



RESEARCH PAPER

The Sustainable Performance of Plastic Organizations: The Role of CSR, TQM and Digitalization

¹Rana Umer Farooq*, ²Dr. Bilal Majid and ³Dr. Nadia Nasir

1. Ph.D. Scholar, Department of Business Administration, Superior University, Lahore, Punjab, Pakistan
2. Assistant Professor, Department of Business Administration, Superior University, Lahore, Punjab, Pakistan
3. Ph.D. Program Leader, Superior University, Lahore, Punjab, Pakistan

***Corresponding Author:** ranaumerf@gmail.com

ABSTRACT

This study contributes to economic profit, environmental care and social equality of any organization. This research addresses the key contributors to attain that sustainable performance. The global plastics industry is an essential element of industrialisation in contemporary economies but its adverse impact is a challenge in developing countries like Pakistan. By quantitative cross-sectional approach, responses were obtained from 225 participants (senior managers and sustainability officers), all working in the plastic industry of Pakistan. The findings show that CSR and TQM practices contribute to sustainable performance, improvement of economic, environmental, and social aspects. While, digitalisation magnifies the benefits of CSR and TQM. This paper fills a gap in the part of regional literature and is actionable and is intended to guide plastic industries in Pakistan to convert towards sustainable ways through digital transformation and by the adoption of these sustainable practices, organizations can get competitive advantage.

KEYWORDS Corporate Social Responsibility (CSR), Total Quality Management (TQM), Sustainable Performance, Digitalization, Sustainable Development Goals (SDGs)

Introduction

The plastic industry worldwide is an important sector for economic development in several fields including packaging, automotive, building and health. Annual estimation of > \$580 billion worth of industry, emphasizes the industry as a crucial part of the global supply chains (Statista, 2023). On the other hand, the environmental issues due to plastic production and waste have attracted the attention of the world to waste management; the production and waste of plastics exceed 300 million t annually of which recycling accounts for only 9 % (UNEP, 2022). The residual waste, approximately categorized as singles used plastics and other non-bio degradable materials, imposes severe threats to ecosystems, human health, and climate stability (Jambeck et al., 2015).

The plastic industry in Pakistan provides jobs to more than 200,000 workers and annually contributes PKR 50 billion to the national economy; it is a key sector for the manufacturing of industrial consumer goods (Pakistan Plastic Manufacturers Association [PPMA], 2021). But, the burden on the environment by this sector is scary. The country produces about A 3.9 million tons of plastic waste annually and 65 % of it is managed either in an unoptimally managed landfill and open dumpsites and contributing to environmental pollution and unhealthy environment (World Bank, 2022).

Cities including Karachi, Lahore, and Islamabad are the primary contributors of plastic waste, hence in these cities efficient solid waste management systems are required (Ali et al., 2021).

The idea of performance sustainability has been introduced as the major objective of any organization throughout the world. Based on TBL concept framework (Elkington, 1997), sustainable performance underlines the incorporation of economic, environmental and social goals. For plastic organizations, this means increasing their energy efficiency, decreasing their carbon footprint, engaging with local communities, and making profit. At the international level, the regulations such as the EU Circular Economy Action Plan (European Commission, 2020) and the Extended Producer Responsibility (EPR) programs from the European Union forced industries to involve in sustainable manufacturing. But in developing economies like Pakistan, the strides to move in that direction have been enabling considerably sluggish, due to paucity of financial resources, technological lacunae and policy ambiguities (Iqbal et al., 2021).

Pakistan's plastic industry faces multifaceted challenges in its quest for sustainability:

Poor Waste Management: Shoddy waste segregation and recycling systems contribute to the problem of plastic pollution. System inefficiencies are also highlighted in the proceeding Pakistan National Plastic Action Plan (2022) as a major stumbling block preventing the recycling rate from increasing (Ali et al., 2021).

Lack of Technology: Digital innovations such as IoT and blockchain that are being increasingly used worldwide to enhance resource efficiency and transparency still have few applications in Pakistan (Zhou et al., 2021).

Immature Policy: Efforts like the Plastic Bag Ban (2019) have failed to curb plastic use due to weak governance (Khan et al., 2020).

Stakeholder Awareness: Lack of adequate social and environmental awareness of organizations and consumers to plastic waste (Ahmed & Ullah, 2021).

Internationally, models such as CSR and TQM have been successful in responding to sustainability issues. CSR values ethical business conduct, environmental management and stakeholder involvement (Carroll, 1991), and TQM on continual improvement in processes and product resource effectiveness and stakeholder satisfaction (Oakland, 2014) and of course economic viability (Mohsin et al, 2024). But the promise of 'digitalization' (which we take as the convergence of disruptive technologies such as IoT, AI, and blockchain to better atomic industrial frameworks) to improve said frameworks has yet to fully manifest in Pakistan's manufacturing sector. Digitalized cities allow for real-time surveillance and even predictive analyses, or can provide an increase in sustainability through supply chain 'transparency' (Müller et al., 2018).

Literature Review

Sustainable Performance in Plastic Organizations

Sustainable performance is defined as the accomplishment of economic, environmental and social objectives on the entity's operations (WCED, 1987). This includes things such as how to reduce waste, how to become more-green when it comes

to manufacturing, how to increase profits and how to make a greater impact in the world when it comes to society. The Triple Bottom Line (TBL) (Elkington, 1997), guidelines for assessing sustainability is guided by the evaluation of the three Ps of sustainability, which are people (social), planet (environmental) and profit (economics).

Germany and Japan, for instance, are ushering in circular economy practices to facilitate better sustainability for their plastic industry. For example, the European Union governments Circular Economy Action Plan (European Commission, 2020), requires a reduction in virgin plastic use, based on recycling and product design improvements. Also, policies such as the Extended Producer Responsibility (EPR) necessitate that companies are responsible for the disposal of plastic products at end-of-life (Zhou et al., 2021).

The plastic sector of Pakistan has fallen behind in the sustainability race owing to certain systemic inefficiencies like lack of efficient waste management system and low usage of advanced recyclability tools (Khan et al., 2020). A study conducted by The World Bank (2022) reveals that 87% of plastic waste in Pakistan is mismanaged, thus becoming a major potential source to make the land and sea impassable. In addition, the public awareness and regulatory enforcement is weak, which becomes a barrier to practice sustainably (Ali et al., 2021).

Ahmed and Ullah (2021) also show that combining sustainability targets with business strategy enhances organizational performance of Pakistan packaging industry. But challenges such as high running costs and lack of technology skills remain and need to be addressed.

Corporate Social Responsibility (CSR)

CSR is the way a company manages its business processes to encourage economic, social and environmental impact in a constructive manner (Carroll, 1991). Carroll's CSR Pyramid categorizes those duties under four headings – economic, legal, ethical and philanthropic. The Stakeholder Theory (Freeman, 1984) underlines the significance of multidimensional stakeholders such as customers, employees, regulators and community.

On an international scale, other corporations like Unilever have implemented aggressive CSR programs. Unilever's Less Plastic Initiative targets virgin plastic consumption and aims to use more post-consumer recycled materials in packaging. Coca-Cola's World Without Waste initiative also focuses on recycling and community involvement to manage plastic pollution (Zhang et al., 2022).

CSR in Pakistan is still in its infancy with a charity-based nature like donations and community projects. But some of the environmental CSR such as waste reduction and green manufacturing is starting to take hold. Cases in point include; Packages Limited (packages.com.pk) who innovated with sustainable packaging solutions which reduced single-use plastic in its product lines (Ahmed & Ullah, 2021). Engro Polymer & Chemicals which already runs education campaigns on plastic waste management, primarily focused on communities and schools. Lucky Cement who practice CSR initiatives for environmental protection and community welfare remains supplementary (Ali et al., 2021).

Iqbal et al. (2021) observed that the adoption of CSR in Pakistan's manufacturing industry was positively associated with the firm's success on worker retention and brand credibility. But the lack of resources and stakeholder awareness continue to be significant barriers to wider implementation.

Total Quality Management (TQM)

TQM is an integrated way of managing an organization that emphasizes on the quality, continuous improvement, customer satisfaction and involvement of employees (Oakland, 2014). Its practices reconcile eco sustainability, focusing on waste decrease, optimization of resources, and enhancement of quality.

TQM procedures like process optimization, leadership commitment, and stakeholder involvement enhance the environmental performance by reducing waste and enhancing energy conservation. For instance, Toyota's Lean production system which is an extension of TQM, has considerably minimized material wastages and energy consumptions (Tummala & Tang, 2020).

In Pakistan, there is a methods to move towards TQM implementation through the certification standards of ISO 9001 and ISO 14001. Such certifications enable companies to meet the requirements of world-class quality and environmental management systems. Examples include:

FMCG Companies: The leading companies such as Unilever Pakistan are using TQM to maintain the quality of the product and sustainability. SMEs in the Plastic Vertical: Though small in number, a few SMEs implement TQM to enhance performance (Ali et al., 2021).

Khan et al. (2020) emphasized that firms in Pakistan that combine TQM with sustainability practices perform better, especially in the reduction of production costs and improvement of customer satisfaction.

Digitalization as a Moderator

Digitalization is about introducing digital technologies such as IoT, AI and Blockchain to business operations for increased efficiency and innovative capabilities. In the sustainability context, digital means real-time monitoring, predictive analytics and transparent reporting are possible (Müller et al., 2018). For example, IoT devices can monitor the usage of energy, while blockchain enables transparency in logistic management.

Nations like China and Germany are front-line users of Industry 4.0 across all industries (including polymer) to enhance resource efficiency within the plastics sector. For instance, China's Made in China 2025 plan emphasizes digital transformation as a priority for upgrading manufacturing competitiveness and sustainability (Zhou et al., 2021).

Digital Pakistan Vision (2020) issued by Pakistan, is a policy initiative which aims to integrate technology in the Pakistani industries. However, it appears that there are quite low adoption levels of such new technology in the manufacturing sector mainly because of the lack of mind-set changes and technical know-how's (Ali et al., 2021). Nonetheless, there is a high potential for digital tools to enhance the sustainability benefits of CSR and TQM, as they:

Transparency: The recycling process and systems are traceable on a blockchain.

Efficiency: In real time, IoT is able to keep track of energy consumption and wasted reduction.

Innovation: AI-led analytics for production process optimization.

Ahmed and Ullah (2021) indicate that investment in digital technologies increases the effectiveness of CSR programmes in Pakistan by increasing the accuracy of data and engagement of stakeholders. Similarly, Iqbal et al. (2021) has shown that the use of technology mitigates the impact linkage amongst TQM and sustainability, especially, in energy consuming sectors.

Despite growing literature on CSR, TQM, and digitalization, significant gaps exist:

- **Limited Regional Focus:** Most studies focus on developed economies, with limited insights into the challenges faced by developing countries like Pakistan.
- **Moderating Role of Digitalization:** While digitalization is recognized as a key enabler of sustainability, its moderating effects on CSR and TQM in the plastic industry remain underexplored, particularly in Pakistan.
- **Sector-Specific Analysis:** Existing research often generalizes findings across industries, neglecting the unique dynamics of the plastic manufacturing sector.

Impact of CSR on Sustainable Performance

The literature indicates that CSR practices have their significant roles on SD in these broad ecological, social, and economic contexts of a company (Carroll, 1991; Ahmed & Ullah, 2021). Some studies have proved that CSR activities like recycling programs, community involvement, and transparency in sustainability reporting improve the reputation of the organization, stakeholder trust, and long-term profitability (Iqbal et al., 2021). In the plastic sector, CSR focuses on areas such as waste management and environmental pollution, aligning with sustainability: the mission of the business is intrinsic to it.

H1: CSR practices have a significant positive effect on the sustainable performance of plastic organizations.

Impact of TQM on Sustainable Performance

TQM principles bias towards improvement, customer satisfaction and optimization at its core which is in line with sustainability goals (Oakland, 2014). Through elimination of waste, enhancing resource efficiency, and involving personnel, TQM adds value and improves environmental and economic performance. In Pakistan, TQM encompassing standards like ISOs 14001 have been associated with enhanced operational efficiency and minimized production costs, particularly in the manufacturing industry (Khan et al, 2020). For plastic companies, the results of TQM implementation are increase in good practices of production, reduce in material waste, improve in product quality and brings long- term results.

H2: TQM practices have a significant positive effect on the sustainable performance of plastic organizations.

Moderating Role of Digitalization in the CSR–Sustainable Performance Relationship

Digitalization has been recognized as a disruptive enabler which increases the effectiveness of CSR activities (Müller et al., 2018; Zhou et al., 2021). Ambient As the Impact of the Internet of Things (IoT) continues to ripple through both industry and society, we see opportunities to use IoT and blockchain to increase transparency in recycling activities, monitor sustainability metrics in real-time, and engage stakeholders. Ahmed and Ullah (2021) showed in case of Pakistan that the use of digital tools strengthen the effect of CSR activities in terms of data authenticity and communication with stakeholders. As a result, digitalization is also expected to reinforce the causal links between CSR and sustainable performance, reining in operational waste while also tightening the accountability net.

H3: Digitalization positively moderates the relationship between CSR practices and sustainable performance, such that the relationship is stronger when digitalization is high.

Moderating Role of Digitalization in the TQM–Sustainable Performance Relationship

Digital technologies including IoT-based sensors and AI-based analytics, on the other hand, can contribute to the efficiency of TQM through predictive maintenance, real-time process optimization, and resource monitoring (Müller et al., 2018). With reference to Pakistan's plastic industry, low penetration of digital technologies has limited the complete realization of the potential of TQM benefits (Ali et al., 2021). But companies that combine digital technologies with TQM methods should not only see their benefits magnified in terms of the sustainability performance (such as energy efficiency and waste reduction).

H4: Digitalization positively moderates the relationship between TQM practices and sustainable performance, such that the relationship is stronger when digitalization is high.

Theoretical Framework

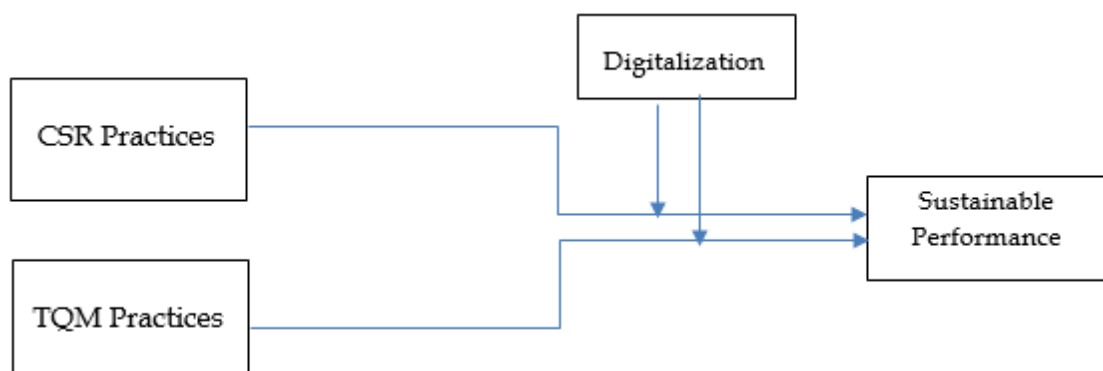


Figure 1 Theoretical Framework

Material and Methods

Research Design

The nature of the study This research takes on a quantitative approach to research and uses the cross-sectional survey method. The quantitative approach was selected in order to measure and investigate the relationships among CSR, TQM, digitalization and sustainable performance based on structured data. The cross-sectional nature allows us to capture the data at an instant, providing an anecdotal perspective of the factors of sustainability in Pakistan plastic industry.

The research follows the positivist paradigm with focus on objectivity and statistical verification. The theoretical model has embedded Stakeholder Theory, Resource-based View (RBV) and the Triple Bottom Line (TBL) framework that makes it empirically testable to see the relationship.

Population and Sampling

Target Population

The target population is senior managers, sustainability officers and quality assurance experts in medium and large plastic manufacturing companies in Pakistan. These are the persons responsible for the practice of CSR, TQM and digitalization and are, thus, the ideal candidates to shed light on the variables examined in this study.

Sampling Method

The research is based on a stratified random sample that is guaranteed to be plenary on organization size (medium and large) and production type (consumer plastics, packaging and industrial plastics). This approach minimizes selection bias and improves the external validity of the results.

Sample Size

A sample of 300 questionnaires were disseminated via organizations registered under Pakistan Plastics Manufacturers Association (PPMA) and other kindred associations. Of 394 IFS users (75% response rate), 225 completed the survey and were included in the analysis. According to Hair et al. (2010), an n of 200 to 300 is considered adequate for structural equation modeling (SEM) represented in robust statistical power.

Data Collection Tools

A pre-tested structured questionnaire was employed to gather information by including validated scales that were adopted from the previous studies. Sections of the questionnaire The questionnaire consisted of 5 sections:

Respondent Demographics: Items about company size, production type, revenue size and the role of the respondent and number of years in the role.

Sustainable actions: Based on Carrol (1991), this includes economic, legal, ethical and philanthropic CSR motives. Example items:

"Our group is involved in recycling programs that help clean up the environment."

"We work with communities to bring an awareness to the environment."

TQM Practices: In the spirit of the Malcolm Baldrige criteria...it's about leadership commitment, process management, being customer driven and constantly improving. Example items:

"We aim to work in a manner of continuous improvement, this is at the heart of our operations."

"Resource usage is controlled and managed continuously by our organization."

Digitalization: Based on a digital maturity index gauging acceptance of technologies like IoT, blockchain and AI. Example items:

"IOT devices are deployed to measure the energy consumption on-line."

"Blockchain technology strengthens the transparency of our recycling processes."

Sustainable Performance: They were operationalized based on the Triple Bottom Line (TBL) framework that focuses on the economic, environmental, and social aspects. Example items:

"We have cut carbon emissions quite sharply over 3 year."

"Our work in sustainability has improved the way we engage with our community."

Pretesting and Validation

Pretesting: A pilot study was conducted with 30 participants from the target population to assess the clarity and relevance of the questionnaire items. Feedback from the pilot study was used to refine the instrument.

Reliability: Internal consistency was tested using Cronbach's alpha, with a threshold of 0.70 indicating acceptable reliability. All constructs exceeded this threshold, with an average Cronbach's alpha score of 0.88.

Content Validity: Ensured through expert reviews from academics and industry professionals.

Construct Validity: Assessed using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).

Data Analysis Techniques

Summary statistics: Summary statistics were used to describe demographic details and information on the main variables.

Exploring Construct Validity Exploratory Factor Analysis (EFA): To determine the structure of the constructs, and to make sure that measurement items are being categorized appropriately.

CFA for Validity of the Measurement Models: Kept the measurement models were tested for their validity by AMOS 24.

Model testing Structural equation modeling (SEM): SEM was employed to test the proverbial relations among CSR, TQM, digitalization, and sustainable performance. SEM is especially well suited for the examination of complex models involving various constructs and mediating or moderating effects.

Moderated Regression Analysis (MRA): We used MRA to test the moderating effect of digitalization on the impact of CSR on sustainable performance, TQM on sustainable performance.

Software: SPSS 25 was used for descriptive statistics and reliability test and AMOS 24 was applied for CFA, SEM and MRA.

Results and Discussions

This section presents the results and analysis of the data collected from 225 respondents in Pakistan's plastic manufacturing industry. The findings are organized to address the research objectives and hypotheses, focusing on the relationships between CSR, TQM, digitalization, and sustainable performance

Demographic Profile of Respondents

The demographic analysis provides insights into the characteristics of the sampled organizations and respondents.

Organizational Characteristics

Organization Size:

- Large Enterprises: 42%
- Medium Enterprises: 36%
- Small Enterprises: 22%

Regional Distribution:

- Punjab: 48%
- Sindh: 34%
- Khyber Pakhtunkhwa: 18%

Type of Production:

- Consumer Plastics: 56%
- Packaging Materials: 30%
- Industrial Plastics: 14%

Respondent Characteristics:

Designation:

- Senior Managers: 46%
- Sustainability Officers: 32%
- Quality Assurance Professionals: 22%

Experience:

- 5-10 Years: 40%

- 10–15 Years: 35%
- Over 15 Years: 25%

Table 1
Descriptive Statistics

Variable	Mean	St. Deviation	Interpretation
CSR Practices	3.85	0.68	Moderate adoption of CSR initiatives
TQM Practices	4.12	0.74	High focus on quality and process optimization
Digitalization	3.35	0.79	Low-to-moderate adoption of technologies
Sustainable Performance	3.92	0.65	Strong economic performance; moderate environmental and social performance

Reliability and Validity Tests

Table 2
Reliability Analysis:

Construct	Cronbach's Alpha
CSR Practices	0.87
TQM Practices	0.91
Digitalization	0.88
Sustainable Performance	0.86

Exploratory Factor Analysis (EFA): All factor loadings were above 0.60, indicating strong item correlations with their respective constructs.

Confirmatory Factor Analysis (CFA): Fit indices demonstrated acceptable model fit:

- $\chi^2/df = 2.01$ (acceptable threshold < 3)
- CFI = 0.94 (threshold > 0.90)
- RMSEA = 0.05 (threshold < 0.08)

Hypothesis Testing (Structural Equation Modeling)

H1: CSR Practices → Sustainable Performance

CSR practices had a significant positive impact on sustainable performance ($\beta = 0.51$, $p < 0.01$). This indicates that organizations adopting CSR initiatives, such as recycling programs and community engagement, experience improved economic, environmental, and social outcomes.

H2: TQM Practices → Sustainable Performance

TQM practices were strongly associated with sustainable performance ($\beta = 0.57$, $p < 0.01$). Continuous improvement, process optimization, and leadership commitment contributed significantly to economic efficiency and environmental sustainability.

H3: Digitalization Moderates the CSR–Sustainable Performance Relationship

Digitalization positively moderated the relationship between CSR and sustainable performance ($\beta = 0.32$, $p < 0.05$). Organizations that utilized technologies like blockchain and IoT to enhance CSR efforts (e.g., recycling transparency) reported higher sustainability outcomes compared to those with lower digital adoption.

H4: Digitalization Moderates the TQM–Sustainable Performance Relationship

The interaction between digitalization and TQM practices was significant ($\beta = 0.38$, $p < 0.01$). Digital tools, such as IoT-enabled monitoring systems, amplified the effects of TQM on resource efficiency, product quality, and waste reduction.

Moderation Analysis (Graphical Representation)

CSR × Digitalization → Sustainable Performance

The moderation analysis revealed that organizations with high levels of digitalization experienced a steeper positive slope in the CSR–sustainable performance relationship compared to those with low digitalization.

TQM × Digitalization → Sustainable Performance

Similarly, the relationship between TQM and sustainable performance was significantly stronger for organizations with advanced digital tools, demonstrating the synergistic effect of combining TQM practices with digital transformation.

Key Findings

- **CSR Practices:** Organizations with robust CSR initiatives (e.g., recycling programs, community outreach) achieve superior environmental and social performance.
- **TQM Practices:** Continuous improvement and quality management enhance operational efficiency, waste reduction, and sustainability.
- **Digitalization as a Moderator:** Technologies such as IoT, AI, and blockchain amplify the effectiveness of CSR and TQM, particularly in resource optimization and stakeholder engagement.

CSR Practices and Sustainable Performance (H1)

The importance of environmental and community-based endeavours in underpinning sustainability results was further emphasized as much with respect to CSR practices significantly improving sustainable performance ($\beta = 0.51$, $p < 0.01$) (Bansal 2005). This finds support in Carroll's Pyramid of CSR (1991) that contends that a firm ought to meet its economic, legal, ethical, and philanthropic obligations.

In the case of Pakistan, CSR is still basically philanthropic, with less orientation towards environmental sustainability. Several companies, such as Packages Limited and Engro Polymer & Chemicals, have launched projects to deal with the problem of plastic waste management and minimize their environmental impact (Ahmed & Ullah, 2021). But these efforts have yet to coalesce into a fully coordinated national effort.

Barriers to CSR Adoption in Pakistan:

- **Poor Recognition at the Stakeholders' Level:** Study of Khan et al. (2020) point out that the lack of public awareness regarding the necessity of CSR hampers its adoption by companies.

- **Regulatory Issues:** Lax enforcement of sustainability facing regulations like the Plastic Bag Ban (2019) impedes general up taking of CSR (World Bank, 2022).
- **Financial Constraints:** Some organizations, especially smaller businesses operating in Pakistan plastic industry, cannot afford to spend on philanthropic activities (Ali et al., 2021).

Opportunities for Improvement:

- Organizations that invest in CSR can leverage community support, improve their reputation, and align with global sustainability standards. Incentives from government bodies, such as tax breaks for green initiatives, could further encourage adoption.

TQM Practices and Sustainable Performance (H2)

TQM practices also exhibited a strong positive impact on sustainable performance ($\beta = 0.57$, $p < 0.01$). This finding aligns with studies emphasizing TQM's role in enhancing process efficiency, reducing waste, and achieving operational excellence (Oakland, 2014).

TQM in Pakistan's Plastic Sector

The adoption of TQM practices in Pakistan is growing, particularly among large enterprises. For example, many companies are now aligning their operations with international quality standards such as ISO 9001 and ISO 14001, which promote environmental management and resource efficiency (Khan et al., 2020).

However, the implementation of TQM in SMEs remains limited due to:

Cost Constraints: High initial investment in TQM systems deters smaller firms.

Knowledge Gaps: Many organizations lack the expertise required to integrate TQM with sustainability initiatives.

Recommendations: Policymakers and industry associations like the Pakistan Plastic Manufacturers Association (PPMA) should provide training and subsidized certifications to support SMEs in adopting TQM frameworks.

Moderating Role of Digitalization (H3 and H4)

The moderating role of digitalization was confirmed, with digital tools amplifying the effects of both CSR and TQM on sustainable performance. This aligns with global studies emphasizing the transformative potential of Industry 4.0 technologies in fostering sustainability (Zhou et al., 2021).

Digitalization in Pakistan

The adoption of digital technologies in Pakistan's plastic industry remains low, with most firms at the initial stages of digital transformation (Ali et al., 2021). Despite the challenges, early adopters such as Packages Limited have reported significant benefits, including improved energy efficiency and enhanced transparency in recycling processes (Ahmed & Ullah, 2021).

Key Barriers to Digitalization

Infrastructure Gaps: Limited access to advanced technologies, especially in rural areas.

Financial Challenges: High costs of digital tools deter widespread adoption among SMEs.

Technical Expertise: A shortage of skilled workers capable of implementing and managing digital systems.

Opportunities for Digital Transformation

IoT and AI: IoT-enabled sensors can track energy and material usage, while AI-driven analytics optimize production processes.

Blockchain: Enhances transparency in recycling systems by tracing material flow across supply chains.

Government Initiatives: The Digital Pakistan Vision (2020) provides a roadmap for enhancing technological integration in the industrial sector.

Theoretical Contribution:

This study contributes to the existing body of knowledge in the following ways:

Validation of Established Theories

- The results support the TBL hypothesis for a developing economy that economic, environmental, and social targets can be achieved in parallel through an effective CSR and TQM.
- It contributes to the Resource-Based View (RBV) by emphasizing digitalization as an important firm resource for the achievement of sustainability.

Integration of Frameworks

- Such integration of CSR and TQM and digitalization within one framework brings an integrated view on sustainable performance, thereby overcoming limitations of earlier studies.

Focus on Emerging Markets

- While examining life cycle of the industry in Pakistan, this study not only points out the specific challenges and opportunities of the plastic organizations in operationalizing their sustainability endeavors; rather, by concentrating on Pakistan, this study would supplement to the scarce literature concerning sustainability practices in the developing countries.

Practical Implications

For Policymakers

- **Rewards for Green Tech:** Governments need to reward companies that are buying digital tools and investing in sustainable actions with subsidies and tax credits.
- **Tightening of Policies:** Better implementation of sustainability-related policies, like the Plastic Bag Ban, can encourage overall compliance throughout the entire industry.

For Industry Leaders

- **Embrace Digital:** Companies will need to invest in technologies such as IoT and AI, to optimise sustainability programs and make them more transparent.
- **Associate with Communities:** NGOs and government and local authorities can add wings to the wings of the CSR initiatives of corporations which can also build trust and community-bonding here.

For Researchers

- **Specific technology Studies:** Research in the future should investigate the differential impact of IoT, blockchain and AI on various dimensions of sustainable performance.
- **Comparative Studies:** Comparative studies across the countries help to know the best practices and areas of improvement by the PPC industry of Pakistan.

Conclusion

Based on this research, the paper verifies that CSR and TQM exert a positive impact on plastic firms' sustainable performance in Pakistan when digitalization is a critical facilitating capability. These results demonstrate the significance of a multifaceted approach to sustainability, including social responsibility, quality management, and digital transformation. These models serve as a way forward to close this gap in Pakistan judiciously, particularly when environmental condition of this country is not too impressive with overstressed plastic, low recycling rate and less transforming towards digital. Policymakers need to enhance the enforcement toolset, give bonuses to green technologies, and support programs for digital transformation. At the same time, industry leaders need to prioritize process optimization and community engagement to meet international sustainability norms. This study makes a valuable contribution by filling a gap in regional literature and offering actionable recommendations to inform the rising conversation on sustainability in developing economies. Further areas of research focus should include other sectors and consider the long-term impacts of digital transformation on sustainability goals.

Recommendations

- **Panel Data Analysis:** Investigate the impact of digitalization on the long-run survival of plastic firms.
- **Extensive Case Studies:** Rich case analysis on successful firms in Pakistan would be useful for practice in other industries.
- **Technology-focused examination:** Evaluate the distinct contributions that various digital technologies make to sustainability.

References

- Ahmed, Z., & Ullah, S. (2021). Green packaging initiatives in Pakistan. *Sustainability in Developing Economies*, 12(4), 134-152.
- Ali, S., Zaman, K., & Razi, M. (2021). Barriers to sustainability in Pakistan's manufacturing sector. *Journal of Cleaner Production*, 278, 123557.
- Bhatti, M. U., & Awan, H. M. (2021). Sustainability practices in Pakistan's manufacturing industry: Challenges and opportunities. *Pakistan Journal of Engineering and Applied Sciences*, 18(3), 75-83.
- Blowfield, M., & Murray, A. (2008). *Corporate Responsibility: A Critical Introduction*. Oxford University Press.
- Carroll, A. B. (1991). The pyramid of corporate social responsibility. *Business Horizons*, 34(4), 39-48.
- Carroll, A. B., & Shabana, K. M. (2010). The business case for corporate social responsibility: A review of concepts, research, and practice. *International Journal of Management Reviews*, 12(1), 85-105.
- Elkington, J. (1997). *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*. Capstone Publishing.
- Ellen MacArthur Foundation. (2019). *Completing the picture: How the circular economy tackles plastic waste*. Ellen MacArthur Foundation Reports.
- European Commission. (2020). *Circular economy action plan: For a cleaner and more competitive Europe*. European Commission Publications.
- Flynn, B. B., Schroeder, R. G., & Sakakibara, S. (1994). A framework for quality management research and an associated measurement instrument. *Journal of Operations Management*, 11(4), 339-366.
- Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances*, 3(7), e1700782.
- Government of Pakistan. (2022). *National Plastic Action Plan*. Ministry of Climate Change.
- Iansiti, M., & Lakhani, K. R. (2020). Competing in the age of AI. *Harvard Business Review*, 98(1), 60-67.
- Iqbal, J., Ahmad, A., & Shah, S. Z. (2021). The role of CSR in sustainable industrial growth: Evidence from Pakistan. *Journal of Cleaner Production*, 278, 123557.
- Lindgreen, A., & Swaen, V. (2010). Corporate social responsibility. *International Journal of Management Reviews*, 12(1), 1-7.
- Mohsin, M., Shamsudin, M.N., Jaffri, N.R., Idrees, M. & Jamil, K. (2024). Unveiling the contextual effects of total quality management to enhance sustainable performance. *The TQM Journal*, <https://doi.org/10.1108/TQM-05-2023-0124>.

- Oakland, J. S. (2014). *Total Quality Management and Operational Excellence: Text with Cases (4th ed.)*. Routledge.
- Pakistan Plastic Manufacturers Association (PPMA). (2021). *Annual Report*.
- Porter, M. E., & Kramer, M. R. (2011). Creating shared value. *Harvard Business Review*, 89(1-2), 62–77.
- Rajput, S., & Singh, S. P. (2021). Connecting circular economy and Industry 4.0. *Journal of Cleaner Production*, 296, 126248.
- Saeed, R., Gull, A., & Lodhi, R. (2020). CSR and sustainable development in Pakistan: A review of corporate practices. *Pakistan Business Review*, 22(1), 15–30.
- UNEP. (2022). *Turning off the Tap: How the World Can End Plastic Pollution*. United Nations Environment Program.
- World Bank. (2022). *Managing plastic waste in South Asia*. World Bank Policy Brief.
- World Economic Forum. (2021). The future of plastic: A circular economy approach. *World Economic Forum Reports*.
- Xu, L. D., Xu, E. L., & Li, L. (2018). Industry 4.0: State of the art and future trends. *International Journal of Production Research*, 56(8), 2941–2962.
- Zafar, A., & Siddiqui, R. (2020). Transitioning to a green economy: Evidence from Pakistan. *Renewable and Sustainable Energy Reviews*, 132, 110034.
- Zairi, M. (2012). Total quality management for sustainable development: Process management perspective. *The TQM Journal*, 24(1), 67–80.
- Zhou, K., Fu, C., & Yang, S. (2021). Industry 4.0 implications for sustainability. *Computers in Industry*, 101, 48–64.