central protective resources behind healthy adjustment? Int J Methods Psychiatr Res., 12, 65–76.

Giddings, B., Hopwood, B., & O'brien, G. (2002). Environment, economy and society: fitting them together into sustainable development. *Sustainable development*, 10(4), 187-196.

Gieryn, T. F. (1999). *Cultural boundaries of science: Credibility on the line*. University of Chicago Press.

Govindan, K., & Soleimani, H. (2017). A review of reverse logistics and closed-loop supply chains: a Journal of Cleaner Production focus. *Journal of Cleaner Production*, 142, 371-384.

Grober, U., & Cunningham, R. (2012). *Sustainability: A cultural history* (p. 156). Cambridge: Green Books.

Hill, M.R. (1999). "Carbon dioxide emissions from the Russian federation – problems and choices", Energy and Environment, 10(1), 51-78.

Hjemdal, O., Friborg, O., Stiles, T. C. (2006). A new scale for adolescent resilience: grasping the central protective resources behind healthy development. Measurement and Evaluation in Counseling and Development, 39, 84-96.

Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual review of ecology and systematics*, 4(1), 1-23.

Holweg, M., Disney, S., Holmström, J., & Småros, J. (2005). Supply chain collaboration: Making sense of the strategy continuum. *European Management Journal*, *23*(2), 170-181.

Kähkönen, A.-K., & Lintukangas, K. (2011). Does power matter? The role of power in supplier relationship management. Journal of Current Issues & Research in Advertising, 29(1), 15-32.

Kates, R. W., Clark, W. C., Corell, R., Hall, J. M., Jaeger, C. C., Lowe, I., & Svedin, U. (2001). Sustainability science. *Science*, 292(5517), 641-642.

Khan, S. A., Liang, Y., & Shahzad, S. (2015). The Effect of Buyer-supplier Partnership and Information Integration on Supply Chain Performance: An Experience from Chinese Manufacturing Industry. *International Journal Supply Chain Management*, 4(2), 20-34.

Klohnen, E. C. (2006) Conceptual analysis and measurement of the construct of ego-resiliency. J Pers Soc Psychol., 70(5), 1067-1079.

Junaid, M., Nazir, S., & Ali, M. (2023). Role of blockchain technology adoption between sustainability related supply chain risks and triple bottom line performance. In *Blockchain driven supply chain management: A multi-dimensional perspective* (pp. 181-199). Springer.

Khan, S., Khan, M., Rais, M., & Aziz, T. (2022). Critical Analysis of The Impact of Employee Motivation on Organizational Productivity. *Reviews of management sciences*, *5*(1), 13-37.

Khan, S., Khan, M. I., Rais, M., & Aziz, T. (2023). Organizational productivity: a critical analysis of the impact of employee motivation. *Reviews of management sciences*, *5*(1), 13-37.

Khan, S., Qabool, S., & Javed, H. (2023). Elevating Consumer Purchase Intentions in Pakistan: The Power of Digital Marketing. *South Asian Journal of Management Sciences*, *17*(2).

Khan, S., Rasheed, R., & Hyder, M. (2022). The Impact of Working Remotely on Employee Job Satisfaction: An SEM-PLS study of people working at universities. *Voyage Journal of Educational Studies*, *2*(2), 84-102.

Khan, S., Rashid, A., Rasheed, R., & Amirah, N. A. (2023). Designing a knowledge-based system (KBS) to study consumer purchase intention: the impact of digital influencers in Pakistan. *Kybernetes*, *52*(5), 1720-1744.

Khan, S., & Sajjad, S. (2013). Factors for Better Selection of Business Universities in Karachi: Perspective of Students. *Journal of Business Strategies*, *7*(1), 55.

Khan, S., Zaman, I., Khan, M. I., & Musleha, Z. (2022). Role of Influencers in Digital Marketing: The moderating impact of follower's interaction. *Gmjacs*, *12*(1), 15-43.

Khan, S., Zaman, S. I., & Mubarik, S. (2023). Obstacles in Disruption and Adoption of Green Supply Chain Management (GSCM) Practices by Manufacturing Industries. In *Advanced Technologies and the Management of Disruptive Supply Chains: The Post-COVID Era* (pp. 153-179). Springer.

Khan, S., Zaman, S. I., Shah, A., & Anwar, A. (2023). A historical comparison of social media influencer's effect on purchase intention of health related products: A longitudinal pre-post Covid 19 study using an Artificial Neural Network (ANN) and Structural Equation Modeling (SEM).

Loppacher, J. S., Cagliano, R., & Spina, G. (2011). Key drivers of buyer-supplier relationships in global sourcing strategies. *International Journal of Procurement Management*, 4(2), 156.

Lummus, R. R., Duclos, L. K., & Vokurka, R. J. (2003). The impact of marketing initiatives on the supply chain. Supply Chain Management: An International Journal, 8(4), 317-323.

Lummus, R. R., Krumwiede, D. W., & Vokurka, R. J. (2001). The relationship of logistics to supply chain management: developing a common industry definition. Industrial management & data systems.

Luthar, S. S. & Cicchetti, D. (2000). The construct of resilience: implications for intervention and social policy. Dev Psychopathol., 12, 857-885.

Masten, A. S. (2001) Ordinary magic. Resilience processes in development. Am Psychol., 56, 227-238.

Moore, C. & Miller, A. (1994). Green Gold: Japan, Germany. The United States and the Race for Environmental Technology, Beacon Press, Boston, MA.

Pearce, D. W., & Atkinson, G. D. (1993). Capital theory and the measurement of sustainable development: an indicator of "weak" sustainability. *Ecological economics*, 8(2), 103-108.

Pennings, J. M. (1987). Technological innovations in manufacturing. In: Pennings, J.M., Buitendam, A. _Eds.., New Technology as Organizational Innovation: The Development and Diffusion of Microelectronics. Ballinger, Cambridge, MA.

Peterson, J. (1993). Observations and modeling of seismic background noise.

Porter, M. E., & Van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of economic perspectives*, 9(4), 97-118.

Rashed, C., Azeem, A, & Halim, Z. (2013). Effect of information and knowledge sharing on supply chain performance: a survey-based approach. *Journal of Operations and suppl chain management*, 3(2), 61-77.

Russo, M. J. (1995). *The female grotesque: Risk, excess, and modernity*. Taylor & Francis.

Rutter, M. (2006). Implications of resilience concepts for scientific understanding. Ann New York Acad Sci., 1094, 1-12.

Sambasivarao, K. V. & Deshmukh, S. G. (1995). Selection and implementation of advanced manufacturing technologies: classification and literature review of issues. International Journal of Operations and Production Management 15 _10, 43-62.

Sarang, J. P., Bhasin, H. V., Verma, R., & Kharat, M. G. (2017). *Critical success factors for supplier development and buyer supplier relationship: Exploratory factor analysis*. *Operations and Service Management: Concepts, Methodologies, Tools, and Applications*.

Schmidheiny, S., & Timberlake, L. (1992). *Changing course: A global business perspective on development and the environment* (Vol. 1). MIT press.

Sinkovics, R. R., Jean, R. J. B., Roath, A. S., & Cavusgil, S. T. (2011). Does IT integration really enhance supplier responsiveness in global supply chains? *Management International Review*, 51(2), 193-212.

Sutton, R. (1999). *The policy process: an overview* (p. 35). London: Overseas Development Institute.

Tatte, A. A., Agrawal, V., & Muhammed, S. (2009). Linking information sharing and supplier network responsiveness with delivery dependability of a firm. Journal of Applied Business Research, 25(3), 37-56.

Thatte, A. A., Rao, S. S., & Ragu-Nathan, T. S. (2013). Impact of SCM practices of a firm on supply chain responsiveness and competitive advantage of a firm. *Journal of Applied Business Research*, 29(2), 499-530

The Ecologist, (1972). A blueprint for survival. Penguin, Harmondsworth.

The Ecology Party, (1975). Manifesto for a sustainable society. The Ecology Party, Leeds

Thomopoulos, N. T. (2016). Just-in-Time. In *Elements of Manufacturing, Distribution and Logistics* (pp. 149-164).

Thompson, P. B. (2017). The spirit of the soil: agriculture and environmental ethics, 2nd edn. Routledge, New York.

Von Carlowitz, H. C. (2013). Sylvicultura oeconomica (1713). In The Future of Nature (pp. 63-66). Yale University Press.

Wald, J., Taylor, S. & Asmundson, G. J. G. (2006). Literature review of concepts: psychological resiliency. Toronto (ON): Defence R&D Canada

Walsh, W. A., Dawson, J. & Mattingly, M. J. (2010). How are we measuring resilience following childhood maltreatment? Is the research adequate and consistent? What is the impact on research, practice and policy? Trauma Violence Abuse, 11, 27-41.

WCED, S. W. S. (1987). World commission on environment and development. *Our common future*, *17*(1), 1-91.

Whitefield, S. (1993). *Industrial power and the Soviet state*. Oxford University Press.

Zairi, M. (1992). Measuring success in AMT implementation using customer–supplier interaction criteria. International Journal of Operations and Production Management 12(10), 34–55.

Zammuto, R. F., O'Connor, E. J. (1992). Gaining advanced manufacturing technologies' benefits: the roles of organization design and culture. Academy of Management Review, 17(4), 701-728.