Aligning Quality Management and Sustainability: A Cross-Industry Analysis of Case Studies for Achieving UNSDGs

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Abstract

Purpose: This study investigates the alignment of Quality Management (QM) practices with sustainability dimensions to achieve the United Nations Sustainable Development Goals (UNSDGs) in Indian industries. The study investigates how these industries utilise QM tools to advance sustainability, mainly focusing on environmental, social, governance, economic, and operational sustainability.

Methodology: A multiple-case study approach was employed, analysing 41 case studies submitted to the International Academy for Quality (IAQ) for the Quality Sustainability Award. The data were collected from various Indian industries and analysed through within-case and cross-case comparisons, focusing on applying QM practices and their alignment with sustainability dimensions. The research methodology utilised both qualitative and quantitative analysis techniques.

Findings: The findings reveal that industries predominantly use Six Sigma, Lean tools, PDCA, and Root Cause Analysis (RCA) to address operational and environmental challenges. The most frequently addressed UNSDGs include Goal 12 (Responsible Consumption and Production), Goal 9 (Industry Innovation and Infrastructure), and Goal 13 (Climate Action). Significant improvements were observed in defect reduction, energy efficiency, and cost management. However, the study also highlights gaps in addressing social sustainability, particularly in areas like diversity and inclusion.

Practical Implications: This research provides practitioners with insights on aligning QM tools with sustainability initiatives to ensure operational excellence while addressing environmental and social challenges. For policymakers, the study highlights the need for regulatory frameworks supporting UNSDGs through QM, emphasising social responsibility mandates. At the same time, academicians can leverage the findings to explore new QM-based sustainability models.

Originality: This research contributes uniquely to the literature by conducting a cross-sectoral analysis within a consistent regulatory environment in India. Unlike multinational studies where legal and regulatory variations can affect comparability, this study provides a controlled context that enhances the reliability of cross-sector comparisons. This allows for clearer

insights into implementing QM practices to achieve sustainability across various sectors. Additionally, the study highlights the role of advanced technologies in enhancing operational efficiency and sustainability while identifying areas for improvement, such as the broader adoption of I4.0 (Industry 4.0) tools and a more balanced focus on social sustainability.
Keywords: Quality Management, Sustainability, UN Sustainable Development Goals, India

1. Introduction

Quality management (QM) is widely acknowledged for optimising processes and facilitating ongoing improvement. Nevertheless, incorporating sustainable techniques has become increasingly popular (Silva *et al.*, 2021). Aligning QM practices with sustainability efforts has become more important as organisations globally strive to balance operational excellence and sustainable development (Antony, Bhat, *et al.*, 2024). QM practices are crucial in improving environmental, social, and governance (ESG) performance as global corporations implement initiatives to achieve the United Nations Sustainable Development Goals (UNSDGs) (Fundin *et al.*, 2020; Zhao *et al.*, 2023). In India, there is a noticeable increase in organisations, in different sectors, acknowledging the need to include sustainability aspects into their QM frameworks (Antony *et al.*, 2023; Antony, Bhat, *et al.*, 2024).

Prior research emphasises that aligning QM approaches with sustainability characteristics may yield various advantages for organisations. These benefits encompass waste minimisation, improved resource effectiveness, better consumer contentment, and adherence to worldwide environmental regulations (Longoni and Cagliano, 2016; Siva *et al.*, 2016). Previous research has shown that QM practices and procedures are essential for addressing sustainability challenges. By utilising these instruments, organisations can improve product quality, reduce waste, and enhance process efficiency (Antony, Bhat, *et al.*, 2024; Wassan *et al.*, 2022; Yeşilyurt *et al.*, 2022). Although the advantages of QM practices are well acknowledged, an absence of thorough research explicitly examines how these practices meet sustainability issues, especially in the Indian context. Several studies have tried to investigate sustainability within specific sectors but have not offered a comprehensive view that spans several industries (De Menezes *et al.*, 2022; Hudnurkar *et al.*, 2023). Most current research either focuses on specific industries or lacks an in-depth analysis of how QM approaches are customised to align with the UNSDGs in various sectors (Antony *et al.*, 2023; Antony, Bhat, *et al.*, 2024). Furthermore, an absence of empirical research demonstrates the precise advancements and inventive approaches Indian corporations use to close the disparity between quality and

sustainability. In addition, although several studies examine the significance of digital transformation tools in QM known as Quality 4.0 (Q4.0), there has been a lack of thorough investigation into the relationship between these advancements and their influence on the UNSDGs (Mayakova, 2019; Sader *et al.*, 2022).

This study addresses the above research gap by systematically examining 41 case studies from Indian enterprises in different industries. This research will analyse how these organisations utilise QM practices and procedures to achieve the UNSDGs. The study aims to emphasise the broader significance of combining QM with sustainability. Also, the potential for acquiring information and applying these strategies across many sectors will be examined. Further, the research is intended to provide practical insights for organisations seeking to balance their sustainability objectives and operational efficiency while contributing to global sustainability initiatives.

Thus, the objective of this research is to examine the extent to which QM practices are aligned with sustainability dimensions to achieve the UNSDGs. This will be achieved by identifying key sustainability areas addressed, analysing the application of QM tools, and exploring unique approaches that contribute to sustainable transformation across industries. This objective guided the formulation the following primary research questions (RQs).

RQ1: What are the sustainability dimensions and QM practices addressed by the case studies?

RQ2: How do companies use QM practices, tools, and techniques to attain the UNSDGs?

RQ3: What are the unique approaches, breakthroughs, leverage potential, and implications of aligning QM practices with sustainability dimensions?

This study is unique due to its cross-sectoral analysis conducted within a consistent regulatory environment in India. Unlike multinational studies where differences in laws and regulations can obscure findings, the uniform legal landscape across Indian industries provides a controlled setting (Eisenhardt and Graebner, 2007; Yin, 2018). This approach gives more precise insights into how various sectors implement QM practices and address sustainability challenges. This leads to more reliable comparisons and conclusions about best practices.

The article is structured as follows. The next section reviews the literature on the study's scope. Section 3 delineates the research methodology adopted. The case study analysis is provided in the Section 4. Discussions and implications of the study are provided in Section 5, and the conclusion in Section 6.

2. Literature Review

2.1 Quality Management (QM) Practices

QM practices are indispensable in improving organisational performance and sustainability to establish a foundation for long-term success (Antony, Bhat, *et al.*, 2024). It is reported that strategic planning and effective leadership foster a culture of proactive behaviour and commitment that permeates all levels of the organisation by aligning organisational objectives with continuous quality improvement (Bolatan *et al.*, 2022; Chansatitporn and Pobkeeree, 2019; Srijithesh *et al.*, 2024). Also, an unwavering emphasis on customers, along with transparent communication and robust connections with suppliers and stakeholders, guarantees that processes are highly efficient and capable of surpassing consumer expectations (Mehra and Ranganathan, 2008; Santouridis and Veraki, 2017). Further, data-driven information analysis and process management improve consistency, allowing organisations to make informed decisions that enhance the quality of their products and services (Bhat *et al.*, 2021; Sariyer *et al.*, 2021). Human resource management is equally critical in developing a continuous innovation and refinement culture, promoting collaboration, and empowering employees (Nayak *et al.*, 2023). In addition to operational advantages, QM practices play a crucial role in fostering environmental and social sustainability, minimising waste, and embracing eco-friendly innovations that guarantee ethical company conduct (Abbas, 2020; Silvestri *et al.*, 2024). QM practices, which encompass economic sustainability and high-quality standards, assist organisations in attaining enduring financial performance while retaining their competitive edge (Siva *et al.*, 2016). Ultimately, these practices establish organisations capable of adapting, growing, and thriving in an increasingly competitive environment. They are also customer-focused, innovative, and resilient. The literature reports the range of QM practices listed in Appendix A.

2.2 Sustainable Performance Dimensions

Recent literature has elucidated the profound impact of sustainable performance dimensions on organizations in environmental, social, governance, economic, and operational categories (Antony *et al.*, 2023; Antony, Bhat, *et al.*, 2024). These dimensions influence an organization's

ability to balance profitability with long-term sustainability goals while ensuring regulatory compliance and stakeholder trust.

From an environmental sustainability perspective, factors such as energy efficiency (Gielen et al., 2019) and emissions control (Churkina et al., 2020) are critical in minimizing ecological footprints and improving resource utilization. Waste reduction strategies and circular economy models further support environmental sustainability by promoting process efficiency and reducing landfill dependency.

Beyond environmental concerns, social sustainability has emerged as a crucial yet often underexplored aspect in industrial sustainability frameworks. Social sustainability focuses on employee well-being, diversity, inclusion, and human rights compliance, which play a fundamental role in long-term organizational resilience and workforce stability (Frolova and Lapina, 2015; Homburg et al., 2017; Hoobler et al., 2018; Neal and Griffin, 2006). Organizations integrating diversity and inclusive decision-making processes within QM frameworks demonstrate enhanced innovation capabilities, stronger stakeholder relationships, and improved employee engagement (Hoobler et al., 2018; Saha et al., 2024). Moreover, workforce well-being, fair labor practices, and human rights compliance contribute to supply chain sustainability and risk mitigation, ensuring ethical business practices and resilience against regulatory scrutiny (Crane et al., 2008; Lannetta, 2022). However, many industries, particularly in emerging economies, lag in embedding social sustainability within QM practices, prioritizing operational and environmental aspects over workforce inclusivity and social responsibility (Cano-Rubio et al., 2021). This gap presents an opportunity for organizations to integrate structured social sustainability metrics into QM processes, aligning operational excellence strategies with global sustainability frameworks like ISO 26000 (Guidance on Social Responsibility).

Governance sustainability is also pivotal in embedding sustainability principles into corporate decision-making. Factors such as corporate ethics, transparency, stakeholder engagement, and risk management ensure that sustainability initiatives are implemented with accountability and long-term strategic vision (Christensen and Cheney, 2015; Mikes and Kaplan, 2015). Organizations that embed sustainability within governance structures demonstrate improved risk mitigation and stronger regulatory compliance, enhancing corporate credibility and investor confidence (Mikes and Kaplan, 2015).

Economic sustainability is directly linked to an organization's ability to maintain financial stability, cost efficiency, and market competitiveness while integrating sustainability objectives. Companies investing in sustainable technologies and circular business models experience long-term cost savings and improved market positioning (Aiginger and Rodrik, 2020; Wagner, 2015).

From an operational perspective, sustainability-oriented practices such as supply chain sustainability, product lifecycle management, and resilience building help industries navigate disruptions while maintaining long-term sustainability goals (Shah et al., 2008; Touboulic and Walker, 2015). By leveraging technology and innovation for sustainability, organizations can optimize resources, reduce waste, and enhance adaptability in response to evolving environmental and social challenges (De Marchi, 2012; Folke et al., 2010). Thus, a holistic sustainability framework that balances environmental, social, governance, economic, and operational dimensions is essential for long-term business resilience. Appendix B provides the various sustainable performance dimensions utilised for the research.

2.3 United Nations Sustainability Development Goals (UNSDGs) and QM

The UNSDGs are a collection of 17 global objectives (Figure 1) designed to resolve social, economic, and environmental challenges to foster sustainable development (United Nations, 2015). Studies suggest that incorporating QM practices into the industrial sector may greatly influence an organisation's long-term viability and effectiveness. Research has demonstrated that aligning quality efforts with the UNSDGs may yield consistent and exceptional outcomes, highlighting the significance of QM in promoting sustainable development at the organisational level (Antony, Bhat, *et al.*, 2024). Moreover, applying QM tools and techniques in Indian manufacturing industries has demonstrated its ability to boost product quality, decrease expenses, and enhance overall performance, following the objectives of the UNSDG (Majumdar and Manohar, 2012). Organisations may encourage economic growth and environmental stewardship by adopting QM practices and aligning them with the UNSDGs. This will improve operational efficiency, product quality, and contribute to larger sustainability goals (Antony *et al.*, 2023).

<< Insert Figure 1 here >>

2.4 Identified Research Gaps and Rationale for the Study

Despite the emphasis and promotion of research on integrating QM and sustainability, there are still several significant voids in the literature, particularly in aligning sustainability principles across diverse industries with QM practices.

First, while studies have explored QM's role in operational and environmental sustainability, there is limited research on how different sustainability dimensions are collectively addressed using QM tools and techniques across industries (Antony *et al.*, 2023; Antony, Bhat, *et al.*, 2024; Siva *et al.*, 2016). Existing research often examines individual sustainability factors, such as emissions control or waste reduction. However, it does not comprehensively understand how QM contributes to multiple sustainability dimensions simultaneously. This gap supports the need to investigate which sustainability dimensions are most frequently addressed by QM frameworks (RQ1).

Second, although several studies have examined the impact of QM practices, tools, and techniques on process optimization and defect reduction, little empirical research exists on how these QM methodologies directly contribute to achieving the UNSDGs in industrial settings (De Menezes et al., 2022; Hudnurkar et al., 2023). Furthermore, the extent to which QM tools facilitate sustainability improvements beyond traditional quality control applications remains underexplored. Addressing this gap is essential for comprehending the way in which organisations employ QM tools to achieve sustainability goals (RQ2).

Third, the literature lacks insights into unique and breakthrough approaches organizations adopt to align QM with sustainability, particularly in an emerging economy like India. While some studies highlight best practices in sustainability-driven QM, they do not explore innovative frameworks, leverage potential, or strategic breakthroughs that organizations employ to integrate sustainability into their quality initiatives (Fundin et al., 2020; Sader et al., 2022). This gap supports the need to examine the unique approaches and their implications for sustainability-driven QM practices (RQ3).

To ensure that organisations can successfully link their quality initiatives with long-term sustainability goals, addressing these research gaps and establishing a holistic understanding of how QM practices contribute to sustainability is vital. These gaps provide the foundation for

the present study, which systematically examines the role of QM in sustainability across various industrial contexts.

3. Research Methodology

A case study research method was selected because in-depth and rich data were needed to determine Indian industries' incorporation of sustainability aspects into their QM practices (Hussey, 1997; Yin, 2005). Moreover, the case study technique allows for in-depth qualitative data analysis, yielding valuable insights into practical applications (Bhat *et al.*, 2019). According to Yin (2005), there are three types of case studies: exploratory, explanatory, and descriptive, all of which are valid approaches. The exploratory phase precedes theory building and aims to "uncover areas for research and theory development" (Nonthaleerak and Hendry, 2008). The case study method provides "exploratory depth" in understanding complex phenomena (Meredith, 1998). Given the limited literature on QM and sustainability, exploratory research is particularly relevant here.

To overcome the limitations of single case study analysis, a multi-case study approach is necessary for a more comprehensive exploration. The multi-case study approach allows a more direct comparison between the similarities and differences of implementing QM practices and sustainability in different contexts, resulting in a more generic and in-depth theoretical explanation (Silverman, 2000). Prior research also employed the case study approach to ascertain the influence of QM on sustainability (Antony *et al.*, 2023; Antony, Bhat, *et al.*, 2024). Thus, a multiple-case study approach was selected to enhance external validity.

The selection of Indian industries as the study's context was strategic. By focusing on a single national context, the research eliminates the variations arising from differences in international regulations (Yin, 2018). This consistent regulatory backdrop allows the study to emphasise the similarities and differences in implementing QM and sustainability practices across sectors, providing a comprehensive understanding unaffected by external legal and policy variations (Schroeder *et al.*, 2008). Furthermore, replication logic strengthens the study's conclusions, as consistent findings across cases support the validity of the observed phenomena (Eisenhardt and Graebner, 2007).

Data collection

The data for this research were obtained from 41 case studies submitted to the International Academy for Quality (IAQ) for the *Quality Sustainability Award*. These data were obtained from IAQ. We used a theoretical sampling approach to select the cases out of the many cases. Theoretical sampling in case study research is a purposeful method where cases are chosen based on their potential to contribute to theory development rather than statistical representation (Schroeder *et al.*, 2008). Unlike random sampling, the focus is choosing cases with rich data and insights related to the RQs (Eisenhardt and Graebner, 2007). The goal is to sample cases that help extend or refine theoretical propositions. By selecting cases representing varying conditions, theoretical sampling enables a more comprehensive exploration of the research problem (Yin, 2018).

The companies have applied for the IAQ Quality-Sustainability award in a specific format with details about the case study. Based on this format, the cases were selected based on several criteria, including the organisation's demonstrated commitment to sustainability, participation in QM initiatives, and availability of detailed performance data. Only case studies that explicitly focused on aligning QM with sustainability goals were included in the analysis (Antony *et al.*, 2023; Antony, Bhat, *et al.*, 2024). This ensured that organisations from different industries with varying sustainability aims were included in the study. This method allows for a comprehensive understanding of how organisations apply QM frameworks in various contexts, making it possible to generalise the findings across various industries (Eisenhardt and Graebner, 2007).

The case studies analyzed in this research were predominantly project-based rather than organization-wide initiatives. These cases primarily focused on specific projects within organizations that aimed to address operational, environmental, governance or social improvements using QM frameworks. This project-centric approach allowed organizations to target discrete challenges with measurable outcomes, such as defect reduction, energy efficiency, or enhanced customer satisfaction.

While these cases often involved collaboration across multiple organizational levels, the emphasis remained on solving specific operational challenges rather than achieving a holistic, enterprise-wide transformation. However, project-based sustainability initiatives often serve as strategic pilot programs that, if successful, are later scaled across the organization (Antony *et*

al., 2023; Antony, Bhat, *et al.*, 2024). Analyzing these initiatives provides valuable insights into real-world implementation challenges, industry-specific adaptations, and emerging sustainability trends within QM practices.

Moreover, the cross-sectoral representation of 41 case studies helps mitigate generalization concerns by ensuring findings are not limited to a single industry but reflect common sustainability-driven QM interventions across diverse sectors. Nonetheless, we acknowledge that organization-wide transformations may offer a broader perspective, and future research could explore longitudinal studies to assess the long-term scalability and impact of these sustainability-focused QM initiatives.

Data analysis

An inductive approach was employed during the analysis phase. This method allows emerging patterns to change the theoretical knowledge of how QM contributes to sustainability in various industries. The names of the companies were anonymised to protect the organisation's identity. Each case study was treated as an individual unit of analysis. The first step was to conduct the within-case analysis. All the authors participated in the within-case analysis. The case analysis aimed to assess each company's specific QM practices and sustainability dimensions. All the authors discussed the within-case analysis to remove subjectivity bias. The next step was cross-case analysis to identify patterns and differences across the cases, providing a broader understanding of how QM practices contribute to sustainability across different sectors. All the authors also participated in cross-case analysis. This collaborative approach ensured that diverse perspectives were considered, and any potential biases were mitigated through collective discussion and triangulation of insights. The process of within-case analysis was rigorous, ensuring that the integrity and objectivity of the research were maintained across all cases. Further, the cross-case analysis helped uncover the common challenges, best practices, and unique innovations companies use to integrate sustainability with QM, further enriching the theoretical insights generated from the study (Stake, 2010; Yin, 2018). Figure 2 provides the themes considered for the case analysis. Table 1 provides a detailed distribution of the 41 projects across different industries, primarily categorised into manufacturing and service sectors.

<< Insert Table 1 here >>

<< Insert Figure 2 here >>

4. Results and Analysis

Outcomes are quantified in Table 2, and qualitative analysis is provided in Appendix C, D, and E.

<< Insert Table 2 here >>

4.1 UNSDGs Addressed

The table illustrates the alignment of the 41 projects with specific UNSDG, highlighting the sustainability dimensions each project addresses. Goal 12, which focuses on responsible consumption and production, is the most frequently addressed, with 24 projects (59%) emphasising resource efficiency, waste reduction, and sustainable practices. Goal 9 (Industry, Innovation, and Infrastructure) follows closely with 19 projects (46%), which strongly focus on fostering innovation and enhancing infrastructure through sustainable methods. Additionally, Goal 13 (Climate Action) is represented in 16 projects (39%), showcasing efforts to mitigate climate change through energy efficiency and emission reduction.

Other key UNSDGs include Goal 7 (Affordable and Clean Energy), addressed by 14 projects (34%), and Goal 11 (Sustainable Cities and Communities), addressed by 6 projects (15%). Goals such as 3 (Good Health and Well-being) and 6 (Clean Water and Sanitation) also play a role, each appearing in 5 projects (12%). Although less frequent, Goal 4 (Quality Education), Goal 15 (Life on Land), and Goal 8 (Decent Work and Economic Growth) are still considered, highlighting efforts in human development, environmental protection, and economic growth. This distribution shows a broad commitment across various UNSDGs, concentrating on sustainable production, infrastructure innovation, and climate action.

4.2 Types of Tools and Techniques

Analysing tools and techniques used across the projects reveals a strong focus on Six Sigma methodologies (such as DMAIC, Capability Analysis, and Control Charts), with 12 projects utilising this. Lean tools and techniques (including 5S, Kaizen, and Standard Work Cycle Time (SWCT), were implemented in 11 projects, reflecting their role in enhancing process efficiency and waste reduction. PDCA (Plan-Do-Check-Act) was applied in 10 projects, emphasising its importance in continuous improvement. Similarly, Root Cause Analysis (RCA) techniques (including 3G, 4W-1H, and Why-Why Analysis) were prevalent in 10 projects. The traditional

7 QC Tools (including Fishbone Diagrams, Pareto Charts, and Check Sheets) appeared in 9 projects. Notably, I4.0 tools (such as IoT, AI, Deep Learning, RFID, GPS, and Blockchain) were used in 7 projects, highlighting the integration of digital technologies in QM. The Design of Experiments (DOE) was also applied in 6 projects. These results highlight the varied utilisation of conventional and advanced QM tools and techniques in various industry applications, reinforcing their significance in facilitating process optimisation, digital transformation, and ongoing enhancement.

4.3 Impact on Quality

The analysis of the case studies highlights significant improvements in key quality areas. The most impactful result was the reduction in defects (reported by 23% of case studies), highlighting the effectiveness of QM tools like Six Sigma and Lean in minimising errors and enhancing product quality. In 22% of the projects, process efficiency was improved, demonstrating how these tools helped streamline workflows and eliminate inefficiencies. Customer satisfaction was enhanced in 18% of the cases, showing the importance of consistently meeting customer expectations through high-quality outcomes. Additionally, cost savings were achieved in 15% of the projects, likely due to reduced defects, waste, and optimised resource usage. Furthermore, waste reduction was observed in 12% of the initiatives, reflecting a commitment to sustainability. In comparison, compliance and safety improvements were recorded in 9% of the cases, emphasising adherence to regulatory standards and safer work environments.

These results indicate that process optimization and defect reduction are the most immediate benefits of QM tools and techniques, but their impact extends beyond operational efficiency. Integrating QM methodologies, particularly Six Sigma and Lean, creates measurable financial benefits, such as cost savings and improved resource utilization, directly contributing to long-term business sustainability. Furthermore, the effectiveness of specific QM tools and techniques varies by sector - while manufacturing industries extensively utilize Six Sigma and RCA for defect reduction, service industries rely more on PDCA and continuous improvement methodologies for customer satisfaction and service optimization. Understanding these sectoral differences in QM tool effectiveness can help organizations tailor their quality strategies to maximize sustainability outcomes.

4.4 Unique Approach Used

Unique approaches refer to innovative strategies or distinctive methodologies organisations employ to achieve quality management and sustainability goals. These approaches go beyond conventional QM practices, often incorporating novel use of technology or unorthodox collaborative methods. These innovations distinguish them from common QM practices, emphasising creativity and adaptability in response to sustainability challenges.

The case studies exhibited a variety of unique approaches to improving quality, with the integration of advanced technologies being the most prominent, which was applied in 24% of the projects. This demonstrates the rising importance of IoT, AI, and automation in driving quality improvements and enhancing real-time decision-making. Additionally, Sustainable Practices were used in 20% of the cases, reflecting the growing focus on reducing environmental impact while maintaining high quality. Cross-functional collaboration was seen in 17% of the projects, emphasising the value of teamwork and cross-departmental problem-solving in achieving quality goals. Customer-centric innovations were evident in 15% of the initiatives, underscoring the importance of aligning quality improvements with customer needs and expectations. Moreover, Custom Tools and Frameworks and Lean and Agile methodologies were each utilised in 12% of the cases, showcasing the flexibility and adaptability of organisations in developing tailored solutions and continuously improving processes. These unique approaches demonstrate companies' diverse strategies to enhance quality and operational excellence.

4.5 Key Lessons

The analysis of the case studies identified several key lessons. These were identified through a detailed within-case analysis of the 41 case studies. This method thoroughly examined each organisation's outcomes, challenges, and innovative strategies. The lessons learned were derived by systematically analysing these cases to extract core themes related to QM practices and their contribution to sustainability. Specifically, the within-case analysis allowed for an in-depth understanding of each case in its context, enabling the identification of critical success factors and unique problem-solving approaches. The findings from each case were then synthesised to form generalised lessons applicable across sectors, highlighting the most impactful practices and recurring insights reported by the organisations.

The most prominent lesson was the importance of data-driven decisions, with 24% of the projects emphasising the role of real-time data and analytics in quality improvement. Cross-functional teams played a critical role in 20% of the initiatives, reflecting the value of collaboration across departments for problem-solving and QM. The need for continuous improvement was evident in 18% of the projects, underscoring the importance of methodologies like PDCA and Kaizen. Additionally, 16% of the projects demonstrated the value of integrating technology, mainly through I4.0 tools, while 14% focused on meeting customer needs through innovations that enhanced satisfaction and reliability. Finally, 10% of the case studies highlighted a commitment to sustainability, demonstrating the growing importance of environmentally responsible practices in QM. These lessons reflect the diverse strategies organisations employ to achieve excellence in quality and sustainability.

4.6 Sustainable Performance Dimensions

As mentioned earlier, five sustainable performance dimensions and multiple factors are considered for the analysis. The quantitative analysis is provided in Table 3. Since case studies have addressed various UNSDGs through the projects, multiple sustainable dimensions are observed in each case study.

<< Insert Table 3 here >>

4.6.1 Environmental Performance Factors

In the study, emissions control was implemented in 28 projects (68%), focusing on reducing greenhouse gas emissions, improving air quality, and lowering pollutants. Organisations achieved these goals by adopting cleaner technologies, optimising processes, and setting emissions reduction targets, reflecting their commitment to reducing their carbon footprint and addressing climate change. Nearly half of the projects focused on energy efficiency, transitioning to renewable energy sources, and adopting energy-efficient technologies. These efforts included optimising equipment, using energy-efficient lighting, and adopting renewable energy solutions to reduce environmental impact and operational costs. Waste reduction was a priority for 17 projects, significantly reducing waste generation, paper consumption, and plastic usage. Organisations optimised processes and promoted recycling, reflecting their proactive sustainability strategies to minimise the environmental impact of waste disposal. Water management was addressed by six projects, focusing on reducing water consumption, enhancing recycling efforts, and implementing efficient water-use practices like rainwater

harvesting. Biodiversity conservation was also highlighted in six projects, with initiatives promoting reforestation and the use of native species showcasing a commitment to ecological sustainability.

4.6.2 Social Performance Factors

Customer satisfaction and safety were the focus of 24 initiatives (59%). These projects implemented feedback mechanisms, quality assurance, product safety tests, and service improvements, resulting in increased customer satisfaction, reduced defects, and positive customer feedback, enhancing loyalty and brand reputation. Nine initiatives (22%) addressed employee health and safety, focusing on ergonomic assessments, safety evaluations, enhanced protocols, and comprehensive safety training and wellness programs. These measures improved health indicators, reduced workplace accidents, and contributed to higher productivity and employee satisfaction. Community engagement was a priority for five initiatives (12%), including development programs, partnerships with local organisations, and employee volunteering. These efforts enhanced the company's image and stakeholder relationships. Only two projects (5%) focused on diversity and inclusion, setting diversity targets and creating inclusive policies. Notably, no projects addressed human rights and labour practices, highlighting an area for improvement.

4.6.3 Governance Performance Factors

The sustainability strategy and reporting were aligned into 37 projects (90%), where organisations incorporated sustainability into their business plans, set measurable goals, and consistently monitored and reported progress. This demonstrates a strong commitment to embedding sustainability in long-term corporate strategy for lasting success. Stakeholder engagement was focused on 33 projects (80%) involving regular meetings, feedback systems, and collaborative decision-making processes. This highlights the importance of fostering partnerships and building strong, inclusive stakeholder relationships. Compliance and risk management featured in five projects (12%), where organisations conducted compliance audits, offered regulatory training, and established risk management frameworks. These efforts underscore the importance of maintaining organisational credibility and ensuring business continuity. Only two projects (5%) addressed board diversity and structure, indicating limited attention to leadership diversity. This suggests that organisations may be overlooking the value of diverse perspectives in enhancing governance. Lastly, corporate ethics and transparency

were not directly addressed, signaling a need for improvement in promoting accountability and ethical governance.

4.6.4 Economic Performance Factors

In the case studies, cost management was a priority in 40 initiatives (98%), where optimising resource utilisation, reducing energy consumption, and minimising waste resulted in improved financial performance and significant cost savings. These efforts underscore the economic advantages of incorporating sustainability into operations. Investment in sustainable technologies was seen in nearly all case studies (98%), with companies implementing energy-efficient solutions, renewable energy sources, and advanced waste management practices. This strategic focus supported sustainability goals and bolstered economic performance and long-term resilience. Value creation was emphasised in 35 initiatives, where sustainable practices improved stakeholder relations, developed eco-friendly products, and enhanced brand reputation. This underscores the importance of sustainability in generating lasting benefits for shareholders and stakeholders. Financial stability and growth were highlighted in 33 initiatives (80%), where efforts such as process optimisations, cost reductions, and market expansion contributed to financial resilience. Additionally, market competitiveness was improved in 24% of the projects, where sustainability-driven innovations, including AI, IoT, and renewable energy technologies, helped companies boost their market position and lead in sustainable practices.

4.6.5 Operational Performance Factors

The study enhanced operational efficiency in 39 projects by optimising the production process, energy consumption, and minimising waste. These actions not only streamlined operations but also delivered environmental and economic benefits, underscoring the role of waste reduction in achieving sustainability goals. Nearly 95% of the initiatives focused on technology and innovation to drive sustainability, incorporating advanced technologies and automation to improve efficiency and reduce environmental impact. These measures emphasised the importance of innovation in enhancing operational processes while minimising the environmental footprint. Resilience and adaptability were key focuses in 31 projects (76%), with efforts to manage disruptions, diversify supply sources, and improve workforce training. These initiatives showcased the organisations' commitment to maintaining operational continuity in the face of environmental and economic challenges. Product lifecycle management was addressed in five initiatives, emphasising sustainable product design,

recyclability, and managing environmental impact throughout a product's lifecycle. Lastly, only two initiatives concentrated on supply chain sustainability, focusing on optimising logistics, sustainable procurement, and reducing emissions, highlighting potential growth areas.

While the findings strongly emphasise environmental sustainability, mainly through emissions control, energy efficiency, and waste reduction, there is limited evidence of systematic supply chain sustainability integration across the analyzed case studies. Most QM-driven sustainability efforts remain internally focused, targeting process optimization, defect reduction, and operational efficiency, rather than extending these practices to supplier engagement, sustainable sourcing, or end-to-end value chain integration. This suggests that while organizations actively incorporate sustainability within their operations, a gap exists in aligning QM frameworks with broader supply chain sustainability goals.

Additionally, the findings reveal that workforce diversity and inclusion are underrepresented within sustainability-focused QM initiatives. Few case studies explicitly address structured diversity programs, ethical labor standards, or workforce inclusivity measures, despite their recognized importance in long-term sustainability strategies. This reinforces the need for integrating social sustainability metrics into QM frameworks, ensuring that organizations move beyond operational efficiency to address broader workforce-related sustainability concerns.

The analysis of sustainable performance dimensions highlights a strong alignment between operational efficiency and sustainability outcomes, where QM-driven initiatives significantly enhance energy efficiency, waste reduction, and cost savings. However, broader sustainability integration requires a more interconnected approach, extending beyond internal operations to include supplier networks, workforce inclusivity, and lifecycle sustainability planning.

One critical observation is that industries focusing on short-term efficiency gains often underutilize strategic QM frameworks for long-term sustainability transformation. This is particularly evident in the limited adoption of structured supplier engagement programs and circular economy models despite their proven potential to enhance resilience and risk mitigation.

Furthermore, advancing sustainable performance in QM-driven organizations requires a more integrated view of cross-functional collaboration, where governance, economic, and social sustainability dimensions synergise with operational and environmental performance goals. A key opportunity lies in leveraging data-driven QM approaches to enhance ESG compliance, transparency, and strategic decision-making, ensuring sustainability remains an embedded practice rather than an isolated initiative.

4.7 QM Practices

Figure 3 illustrates the top 25% of the QM practices that significantly drove quality improvements and organisational performance across various industries. Leadership commitment and strategic planning were pivotal in setting the direction and priorities and fostering a quality culture across industries. Additionally, process management ensured that the processes were efficient and met customer needs, supporting overall operational effectiveness.

Human resource management, information, and analysis were integral to continuous improvement, emphasising the importance of skilled personnel and data-driven decision-making. Case studies also emphasised economic sustainability significantly, reflecting the concern for stakeholders and financial viability. Knowledge creation and application notably highlighted the importance of learning organisations, where knowledge is continuously generated, shared, and applied to drive innovations and improvements.

Conversely, the least addressed QM practices included the CSR (Corporate Social Responsibility) framework, supplier relationships, and stakeholder engagement. While these are critical for aligning quality with broader social responsibility and long-term sustainability, they may not have been the immediate focus of the majority of the QM initiatives in these specific case studies. Strengthening these areas could further enhance stakeholder trust and ensure alignment with external sustainability goals.

<< Insert Figure 3 here >>

4.8 Cross-Case Analysis

In the manufacturing sector, automotive, mining, automation, and chemicals industries focused on tools like Lean, Six Sigma, and digital transformation to optimise processes, reduce defects,

and enhance energy efficiency. These industries significantly improved operational efficiency, cost savings, and environmental performance, engaging stakeholders like suppliers, local communities, and regulators. For instance, the automotive sector applied Six Sigma and Lean to improve customer satisfaction and reduce production defects. In contrast, the mining sector focused on digital tools to enhance safety and process efficiency, reducing environmental impacts in collaboration with local communities. In the power sector, energy efficiency and risk management tools were central to achieving long-term cost savings and strengthening governance frameworks, engaging policymakers and local stakeholders.

In the service sector, industries like healthcare, logistics, and non-profit organisations adopted PDCA, continuous improvement, and Lean tools to improve service delivery, optimise resource usage, and engage internal stakeholders such as employees and volunteers. The healthcare industry focuses on improving service quality and employee well-being. In contrast, the logistics industry targeted energy savings and reduced emissions.

The analysis emphasises how industries in both sectors have customised their sustainability and QM strategies to meet the unique operational challenges and stakeholder requirements. These industries have successfully balanced economic performance, environmental goals, and social impact by combining traditional QM tools with emerging technologies like IoT and AI. The summary of the cross-case analysis is provided in Table 4.

<< Insert Table 4 here >>

5. Discussion and Implications

This study aimed to examine the alignment of QM practices with sustainability initiatives across various Indian industries, emphasizing their connection to the UNSDGs. The analysis of 41 case studies addressed the RQs concerning the most frequently used QM tools, how industries incorporate sustainability dimensions and the outcomes derived from these practices. The findings reveal critical insights into applying QM tools, adopting advanced technologies, and the challenges and opportunities in achieving sustainability through QM. The overview of the research outcome is presented in Figure 4.

<< Insert Figure 4 here >>

The results demonstrate that industries across the manufacturing and service sectors rely heavily on Six Sigma, Lean tools, and PDCA for process improvements, defect reduction, and energy efficiency. These QM tools have effectively addressed operational and environmental challenges, especially in the automotive, chemical, power, and mining industries. The widespread use of these tools aligns with previous research that identifies them as fundamental for achieving operational excellence and sustainability (Cherrafi *et al.*, 2017; Yadav *et al.*, 2023). Also, studies suggest that Six Sigma and Lean methodologies have been widely applied in manufacturing to enhance defect reduction and process optimization, which corroborates our findings that these tools were extensively used in the automotive and power industries (Raja Sreedharan and Raju, 2016; Singh and Rathi, 2019). Additionally, existing research emphasizes that service industries benefit more from PDCA and continuous improvement frameworks, reinforcing our findings that these methodologies are critical for customer satisfaction and service sustainability efforts (Ahmed *et al.*, 2013; Bhat *et al.*, 2023).

Aligning QM practices with sustainability objectives, such as emissions control, waste reduction, and energy efficiency, highlights the strategic importance of embedding these tools into core business processes. These findings are consistent with other studies' findings, suggesting that combining sustainability with quality improvement is essential for long-term organisational success (Antony *et al.*, 2023; Antony, Bhat, *et al.*, 2024).

A notable aspect of the findings is that I4.0 technologies, including IoT, AI, and predictive analytics, support sustainability. Power, automotive, and mining industries have successfully leveraged these technologies to enhance operational efficiency and reduce their environmental footprint. For example, predictive analytics and AI-driven solutions have been employed to optimise energy consumption and reduce defects, resulting in considerable cost savings and resource conservation. This aligns with the broader literature that positions I4.0 as a key enabler of QM and sustainability goals (Fadilasari *et al.*, 2024; Nguyen *et al.*, 2024; Yadav *et al.*, 2020). However, the uneven adoption of these technologies across sectors, particularly in textiles and construction, suggests that barriers to digital transformation persist in specific industries. The lag in adoption in these sectors highlights a critical gap in the broader implementation of advanced technologies, which could significantly enhance their sustainability performance.

The challenges hindering the adoption of I4.0 technologies in sectors like textiles and construction stem from factors such as high initial investment costs, lack of technical expertise,

resistance to change, and infrastructure limitations (Antony, Kaul, *et al.*, 2024; Fadilasari *et al.*, 2024). This is consistent with research showing that the digital transition in sustainability is more pronounced in high-tech sectors. In contrast, traditional industries require targeted interventions such as government incentives and structured upskilling programs (Khan *et al.*, 2025). Additionally, fostering public-private collaborations between industry leaders, academia, and policymakers can drive knowledge-sharing and technological integration, ensuring a more inclusive and efficient transition to I4.0.

The findings also reveal that industries increasingly address sustainability through their QM frameworks. Environmental sustainability was the primary focus, emphasising emissions control and energy efficiency. This is especially evident in sectors like automotive and chemicals, where regulatory pressures and global sustainability trends drive the adoption of cleaner technologies and more efficient resource management practices. These findings are consistent with De Menezes et al. (2022), who suggest that industries with high environmental impact are more likely to integrate sustainability into their QM processes to meet regulatory requirements and stakeholder expectations.

In contrast to the strong environmental focus, the study identified a notable gap in addressing social sustainability, particularly diversity and inclusion. Few case studies highlighted the importance of inclusive workforce practices or ethical labor standards despite growing global awareness of the role of social sustainability in achieving comprehensive business success. This gap contrasts with research from European and North American contexts, where there has been greater emphasis on aligning diversity and human rights into quality and sustainability frameworks (De Menezes *et al.*, 2022; Frolova and Lapina, 2015; Rahi *et al.*, 2023). The underrepresentation of these social dimensions suggests that Indian industries may still be focused primarily on environmental and economic outcomes, with less attention paid to the broader social implications of their sustainability efforts. This presents a significant opportunity for future research and practice, as incorporating social equity and workforce diversity into QM practices will likely yield long-term benefits for organisations and society.

The findings also indicate that while stakeholder engagement is increasingly recognised as critical for the success of sustainability initiatives, there are variations in how industries approach this. Sectors such as mining and healthcare firmly focused on engaging local communities, employees, and other stakeholders to ensure their projects' social and

environmental success. This aligns with studies highlighting the importance of stakeholder involvement in driving sustainability (Chen *et al.*, 2020).

Prior studies indicate that supply chain sustainability is often overlooked in QM-driven sustainability models, with most organizations focusing on internal process improvements rather than supplier engagement (Touboulic and Walker, 2015). Our findings align with this observation, as the case studies demonstrate a limited emphasis on sustainable procurement, ethical sourcing, and supplier collaboration. While previous research has called for greater alignment between QM frameworks and supply chain sustainability, our study reinforces this need. It suggests that structured QM-based supplier audits and sustainable procurement strategies are critical for closing this gap.

Furthermore, social sustainability remains an underrepresented aspect of QM adoption, as observed in previous research (Cano-Rubio et al., 2021). Our study echoes these findings, showing that Indian industries primarily emphasize environmental and operational sustainability, with limited integration of workforce diversity, human rights, and ethical labor standards. Existing studies have highlighted the increasing regulatory and societal pressures to embed social sustainability into QM, reinforcing our argument that ISO 26000 and ESG frameworks should be more systematically incorporated into QM-driven sustainability initiatives (De Menezes et al., 2022).

Furthermore, the study highlights a significant gap in integrating workforce diversity and inclusion within QM-driven sustainability efforts. Although social sustainability is recognized as a critical pillar, few organizations have implemented structured diversity and labor inclusivity initiatives within their QM frameworks. Future research should explore how QM tools, such as Lean and Six Sigma, can be adapted to assess and enhance workforce inclusivity, fair labor practices, and ethical employment standards. Integrating these elements will ensure that sustainability-driven QM efforts comprehensively address environmental, economic, and social sustainability dimensions.

The outcomes from aligning sustainability into QM frameworks were largely positive, with many industries reporting defect reduction, cost savings, and enhanced customer satisfaction as direct results of these initiatives. These findings mirror previous studies' findings, showing that sustainability-driven QM practices improve environmental performance and lead to

significant operational efficiencies (Antony, Bhat, *et al.*, 2024; Antony *et al.*, 2023). The case studies also demonstrated that industries adopting advanced digital tools alongside traditional QM practices could improve operational and environmental performance. However, many projects' lack of product lifecycle management (PLM) represents a missed opportunity for industries to reduce their environmental impact by focusing on the circular economy and end-of-life management (De Oliveira and Soares, 2017). The absence of PLM suggests that while industries are progressing in resource efficiency, they are not yet fully embracing the potential of circularity to achieve sustainability goals.

Implications and Future Research

The results of this study offer several implications for practitioners, policymakers, and academics. The findings highlight the need for practitioners to adopt more aligned approaches encompassing environmental and operational dimensions and social sustainability. Industries that have been slower to adopt I4.0 technologies, such as textiles and construction, should prioritise digital transformation to enhance their sustainability performance and remain competitive in a global market. The success of industries like automotive and mining in using AI and IoT to drive energy efficiency and defect reduction demonstrates these technologies' significant potential to deliver operational and sustainability benefits.

Policymakers have a clear opportunity to incentivise the adoption of digital technologies and promote supply chain sustainability. Policymakers can play a key role by establishing regulatory frameworks that encourage industries to adopt sustainable procurement practices and engage suppliers in their sustainability efforts.

Furthermore, this study highlights the role of QM frameworks in shaping public policy and corporate accountability regarding social sustainability. Regulatory bodies can leverage QM methodologies, such as ISO 26000 (Guidance on Social Responsibility), to establish clear standards for workforce diversity, ethical labor practices, and corporate sustainability reporting. By integrating these elements into national sustainability policies, governments can encourage businesses to embed inclusivity, fair labor conditions, and human rights within their quality management systems. Such policies can enhance CSR practices and influence public attitudes toward sustainable and ethical business operations. Additionally, the findings suggest that CSR reporting and diversity and inclusion initiatives should be mandated to prioritise social sustainability over environmental and economic outcomes.

For academics, this study identifies several gaps that warrant further research. The limited focus on social dimensions such as diversity, inclusion, and human rights presents an opportunity to explore how these aspects can be better aligned with QM frameworks. Future research should also investigate how PLM and circular economy principles can be incorporated into QM practices to enhance product sustainability. Additionally, more research is needed on how I4.0 technologies can be effectively applied in sectors that have been slower to adopt them.

Originality, Contribution, and Limitations of the Study

This study contributes originality by conducting a cross-sectoral analysis within a consistent regulatory environment. This approach enables reliable insights into implementing QM practices across various industries to address sustainability while minimizing the confounding effects of regulatory differences across countries. While previous research has focused primarily on Western or global contexts, this study uniquely examines the Indian context, where different regulatory pressures, economic conditions, and cultural factors shape sustainability initiatives. The study highlights the critical role of I4.0 technologies in driving sustainability, particularly in high-resource and high-emission industries like automotive and power. Additionally, the research identifies significant gaps in social sustainability—an area that has received less attention in previous QM-focused studies in India—thereby contributing to the broader understanding of how diversity, inclusion, and human rights can be aligned into sustainability practices.

The study also contributes to the field by providing practical insights into the QM tools and techniques that are most effective in helping companies meet the UNSDGs, particularly in an emerging economy. By combining traditional QM tools with digital transformation, this research offers new pathways for practitioners and policymakers seeking to align QM with sustainability objectives. The findings have important implications for industry leaders, policymakers, and academics, providing a roadmap for future innovations in QM and sustainability.

A significant aspect of this research is the consistent regulatory environment in which all the case studies were conducted. This uniformity enhances the reliability of cross-sectoral comparisons, as differences observed across the industries can be confidently attributed to sectoral characteristics rather than varying legal frameworks (Bhat *et al.*, 2023; Yin, 2018).

Such a setting provides a unique advantage in understanding how different sectors align QM practices with sustainability under consistent regulatory conditions.

While this study offers valuable insights into aligning QM practices with sustainability efforts in Indian industries, certain limitations should be acknowledged. The focus on the Indian context, while providing unique perspectives, may limit the generalizability of the findings to other global regions, where different regulatory and market conditions might influence the adoption of QM and sustainability practices. Additionally, the use of case studies, while offering in-depth insights, may not capture the full range of sustainability practices across all sectors, potentially narrowing the scope of the analysis.

Furthermore, this study primarily focuses on project-based sustainability initiatives rather than organization-wide transformations. While project-based interventions allow for precise and measurable insights into QM-driven sustainability improvements, they may not fully capture long-term strategic shifts at the corporate level. However, these project-level initiatives often serve as prototypes or pilot programs, leading to more significant organizational sustainability transitions over time. Future research could explore longitudinal studies to assess the evolution of project-specific sustainability efforts into enterprise-wide transformations, offering a more comprehensive perspective on their lasting impact. Also, less emphasis on social sustainability dimensions demands that future research should explore the potential for QM frameworks to incorporate social responsibility components more effectively, thereby assuring a more comprehensive sustainability approach.

Another limitation stems from the uneven adoption of I4.0 tools across sectors where industries such as automotive and power have made significant strides. In contrast, the textile and construction sectors lag in digital transformation. Further research should explore the barriers and enablers for digital adoption in sustainability-driven QM, particularly in industries that have been slower to integrate advanced technologies.

Moreover, supply chain sustainability remains an underexplored area in this study despite its critical role in ensuring long-term sustainability. Organizations often implement QM-driven sustainability efforts internally but may not extend them across their value chains and supplier networks. Future studies should focus on how sustainability-driven QM frameworks can be expanded to supplier engagement, sustainable procurement, and ethical sourcing strategies.

Lastly, this study identifies that PLM and circular economy principles are not widely adopted in the analyzed case studies. This represents a missed opportunity for industries to integrate sustainability across the entire product lifecycle, from design to disposal. Future research could explore how QM tools can facilitate end-of-life product strategies, resource optimization, and circularity principles, ensuring long-term environmental and economic sustainability.

By addressing these research opportunities and limitations, future studies can contribute to developing comprehensive models for integrating QM with sustainability, ensuring long-term environmental, economic, and social impact.

6. Conclusions

This investigation aimed to investigate the extent to which Indian industries integrate QM practices with sustainability dimensions, particularly following the UNSDGs. Through the analysis of 41 case studies across various sectors, the research aimed to answer three RQs as follows.

The study found that the case studies addressed environmental, operational, economic, and governance sustainability dimensions. It is determined that Emission Control, Customer Satisfaction and safety, Sustainable Strategy and Reporting, Investment in Sustainable Technologies, Cost Management, Operational Efficiency, and Technology and innovation were the most frequently addressed dimensions. Also, it has been found that organisations are using QM practices such as strategic planning, leadership, process management, HRM, information and analysis, economic sustainability, knowledge creation, and application to integrate and align their efforts with the UNSDGs.

The most frequently used QM tools included Six Sigma, Lean tools, PDCA, RCA, 7 QC Tools, Brainstorming, I4.0 tools, and DOE, which were instrumental in improving process optimisation, defect reduction, and resource efficiency. The case studies more frequently addressed UNSDGs 12 (Responsible Consumption and Production), 9 (Industry, Innovation, and Infrastructure), 13 (Climate Action), 7 (Affordable and Clean Energy), and 11 (Sustainable Cities and Communities). The commonality between these goals lies in their focus on fostering more efficient, climate-resilient systems where industries can reduce emissions, improve resource efficiency, and build infrastructure supporting economic growth and environmental

protection. This alignment of QM practices with UNSDGs highlights the importance of holistic, cross-functional approaches to achieving both business excellence and sustainability, reinforcing the potential for long-term resilience in global challenges like climate change and resource scarcity.

Several unique approaches and breakthroughs emerged from the case studies, including combining traditional QM tools with advanced technologies like AI and IoT. These innovations allowed for real-time data analytics, which improved predictive maintenance and resource management, especially in high-consumption industries. Cross-functional collaboration and the development of customised frameworks also played key roles in sectors like automotive, where supply chain sustainability and customer-centric innovations were prioritised. These approaches highlight the significant leverage potential of integrating digital tools and collaborative practices with QM to scale sustainability efforts.

In addition to providing practical and theoretical insights, this study makes several unique contributions to the field of QM and Sustainability. Unlike prior research focusing on single-industry applications, this study conducts a cross-sectoral analysis within a consistent regulatory framework, enabling a more reliable comparison of QM and sustainability practices across industries. Moreover, it uniquely highlights the uneven adoption of I4.0 technologies in different sectors, identifying barriers that hinder digital transformation in sustainability-driven QM. Another significant contribution is the study's identification of gaps in social sustainability, particularly in diversity, inclusion, and human rights, which have been relatively underexplored in the Indian context. Additionally, this research provides practical recommendations for integrating QM practices with sustainability objectives tailored to emerging economies, making it directly relevant for practitioners, policymakers, and researchers aiming to implement sustainable business excellence strategies.

Future research could delve deeper into social sustainability, including human rights, workforce diversity, and inclusive labor practices, and how these elements can be better aligned into QM frameworks. Additionally, more work is needed to explore the barriers to adopting I4.0 technologies in sectors like textiles and construction and how these technologies can drive operational efficiency and sustainability.

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Figure 1: United Nations 17 Sustainable Development Goals (Source: United Nations, 2015)

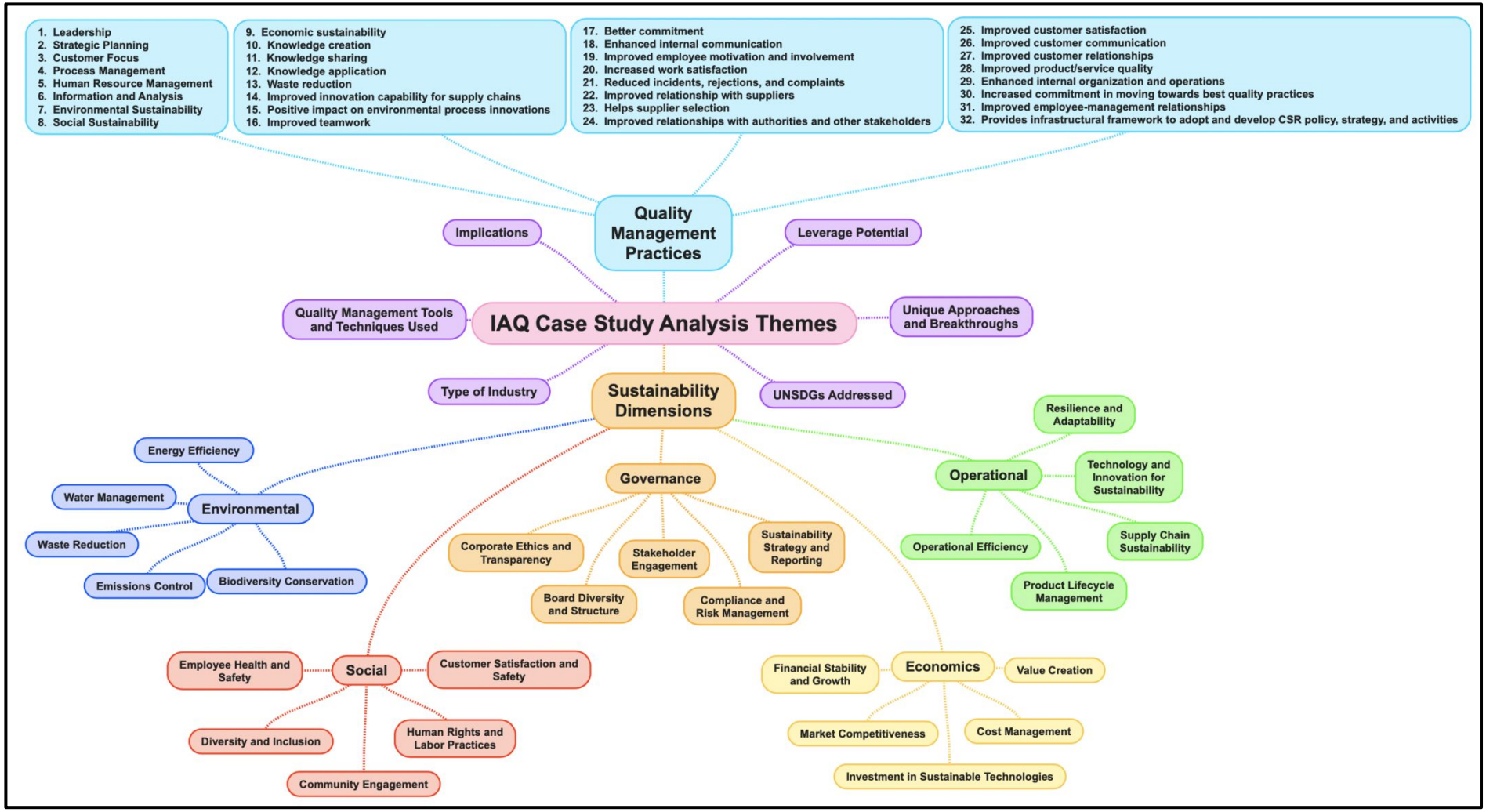

Figure 2: Themes for the analysis (Source: Authors' Own Creation)

Figure 3: Top quarter of QM practices adopted (Source: Authors' Own Creation)

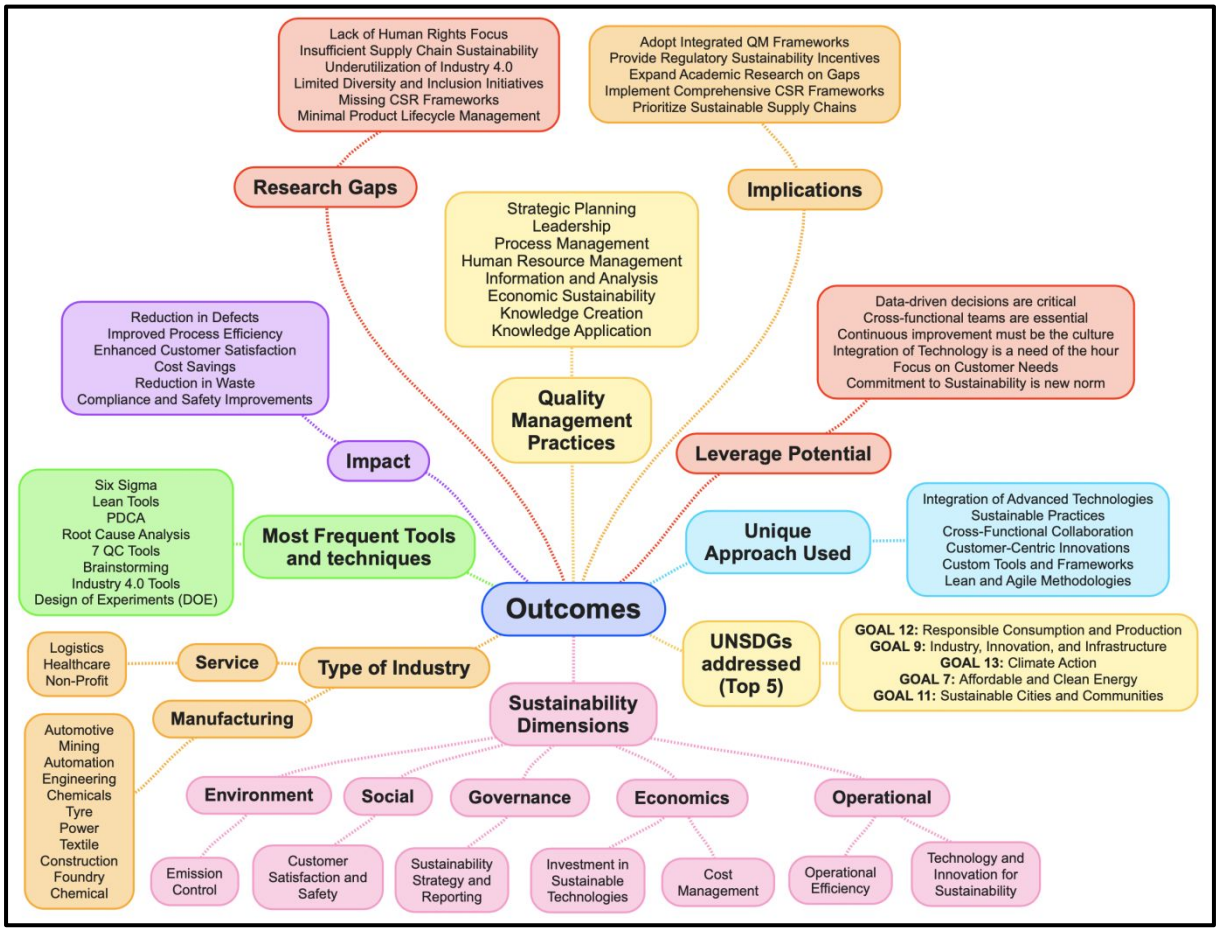

Figure 4: Research outcomes and implications (Source: Authors' Own Creation)

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Table 1: Type of Industry (Source: Authors' Own Creation)

Category	Type	Number
Manufacturing (38)	**Automotive**	**14 (34%)**
	Mining	6 (15%)
	Automation	4 (10%)
	Engineering	3 (7%)
	Chemicals	2 (5%)
	Tyre	2 (5%)
	Power	2 (5%)
	Textile	2 (5%)
	Construction	1 (2%)
	Foundry	1 (2%)
	Chemical	1 (2%)
Service (3)	Logistics	1 (2%)
	Healthcare	1 (2%)
	Non-Profit	1 (2%)

Table 2: Quantitative analysis of the case studies (Source: Authors' Own Creation)

Components of Analysis	Particulars	Frequency
UNSDGs Addressed	GOAL 12	24 (59%)
	GOAL 9	19 (46%)
	GOAL 13	16 (39%)
	GOAL 7	14 (34%)
	GOAL 11	6 (15%)
	GOAL 3	5 (12%)
	GOAL 6	5 (12%)
	GOAL 4	4 (10%)
	GOAL 15	3 (7%)
	GOAL 8	2 (5%)
	GOAL 1	2 (5%)

Components of Analysis	Particulars	Frequency
	GOAL 10	1 (2%)
	GOAL 5	1 (2%)
	GOAL 14	1 (2%)
	GOAL 2	1 (2%)
Types of Tools and Techniques	**Six Sigma**	**12 (12%)**
	Lean Tools	11 (11%)
	PDCA	10 (10%)
	Root Cause Analysis	10 (10%)
	7 QC Tools	9 (9%)
	Brainstorming	8 (8%)
	I4.0 Tools	7 (7%)
	Design of Experiments (DOE)	6 (6%)
	Others (Kaizen, Regression analysis, Why-Why analysis, Hypothesis testing, 12 steps of problem solving in QC, Sankey Diagram, Debottlenecking, 4W1H, Ex-Situ Method, In-Situ Method, Pugh matrix, FMEA, 8 steps problem solving approach, Yamazumi charts, Tree Diagram, ROTI approach, Green manufacturing techniques, 4W-1H, TPM 7 Step methodology, Decision tree matrix, Speed Week Approach (Agile Tool), 4R, SWCT (Standard Work Cycle Time Study) chart, QC Circle, Model predictive control, Social Responsibility Index, Change Management, ESG Principles)	29 (28%)
Impact on Quality	**Reduction in Defects**	**15 (23%)**
	Improved Process Efficiency	14 (22%)
	Enhanced Customer Satisfaction	12 (18%)
	Cost Savings	10 (15%)
	Reduction in Waste	8 (12%)

Components of Analysis	Particulars	Frequency
	Compliance and Safety Improvements	6 (9%)
Unique Approach Used	**Integration of Advanced Technologies**	**10 (24%)**
	Sustainable Practices	8 (20%)
	Cross-Functional Collaboration	7 (17%)
	Customer-Centric Innovations	6 (15%)
	Custom Tools and Frameworks	5 (12%)
	Lean and Agile Methodologies	5 (12%)
Key Lessons	**Importance of Data-Driven Decisions**	**12 (24%)**
	Value of Cross-Functional Teams	10 (20%)
	Need for Continuous Improvement	9 (18%)
	Integration of Technology	8 (16%)
	Focus on Customer Needs	7 (14%)
	Commitment to Sustainability	5 (10%)

Table 3: Quantitative Analysis of Sustainable Performance Dimensions (Source: Authors' Own Creation)

Sustainable Performance Dimensions	**Sustainable Performance Factors**	**Frequency**
Environmental Performance	**Emissions Control**	28 (68%)
	Energy Efficiency	19 (46%)
	Waste Reduction	17 (41%)
	Water Management	6 (15%)
	Biodiversity Conservation	6 (15%)
Social Performance	**Customer Satisfaction and Safety**	24 (59%)
	Employee Health and Safety	9 (22%)
	Community Engagement	5 (12%)
	Diversity and Inclusion	2 (5%)
	Human Rights and Labor Practices	0
Governance Performance	**Sustainability Strategy and Reporting**	37 (90%)
	Stakeholder Engagement	33 (80%)
	Compliance and Risk Management	5 (12%)
	Board Diversity and Structure	2 (5%)
	Corporate Ethics and Transparency	0
Economic Performance	**Cost Management**	40 (98%)
	Investment in Sustainable Technologies	40 (98%)
	Value Creation	35 (85%)
	Financial Stability and Growth	33 (80%)
	Market Competitiveness	10 (24%)
Operational Performance	**Operational Efficiency**	39 (95%)
	Technology and Innovation for Sustainability	39 (95%)
	Resilience and Adaptability	31 (76%)
	Product Lifecycle Management	5 (12%)
	Supply Chain Sustainability	2 (5%)

Table 4: Summary of Cross-Case Analysis (Source: Authors' Own Creation)

Sector	Type of Industry	UNSDGs Addressed	Sustainability Dimensions	QM Practices/Tools	Impact	Stakeholder Engagement
Manufacturing	Automotive (#14)	12, 9	Environmental, Social	Six Sigma, Lean, Customer Focus	Defect reduction, customer satisfaction, cost savings	Customers, suppliers
Manufacturing	Mining (#6)	13, 9	Environmental, Operational	Digital Transformation, Lean Tools	Safety improvements, process efficiency, reduced environmental impact	Employees, local communities
Manufacturing	Automation	12, 9	Environmental, Economic	Six Sigma, Process Optimization	Energy efficiency, defect reduction, cost savings	Internal stakeholders, suppliers
Manufacturing	Engineering (#3)	13, 12	Environmental, Economic	Lean Tools, Six Sigma	Process optimization, CO2 reduction, operational efficiency	Suppliers, internal stakeholders
Manufacturing	Chemicals (#2)	12, 9	Environmental, Economic	Waste Reduction, Emissions Control	Waste reduction, energy efficiency, regulatory compliance	Regulators, internal stakeholders
Manufacturing	Tyre (#2)	12, 8	Environmental, Social	Lean Tools, Process Management	Waste reduction, sustainable material usage	Suppliers, local communities

Sector	Type of Industry	UNSDGs Addressed	Sustainability Dimensions	QM Practices/Tools	Impact	Stakeholder Engagement
Manufacturing	Power (#2)	7, 13	Environmental, Economic, and Governance	Energy Efficiency, Risk Management	Long-term cost savings, improved governance	Policymakers, communities
Manufacturing	Textile (#2)	12, 8	Environmental, Social	Lean, Waste Reduction	Waste reduction, sustainable processes	Local communities, suppliers
Manufacturing	Construction (#1)	11, 13	Environmental, Social	Lean, Process Optimization	Sustainable construction, resource savings	Local communities, engineers
Manufacturing	Foundry (#1)	12, 9	Environmental, Economic	Process Optimization, Six Sigma	Energy efficiency, operational improvement	Internal stakeholders, suppliers
Service	Logistics (#1)	13, 12	Environmental, Economic	Lean Tools, Process Optimization	Energy savings, reduced emissions	Customers, regulators
Service	Healthcare (#1)	3, 8	Social, Economic	Continuous Improvement, PDCA	Improved service quality, employee well-being	Patients, employees
Service	Non-Profit (#1)	11, 8	Social, Environmental	Lean Tools, Process Optimization	Community support, resource efficiency	Local communities, volunteers

Appendix A: QM Practices (Source: Authors' Own Creation)

No.	QM Practices	Impact from the perspective of QM	References
1	Leadership	Ensures strategic alignment and drives continuous improvement across all levels of the organization.	(Chansatitporn and Pobkeeree, 2019)
2	Strategic Planning	Involves setting quality-focused objectives and integrating them into the organizational vision.	(Bolatan *et al.*, 2022)
3	Customer Focus	Ensures organizational processes are designed to meet or exceed customer expectations.	(Mehra and Ranganathan, 2008)
4	Process Management	Ensures that organizational processes are optimized for consistency and efficiency in quality outputs.	(Bhat *et al.*, 2021)
5	Human Resource Management (HRM)	Focuses on training, empowerment, and fostering teamwork to drive continuous improvement.	(Nayak *et al.*, 2023)
6	Information and Analysis	Involve using data and metrics to drive informed decisions and improvements.	(Sariyer *et al.*, 2021)
7	Environmental Sustainability	Involves practices that reduce environmental impact and promote resource efficiency.	(Abbas, 2020)
8	Social Sustainability	Ensures organizational activities positively impact employees, communities, and stakeholders.	(Hudnurkar *et al.*, 2023)
9	Economic Sustainability	Ensures long-term financial performance while maintaining quality standards.	(Siva *et al.*, 2016)
10	Knowledge Creation	Fosters innovation and continuous improvement in processes, products, and services.	(Barua, 2021)

No.	QM Practices	Impact from the perspective of QM	References
11	Knowledge Sharing	Encourages the dissemination of best practices to improve organizational processes and outcomes.	(Barua, 2021)
12	Knowledge Application	Ensures that information and expertise are effectively used to enhance processes and outcomes.	(Honarpour *et al.*, 2018)
13	Waste Reduction	Focuses on eliminating waste in processes to improve efficiency and sustainability.	(Kurdve *et al.*, 2015)
14	Innovation Capability for Supply Chains	Enhances flexibility and responsiveness, ensuring competitive advantage.	(Kwak *et al.*, 2018)
15	Environmental Process Innovations	Involve adopting green practices to reduce environmental impact.	(Silvestri *et al.*, 2024)
16	Teamwork	Fosters collaboration, problem-solving, and continuous improvement.	(Cooney and Sohal, 2004)
17	Commitment	Commitment from leadership and employees strengthens organizational quality practices and alignment with goals.	(Bou and Beltrán, 2005)
18	Internal Communication	Ensures alignment and helps implement quality initiatives.	(Bakotić and Rogošić, 2017)
19	Employee Motivation and Involvement	Increased motivation drives involvement in continuous improvement, leading to higher productivity.	(Yang *et al.*, 2024)
20	Work Satisfaction	Involving employees in quality practices leads to higher satisfaction and engagement at work.	(Bakotić and Rogošić, 2017)
21	Incidents, Rejections, and Complaints	Help to reduce defects and improve customer satisfaction through robust control measures.	(Patyal and Koilakuntla, 2017)

No.	QM Practices	Impact from the perspective of QM	References
22	Improved Relationship with Suppliers	Stronger supplier relationships lead to better collaboration, ensuring quality inputs for operations.	(Kim *et al.*, 2019)
23	Helps Supplier Selection	Ensure rigorous supplier selection, maintaining alignment with quality goals.	(Du *et al.*, 2023)
24	Relationships with Authorities and Other Stakeholders	Strong relationships with regulatory bodies and stakeholders ensure compliance and improve collaboration.	(Zink, 2007)
25	Customer Satisfaction	Continuous feedback from customers and improved processes ensures higher satisfaction.	(Mehra and Ranganathan, 2008)
26	Customer Communication	Effective customer communication fosters transparency and clarity, improving relationships and satisfaction.	(Santouridis and Veraki, 2017)
27	Customer Relationships	Building long-term relationships with customers ensures loyalty and repeat business.	(Santouridis and Veraki, 2017)
28	Product/Service Quality	Continuous monitoring and improvement of products and services lead to higher quality and customer satisfaction.	(Lepistö *et al.*, 2024)
29	Internal Organization and Operations	Streamlined processes and improved collaboration drive operational efficiency and internal performance.	(Escrig-Tena *et al.*, 2018)
30	Commitment in Moving Towards Best Quality Practices	Organizational commitment to continuous improvement drives the adoption of advanced quality practices.	(Benkarim and Imbeau, 2021)
31	Employee-Management Relationships	Strong relationships between employees and management enhance collaboration and trust.	(Yang *et al.*, 2024)
32	Infrastructural Framework to Adopt	QM practices provide the framework for the development of CSR policies,	(Frolova and Lapina, 2015)

No.	QM Practices	Impact from the perspective of QM	References
	and Develop CSR Policy, Strategy, and Activities	ensuring sustainability and ethical practices.	

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Appendix B: Sustainable Performance Dimensions (Source: Authors' Own Creation)

Dimensions	Factors	Explanation	Reference
Environmental	Energy Efficiency	Implementation of energy-saving measures and transition to renewable energy sources	(Gielen *et al.*, 2019)
	Water Management	Efficient use and recycling of water, along with proper wastewater treatment	(Gleick, 2014)
	Waste Reduction	Strategies for minimizing waste generation through process optimization and material recycling	(Jaramillo and Destouni, 2015)
	Emissions Control	Reduction of greenhouse gas emissions and pollutants to mitigate climate impact	(Churkina *et al.*, 2020)
	Biodiversity Conservation	Efforts to protect and restore biodiversity affected by manufacturing activities	(Mace *et al.*, 2018)
Social	Employee Health and Safety	Ensuring safe working conditions and promoting health and wellness	(Neal and Griffin, 2006)
	Diversity and Inclusion	Promoting a diverse workforce and inclusive work environment	(Hoobler *et al.*, 2018)
	Community Engagement	Active participation in community development and support for local initiatives.	(Bowen *et al.*, 2010)
	Human Rights and Labor Practices	Upholding human rights and fair labor practices throughout the supply chain	(Crane *et al.*, 2008)
	Customer Satisfaction and	Ensuring product safety and high levels of customer satisfaction	(Homburg *et al.*, 2017)

Dimensions	Factors	Explanation	Reference
	Safety		
Governance	Corporate Ethics and Transparency	Adherence to ethical business practices and transparent reporting	(Christensen and Cheney, 2015)
	Board Diversity and Structure	Ensuring a diverse and effective governance structure	(Rao and Tilt, 2016)
	Stakeholder Engagement	Mechanisms for engaging with and responding to stakeholders	(Freeman *et al.*, 2017)
	Compliance and Risk Management	Robust systems for regulatory compliance and risk assessment	(Mikes and Kaplan, 2015)
	Sustainability Strategy and Reporting	Integration of sustainability into corporate strategy and detailed sustainability reporting	(Eccles *et al.*, 2014)
Economical	Financial Stability and Growth	Maintaining financial health and ensuring sustainable growth	(Aiginger and Rodrik, 2020)
	Market Competitiveness	Enhancing competitiveness through sustainability-driven innovation	(Barney and Clark, 2007)
	Investment in Sustainable Technologies	Allocating resources to sustainable practices and technologies	(Wagner, 2015)
	Cost Management	Effective management of costs associated with raw materials, energy, and waste	(Christ and Burritt, 2015)
	Value Creation	Generating long-term value for shareholders and stakeholders through sustainable practices	(Grönroos, 2011)
Operational	Supply Chain Sustainability	Ensuring sustainability in procurement, production, and	(Touboulic and Walker, 2015)

Dimensions	Factors	Explanation	Reference
		logistics	
	Product Lifecycle Management:	Designing and managing products with consideration for their entire lifecycle	(Stark, 2015)
	Operational Efficiency	Streamlining operations to reduce resource use and improve productivity	(Shah *et al.*, 2008)
	Technology and Innovation for Sustainability	Leveraging technology and innovation to enhance sustainability	(De Marchi, 2012)
	Resilience and Adaptability	Building resilience to environmental, social, and economic changes.	(Folke *et al.*, 2010)

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Appendix C: Qualitative Analysis of the Case Studies (Source: Authors' Own Creation)

Initial Information					Quality Management Tools and Techniques Used			Unique Approaches and Breakthroughs			Leverage Potential			Implications		
Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
1.	Manufacturing	Automotive	Reduction in Rejection and Customer Complaints in Gear Line through Innovative Approach	GOAL 9, GOAL 10	Six Sigma DMAIC, Pareto Chart, 2 Sample T-test, Box Plot, Design of Experiments (DOE)	Six Sigma DMAIC approach was used to identify and analyze the rejection reasons. Pareto chart highlighted major contributors to rejection. 2 Sample T-test and Box Plot were used to study heat treatment distortion. DOE determined the correction in the hobbing process.	Reduction in rejection PPM from 1345 to 1045, improving customer satisfaction and eliminating teeth un wash issues.	Studying distortion patterns and applying compensatory corrections in the soft stage of hobbing to nullify heat treatment distortion.	The project involved a detailed study of heat treatment distortion and implementation of corrective actions in the soft stage to prevent post-heat treatment issues.	Elimination of teeth un wash and reduction in rejection PPM by 22%.	Detailed analysis and corrective actions can significantly reduce rejection rates. Cross-functional team collaboration is crucial.	Improved product quality and customer satisfaction. Reduction in production costs due to lower rejection rates.	The compensatory approach for handling heat treatment distortion can be applied in other industries with similar processes.	Demonstrates the effectiveness of Six Sigma and DOE in addressing quality issues in manufacturing.	Provides a practical approach for reducing defects and improving quality in gear manufacturing.	Enhances product reliability and customer satisfaction, contributing to economic and social well-being.
2.	Manufacturing	Automotive	Customer delight through prompt efforts to resolve Synchro parts concern	GOAL 9, GOAL 12	Histogram, Boxplot, Fish Bone Diagram, Brainstorming, Why Why Analysis, Mistake Proofing, New Inspection Facility	Problem solving tools were used to analyze the voice of customer and their concerns related to Synchro parts. Potential causes were validated and actions were taken on root causes using mistake proofing and new inspection facility.	Inter Unit Transfer of Synchro parts PPM reduced from 69 PPM to Zero PPM, achieving zero customer complaints in the last two months.	In-house development of new inspection fixture for groove checking of F16243119S sleeve with visual output.	Developed a new inspection fixture using available resources to detect incomplete or missing groove operations, eliminating quality concerns in groove operations.	Achieved Zero PPM in Inter Unit Transfer of Synchro parts, leading to customer delight and zero customer concerns.	Innovation and process improvements can significantly reduce defects and improve customer satisfaction. Cross-functional team collaboration is crucial.	Improved product quality and customer satisfaction. Reduction in production costs due to lower rejection rates. Cost saving of Rs. 29,983 per annum and Rs. 1,00,000 on one-time basis.	The developed inspection fixture and mistake proofing techniques can be applied in other industries with similar processes.	Exhibits the efficacy of problem-solving instruments and creativity in resolving quality concerns in production.	Offers a pragmatic methodology for minimising faults and enhancing quality in the manufacture of Synchro components.	Improves product dependability and consumer contentment, fostering economic and social prosperity.

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Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
3.	Service	Logistics	Electricity (KWH) Consumption Reduction by 25% in FY 23 on baseline of previous year	GOAL 12	DMAIC, 4W-1H, 3G, Brainstorming, Benchmarking, Kaizens, IMR Control Charts, Normality Test, 2T Test, Box Plot, Capability Analysis, 2x2 Matrix	The DMAIC approach was used to define, measure, analyze, improve, and control the project. Tools such as process mapping, normality tests, run charts, box plots, and histograms were employed for analysis. IMR control charts and capability analysis were used for monitoring and control.	Electrical energy saving of approximately 22 lakh kWh, reducing 1,638 tons of CO2 emissions, equivalent to the conservation of ~9,809 trees. Cost savings of INR 2.34 crore in FY 23.	Conducted road shows at top 30 sites, deployed quick win initiatives, and implemented a 3-tier approach for driving improvements.	Implemented a 3-tier approach (quick wins, electromechanical devices, AI & IoT) and developed a unique organizational structure to drive improvements across top 100 sites.	Achieved significant energy savings and carbon emission reductions, with cost savings and improved energy efficiency awareness across the organization.	Innovative strategies and cross-functional team collaboration can significantly reduce energy consumption and carbon emissions.	Potential benefits over 4 years include saving ~60 Lac kWh, reducing ~5003 tons of CO2 equivalent, conserving ~29000 trees, and saving INR 10.4 crore.	The developed strategies and tools for energy efficiency can be applied in other industries to achieve similar benefits.	Illustrates the efficacy of Six Sigma and DMAIC tools in resolving sustainability and energy efficiency concerns.	Provides a feasible approach to reducing energy consumption and improving the sustainability of supply chain management and logistics.	Contributes to the global fight against climate change by reducing carbon emissions and conserving energy, thereby enhancing environmental sustainability.
4.	Manufacturing	Automotive	Eco Friendly coating and sealing materials for new range of Automotive vehicles	GOAL 8, GOAL 12	Eco-friendly materials, Sustainable processes, Green manufacturing techniques	The project focused on using eco-friendly coating and sealing materials in the manufacturing of new automotive vehicles, implementing sustainable processes and green manufacturing techniques.	Improved environmental sustainability of the manufacturing process, reduced carbon footprint, and enhanced product quality and durability.	Development and implementation of eco-friendly materials and sustainable manufacturing techniques in the automotive industry.	Utilized eco-friendly materials for coating and sealing, reducing the environmental impact and ensuring compliance with sustainability goals.	Achieved significant reductions in environmental impact, improved product quality, and set a new standard for sustainable manufacturing in the automotive industry.	Adopting eco-friendly materials and sustainable processes can significantly enhance environmental sustainability and product quality.	Reduced environmental impact, improved product quality, compliance with global sustainability goals, and enhanced corporate reputation.	The techniques and materials used in this project can be applied in other industries to achieve similar sustainability and quality improvements.	Provides evidence of the efficacy of sustainable processes and environmentally favourable materials in the manufacturing process.	Offers a practical method for incorporating sustainability into manufacturing processes.	Promotes the use of eco-friendly materials, reduces the carbon footprint, and contributes to environmental sustainability.

Initial Information					Quality Management Tools and Techniques Used			Unique Approaches and Breakthroughs			Leverage Potential			Implications		
Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
5.	Manufacturing	Mining	Digital and Sustainable transformation of transportation in Mines	GOAL 9	e-log system, RFID, GPS, DMADIC, TQM, PDCA, Observational Analysis, Quasi blockchain, Artificial Intelligence	A digitally enabled e-log system was implemented using RFID and GPS technology. The DMADIC methodology and TQM philosophy (PDCA) were used for defining, designing, and implementing the project. Observational analysis, quasi blockchain, and AI were also utilized.	Improved safety with reduced manual interventions, significant paper savings, reduced turnaround time for trucks, improved work-life balance for drivers, and complete process digitization.	End-to-end digitalization of truck movement within mines using advanced technologies such as RFID, GPS, and AI.	The project involved implementing a digital e-log system with RFID and GPS for truck tracking, automated documentation, and real-time monitoring, reducing manual interventions and enhancing safety and efficiency.	Achieved significant improvements in safety, efficiency, and sustainability, reducing carbon footprint and enhancing overall operational efficiency.	Digitalization and advanced technologies can significantly improve operational efficiency, safety, and sustainability in mining operations.	Potential for horizontal deployment across all mines, reducing TAT and man-machine interface, leading to improved safety and efficiency.	The digitalization techniques and tools used in this project can be applied in other industries to achieve similar improvements in efficiency, safety, and sustainability.	Demonstrates the effectiveness of digitalization and advanced technologies in improving mining operations.	Provides a practical approach for integrating digital technologies into mining operations for improved efficiency and sustainability.	Enhances environmental sustainability, reduces carbon footprint, and improves safety and efficiency in mining operations.
6.	Manufacturing	Automation	Utilization of Clean Energy Source more than 50% and Optimize Energy usages At Bosch Rexroth Ahmedabad Location	GOAL 7	Roof top solar project, Wind energy sourcing, PDCA methodology	Installed captive base roof top solar project and opted sourcing of wind energy under Third Party Power Purchase Model. Implemented PDCA methodology for solving problems systematically.	Increased contribution of clean energy to 54% in total energy consumption, reduced energy costs, and improved carbon footprint of the plant by 62%.	Implemented a combination of roof top solar project and wind energy sourcing to maximize clean energy usage and optimize energy consumption.	Installed roof top solar panels and sourced wind energy, integrating them with existing energy sources and implementing advanced cleaning systems for maintaining solar panel efficiency.	Achieved significant reductions in energy costs and carbon footprint, demonstrating a reliable and cost-effective alternative to conventional energy sources.	Renewable energy projects can significantly reduce energy costs and carbon footprint, contributing to sustainable development.	The project can be easily replicated in other plants and organizations, increasing the usage of clean energy and improving sustainability.	The techniques and tools used in this project can be applied in other industries to achieve similar improvements in energy efficiency and sustainability.	Illustrates the efficacy of renewable energy initiatives in mitigating energy expenditures and carbon emissions.	Presents a practicable method for incorporating renewable energy sources into manufacturing operations.	Improves ecological sustainability by cutting down on carbon emissions and the use of fossil fuels.

Initial Information					Quality Management Tools and Techniques Used			Unique Approaches and Breakthroughs			Leverage Potential			Implications		
Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
7.	Manufacturing	Automation	Autonomous working of air compressor bank as per real time demand scenario using deep learning	GOAL 7, GOAL 9, GOAL 12, GOAL 13	Deep learning models, Decision tree matrix, Model predictive control, Regression analysis	Deep learning models deployed to predict CFM requirements and decide compressor operations. Model predictive control used for the cooling tower, with regression analysis to regulate water flow as per heat load.	Achieved energy savings of 108 MWh, reduced CO2 emissions by 78 tons, and improved overall efficiency with a payback period of ~3.8 years.	Implemented autonomous control of compressors and cooling towers using deep learning and predictive models to optimize energy usage and reduce manual intervention.	AI models predict CFM requirements and control compressor operations in real time, while predictive control optimizes cooling tower water flow based on heat loads and environmental conditions.	Significant energy savings, reduced CO2 emissions, and enhanced operational efficiency through autonomous control systems.	Advanced AI and predictive control can greatly improve energy efficiency and sustainability in industrial operations.	The AI solution can be applied in industries using air compressors, leading to substantial energy savings and reduced environmental impact.	The AI and predictive control techniques used in this project can be leveraged by other industries to optimize energy usage and improve operational efficiency.	Proves that AI and predictive control can optimise industrial processes while cutting energy usage..	Presents a workable strategy for improving factory energy efficiency through the use of control systems based on artificial intelligence.	Helps achieve sustainable development objectives by lowering energy usage and carbon dioxide emissions; backs efforts to combat climate change and promotes ethical consumerism.
8.	Manufacturing	Automation	Digital Bill of material and Setup checklist in Assembly line for process improvement and paper consumption elimination	GOAL 12	QC Circle, Flowchart, Brainstorming	Developed a digital solution to interact with SAP and BOSCH drawing management system to display bill of material and setup checklist at each assembly line station, including interlocks to avoid bypass of setup check activity.	Saved 36,000 A4 sheets per year, saved 600 hours per year of team leader time, eliminated human errors in selecting relevant parts during setup, and reduced paper consumption to zero.	Implemented a digital solution with shop floor associate involvement, achieving zero paper usage for bill of material and setup checklist.	The digital solution interacts with SAP and drawing management system based on production planning, eliminating manual involvement and ensuring no steps are skipped in setup activities.	Achieved zero paper usage for bill of material and setup checklist, saving time and reducing errors in the setup process.	Digital transformation can significantly reduce paper usage and improve process efficiency in manufacturing.	The digital solution can be deployed on other assembly lines, leading to further paper savings and process improvements.	The digital bill of material and setup checklist approach can be applied in other industries to achieve similar benefits in paper savings and process efficiency.	Proves that digital transformation may cut down on paper use while simultaneously increasing productivity.	Outlines a workable strategy for integrating digital technologies to enhance setup procedures while doing away with paper.	Promotes digital solutions and decreases paper usage, which contributes to environmental sustainability.

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Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
9.	Manufacturing	Chemicals	Scrap to Art work – Delivering a green Sustainable Future	GOAL 9, GOAL 12, GOAL 13	Root Cause Analysis, DOE, Brainstorming	Transformed end-of-life R&D equipment into science-themed artwork, specifically a Blue Mormon butterfly, to repurpose the equipment creatively and give them a new life. The project underwent rigorous testing to ensure structural integrity and aesthetic appeal.	Created a visually appealing and meaningful monument that highlights the synergy between technology and creativity while promoting environmental sustainability.	Utilized waste equipment from the laboratory to create a monument, demonstrating a commitment to sustainability and innovation by merging science and art.	Repurposed various equipment parts into an art piece depicting a Blue Mormon butterfly, symbolizing our dedication to a sustainable future and the intersection of science and creativity.	Achieved a unique and outstanding monument that represents innovation, sustainability, and resourcefulness, showcasing the ability to transform challenges into opportunities.	Creative repurposing of end-of-life equipment can effectively promote sustainability and inspire engagement with environmental values.	The project can serve as a model for other organizations to creatively repurpose equipment and promote sustainability through innovative approaches.	The Scrap to Art approach can be applied in other industries to creatively repurpose end-of-life equipment and promote sustainability.	Exhibits the possibility of engaging with environmental ideals and promoting sustainability via innovative use of obsolete technology.	Gives a concrete illustration of how to use art and science to encourage sustainability and find new uses for old machinery.	Aids in environmental sustainability by encouraging innovative uses for discarded machinery and cutting down on waste.
10	Manufacturing	Automotive	JPH Improvement from 40 to 60 JPH, Energy saving of 4200 kWh / annum and CO2 reduction of 4.2 Ton	GOAL 4, GOAL 5, GOAL 9, GOAL 11, GOAL 12, GOAL 13	Brainstorming, PDCA, Hypothesis, Work Balance chart, Lean Manufacturing, SWCT (Standard Work Cycle Time Study) chart	Implemented various tools and techniques including brainstorming, PDCA, hypothesis, work balance chart, lean manufacturing, and SWCT chart to improve productivity and efficiency of the W601/Z101 console line.	Improved JPH from 40 to 60, saved 4200 kWh of energy per annum, and reduced CO2 emissions by 4.2 tons per annum.	Implemented line commonization for W601 & Z101 consoles and optimized the production process to reduce non-value-added activities and improve efficiency.	Optimized the production process by commonizing W601/Z101 console assembly operations, reducing non-value-added activities, and implementing line balancing as per TAKT time.	Achieved significant improvements in productivity, energy savings, and CO2 reduction, setting a new standard for efficiency and sustainability in automotive manufacturing.	Process optimization and line balancing can significantly improve productivity and sustainability in manufacturing operations.	The project can be replicated in other automotive manufacturing lines to achieve similar improvements in productivity, energy savings, and CO2 reduction.	The techniques and tools used in this project can be applied in other industries to optimize production processes and improve sustainability.	Shows how line balance and process optimisation may increase manufacturing productivity while decreasing environmental impact.	Outlines a workable strategy for optimising processes and balancing lines to boost manufacturing productivity and sustainability.	Supports climate action and responsible consumption objectives while lowering energy usage and CO2 emissions, which contributes to environmental sustainability.

Initial Information					Quality Management Tools and Techniques Used			Unique Approaches and Breakthroughs			Leverage Potential			Implications		
Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
11	Manufacturing	Chemical	Reduction in waste generation by optimization of raw material quantities, utilizing the principles of 4R (Reduce, Reuse, Recycle & Recover) with ESG anchored approach of PI Industries Limited	GOAL 12, GOAL 13	4R (Reduce, Reuse, Recycle & Recover), ESG principles, E-factor, Change Management, PDCA	Utilized 4R principles (Reduce, Reuse, Recycle & Recover) and ESG principles to reduce waste generation. Adopted E-factor at R&D level to categorize products based on waste generation and implemented change management and PDCA methodologies to achieve the results.	Reduced waste generation by 23.8%, improved environmental sustainability, and achieved significant cost savings in waste disposal and raw material usage.	Implemented a comprehensive waste reduction strategy involving optimization of raw material quantities, reuse and recycling of solvents, and recovery of waste, guided by ESG principles and the PDCA methodology.	Adopted a holistic approach to waste management, integrating waste reduction at the R&D level, implementing changes at commercial scale, and continuously monitoring and improving the process through PDCA cycles.	Achieved a 23.8% reduction in waste generation, demonstrating the effectiveness of the 4R principles and ESG approach in improving sustainability in chemical manufacturing.	Integrating waste reduction strategies at the R&D level and continuously monitoring and improving processes can significantly enhance sustainability and reduce waste in chemical manufacturing.	The project can serve as a model for other chemical manufacturing companies to adopt similar waste reduction strategies and improve their sustainability performance.	The 4R principles and ESG approach used in this project can be applied in other industries to achieve similar waste reduction and sustainability improvements.	Shows that the 4Rs and an ESG strategy may help chemical manufacturers reduce waste and become more sustainable.	Offers a workable method for reducing chemical industrial waste completely.	Promotes responsible consumption and production while decreasing hazardous waste output, which contributes to environmental sustainability.

Initial Information					Quality Management Tools and Techniques Used			Unique Approaches and Breakthroughs			Leverage Potential			Implications		
Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
12	Manufacturing	Automotive	Best From Waste	GOAL 11	DMAIC methodology	Used DMAIC methodology to identify the problem of scrapping precious metals, evaluate high-value content materials, and recycle the same. Implemented a structured approach to solve problems and ensure accurate baselines.	Recycling of essential scarce metals and reduction in waste loss, yielding about 2 Crores to the organization in FY 22-23.	Recycled precious metals from scrapped exhaust systems and copper from vehicle wiring harnesses, which is unique to the automotive industry.	Developed a methodology to evaluate and recycle precious metals from used/scrapped parts and copper from vehicle wiring harnesses, using them as raw materials for new products.	Achieved significant financial savings and reduced environmental impact through innovative recycling processes.	Innovative recycling processes can significantly reduce waste and yield substantial financial and environmental benefits.	The project can be replicated in other automotive plants and industries to achieve similar benefits in recycling and sustainability.	The recycling methodology used in this project can be applied in other industries to optimize resource use and reduce waste.	Proves that the DMAIC approach works for recycling valuable metals and optimising resource utilisation.	Provides a practical approach for implementing innovative recycling processes in the automotive industry.	Helps maintain a sustainable environment by encouraging conscientious consumption and manufacturing practices and cutting down on waste.

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Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
13	Manufacturing	Automation	Elimination of Hazardous Lapping process from NHA manufacturing	GOAL 3, GOAL 9, GOAL 12	Lean Tools, Lean Line Design, Speed Week Approach (AGILE Tool), Suggestion and Kaizen from Operators	Used various improvement tools to reduce space of machine, optimize resources, and generate empty space. Key methodologies include Lean Line Design, removal of surplus MAE, Smart cell concept, merging of stations, and validation.	Reduced total space by 1600 m2, resulting in power savings of 6.98 MINR, AMC reduction of 4.48 MINR, CL reduction of 5.77 MINR, and other variable cost savings of 6.94 MINR.	Consolidated manufacturing setup of VE pump and NHA in one hangar, optimizing space and reducing power and resource consumption.	Implemented consolidation of manufacturing setup by reducing the size of lines, removing surplus MAE, applying Smart cell concept, merging stations, and validating the process to optimize resources and generate space.	Achieved space optimization, reduced power and resource consumption, and prepared space for future products.	Effective use of Lean tools and methodologies can significantly optimize space and resources, leading to cost savings and sustainability.	The project can be replicated in other manufacturing setups to optimize space, reduce power and resource consumption, and prepare for future product lines.	The Lean tools and methodologies used in this project can be applied in other industries to achieve similar space and resource optimization.	Shows how Lean tools and practices may optimise production space and resources.	Offers a realistic strategy for making use of Lean tools and processes to maximise production space and resources.	Contributes to environmental sustainability by reducing power and resource consumption and optimizing space for future use.
14	Manufacturing	Power	Improvement of Net Station Heat Rate	GOAL 9, GOAL 12	Six Sigma methodology, DMAIC philosophy	Improvement of process output, optimization of energy charge rate, and reduction of heat rate.	Enhanced efficiency and reduced CO2 emissions.	Optimization of power generation processes to improve efficiency and reduce emissions.	Implementation of Six Sigma methodology and DMAIC philosophy to improve heat rate and efficiency.	Improvement in net station heat rate, reduction in CO2 emissions, and financial benefits.	Process optimization can lead to significant improvements in efficiency and sustainability.	Improved efficiency, reduced environmental impact, and cost savings.	Adopt similar process optimization techniques in other power generation and industrial processes.	Helps to understand research on process optimization techniques in power generation.	Provides roadmap for Adopting and implementing Six Sigma methodology for process improvements.	Reduced environmental impact, improved efficiency, and sustainable power generation.

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15	Service	Healthcare	Career and Competency Development Program (CCDP)	GOAL 4	TQM, 5S, Kaizen	50-day training program for unemployed youth to improve employability skills.	Improved employability and livelihood for rural youth.	Providing free training and placement assistance to underprivileged youth.	Training in soft skills, English proficiency, computer skills, and hospital administration.	Successful training and placement of students in various sectors like healthcare, finance, banking, retail, and more.	Skill development programs can significantly improve employability and livelihood.	Enhanced employability, economic development, social inclusion.	Implement similar training and skill development programs in other sectors.	Provides insights about skill development programs on employability.	Adopted and implemented skill development programs to enhance employability.	Improved livelihood, economic development, and social inclusion for underprivileged youth.
16	Manufacturing	Power	A Big Sustainability Swing through change in the cable & cable drum design	GOAL 7, GOAL 9, GOAL 12, GOAL 13	Root cause Analysis, Tree Diagram, QC tools	Replacement of Lead Naphthenate with environment-friendly additives. Longitudinal water sealing of conductor. Hybrid design of cable drums combining wood and mild steel.	Reduction in wood consumption, reduced lead usage, enhanced durability of cables, fault-free cables.	Environmentally friendly cable and drum design to reduce lead usage and wood consumption while enhancing cable durability.	Combining wood and mild steel for cable drums and using water sealing techniques in cables.	919 Hybrid Drums, 55 Ton Wood saved, 78 Trees saved, 46 ton carbon footprint reduction, reduced lead consumption by 4 tons, and fault-free cables.	Innovative design changes can lead to significant sustainability improvements.	Enhanced product durability, reduced environmental impact, cost savings.	Adopt similar design changes and sustainable practices in cable manufacturing and other related industries.	Research on sustainable materials and techniques for cable manufacturing.	Adoption of environmentally friendly materials and designs in manufacturing.	Reduced environmental impact, improved sustainability, and resource conservation.
17	Manufacturing	Automotive	Reduce carbon foot print in IB packaging process	GOAL 12	TPM 7 Step methodology, ROTI approach	Analyzing and reducing waste in the packaging process.	Reduction in carbon footprint from 60% to 10%.	Reuse of plastic covers for packing parts.	Waste elimination approach to identify and reduce waste in the packaging process.	Significant reduction in carbon footprint.	Reuse of materials can lead to significant sustainability improvements.	Reduced waste, lower carbon footprint.	Implement waste reduction measures in packaging processes.	Study the impact of waste reduction measures on carbon footprint.	Adopt waste reduction measures in packaging processes.	Reduced waste and carbon footprint.

Initial Information					Quality Management Tools and Techniques Used			Unique Approaches and Breakthroughs			Leverage Potential			Implications		
Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
18	Manufacturing	Mining	Improvement in substitution of conventional Energy by Renewable energy	GOAL 7, GOAL 9, GOAL 12, GOAL 13	DMAIC, Check sheet, Why-Why analysis, Fishbone analysis	Converting LDO fired boiler to biomass briquette fired boiler and installation of solar panels.	Renewable energy substitution by 70.5% of total plant energy.	Conversion of existing boiler to biomass briquette fired boiler.	Use of renewable energy sources to replace conventional energy sources.	Significant increase in renewable energy usage and reduction in emissions.	Renewable energy sources can significantly reduce reliance on conventional energy sources.	Reduced energy costs, lower emissions.	Implement renewable energy projects in other industries.	Research on renewable energy solutions in manufacturing.	Implement sustainable energy solutions in manufacturing operations.	Reduced reliance on conventional energy sources and lower emissions.
19	Manufacturing	Automotive	Adiabatic Smart Cooling Technology for our existing air-cooled chillers	GOAL 7, GOAL 9, GOAL 12, GOAL 13	7 QC tools, Pie chart, Why Why analysis	Analyzing chiller energy consumption trend using various quality management tools.	Reduction in energy consumption and improved chiller efficiency.	First time in India, implemented within Mahindra group, reducing the ambient temperature using adiabatic process.	Adiabatic pre-cooling system designed to reduce incoming air temperature on condenser coils.	Reduction in carbon footprint by 151 Tons.	Adiabatic cooling can significantly reduce energy consumption.	Improved chiller efficiency, reduced energy consumption, and lower carbon footprint.	Deploy the technology across air-cooled chillers in various industries.	Study the impact of adiabatic cooling on energy consumption.	Implemented adiabatic cooling in air-cooled chillers.	Decreased energy usage and carbon emissions.
20	Manufacturing	Mining	Surge in recovery & quality of iron ore fines from hydrocyclone	GOAL 3, GOAL 8, GOAL 9, GOAL 11, GOAL 12	Brainstorming, Why-Why Analysis, 7 QC tools	Root cause analysis and pilot testing to improve iron ore recovery.	Recovery increased from 4.96% to 8%, Fe% increased by 0.5, Alumina reduced by 0.3%.	Laminar flow hydrocyclone and 3D panels for better recovery.	Implemented CVD 400 hydrocyclone and 3D panels to improve recovery.	Significant surge in recovery and improvement in quality.	Innovative technologies can significantly improve resource recovery.	Improved recovery and quality of iron ore, reduced waste.	Implement similar technologies for resource recovery in other industries.	Examined the effects of cutting-edge technology on resource recovery.	Adopted innovative technologies for resource recovery.	Improved resource recovery and reduced waste.
21	Manufacturing	Automotive	Reduction of Energy Consumption (Project-Sambhav)	GOAL 13	7 QC Tools, Brainstorming, Line Charts	Used various quality tools to analyze and reduce energy consumption.	Energy consumption reduction achieved from 305480 kWh to 289756 kWh.	Use of renewable energy sources and quality tools to reduce energy consumption.	Analyzed energy consumption and implemented changes to reduce it.	Energy consumption reduction and cost savings.	Renewable energy sources can significantly reduce energy consumption.	Reduced energy costs, lower carbon emissions.	Implement similar energy-saving measures in other industries.	Research on energy-saving techniques in manufacturing.	Implement energy-efficient practices in manufacturing operations.	Reduced energy consumption and carbon emissions.

Initial Information					Quality Management Tools and Techniques Used			Unique Approaches and Breakthroughs			Leverage Potential			Implications		
Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
22	Manufacturing	Mining	Remote Wireless Operation of moving machineries i.e., Stacker and Reclaimer from Yard Control Room	GOAL 1, GOAL 9, GOAL 12	12 steps of problem solving in QC, Pareto Diagram, Cause & Effect Diagram, Histogram, Milestone chart, Flow diagram, Brainstorming, Priority number	Implemented remote operation through wireless communication and installed CCTVs for continuous monitoring.	Increased safety, reduced operational detention, increased production, reduction in overtime, improved monitoring.	First implementation of wireless remote control of stacker and reclaimer in mines in India.	Remote operation of machines to improve safety and efficiency.	Reduction in operational detention, increased production, and tangible benefits of around Rs 1.89 Crores.	Remote operation can significantly improve safety and efficiency.	Improved safety, increased production, reduced operational costs.	Implement remote control technology in other mines and industries with similar machinery.	Study the impact of remote operation on safety and efficiency.	Adopt remote operation technology in mining and other industries.	Enhanced safety and efficiency in mining operations.
23	Manufacturing	Automotive	Steel coil width reduction of 'Frame Side Member' through product parameter optimization	GOAL 4, GOAL 6, GOAL 7, GOAL 13, GOAL 15	Hypothesis testing, regression analysis, DOE, PDCA	Optimization of steel coil width to reduce steel consumption.	Reduction in steel consumption, cost savings, reduced emissions.	Optimization of product parameters to reduce resource consumption.	Reduction of steel coil width through data analysis and optimization techniques.	Reduction in steel consumption, cost savings, and reduced emissions.	Optimization of product parameters can lead to significant resource savings.	Reduced resource consumption, cost savings, lower emissions.	Implement similar optimization techniques in other manufacturing processes.	Study the impact of product parameter optimization on resource consumption.	Adopt optimization techniques to reduce resource consumption.	Reduced resource consumption and emissions.
24	Manufacturing	Automotive	Reduction in Natural Resources depletion through innovation in Cabin painting process	GOAL 4, GOAL 6, GOAL 7, GOAL 13	7 steps problem solving methodology, PDCA, DOE, Regression analysis	Developed integrated painting process to reduce resource consumption.	Reduced resource consumption, improved productivity, cost savings.	Innovative fixtures and skid modifications to optimize the painting process.	Developed fixtures and skid modifications to reduce resource consumption in the painting process.	Significant reduction in resource consumption and cost savings.	Innovative process modifications can lead to significant resource savings.	Reduced resource consumption, improved productivity, cost savings.	Implement similar process modifications in other manufacturing operations.	Examine the effects of process changes on resource utilisation.	Implement procedural alterations to minimise resource use.	Decreased resource use and emissions.
25	Manufacturing	Mining	Anti-toppling mechanism implementation in all HEMM of Khondbond Iron Mines	GOAL 3, GOAL 9, GOAL 12	Pareto Analysis, Cause Effect Diagram, Check sheet, Kaizen	Engineering solutions (Poka-yoke) to prevent safety standard violations.	Elimination of toppling incidents, improved safety and cost savings.	Implementation of mistake-proof solutions to prevent equipment toppling.	Engineering solutions to prevent safety standard violations.	Zero toppling incidents in the last six months.	Engineering solutions can effectively prevent equipment toppling.	Improved safety, reduced equipment damage costs.	Implement similar safety solutions in other mining operations.	Study the impact of engineering solutions on safety in mining.	Adopt engineering solutions to improve safety in mining operations.	Improved safety and reduced equipment damage in mining operations.

Initial Information					Quality Management Tools and Techniques Used			Unique Approaches and Breakthroughs			Leverage Potential			Implications		
Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
26	Manufacturing	Construction	Peninsula Salsette 27 Project	GOAL 3, GOAL 6, GOAL 7, GOAL 11, GOAL 12	Root cause Analysis, SOPs, Quality Control Plan	Implementation of IGBC Platinum-certified green building practices.	Improved energy efficiency, reduced water consumption, reduced carbon footprint.	Implementation of green building practices in a high-rise residential project.	Eco-friendly homes with solar lights, water heaters, and waste and sewage treatment plants.	Improved energy efficiency and reduced environmental impact.	Green building practices can significantly improve energy efficiency and reduce environmental impact.	Improved energy efficiency, reduced water consumption, lower carbon footprint.	Implement green building practices in other construction projects.	Investigated the influence of green building practices on environmental impact and energy efficiency.	Incorporated sustainable building practices into construction initiatives.	Enhanced energy efficiency and diminished environmental impact in residential buildings.
27	Manufacturing	Foundry	Electrical Energy Consumption Reduction for 6 Melting Furnace - Material Grade Combinations in Foundry	GOAL 7	Six Sigma DMAIC Approach, Regression Analysis, DOE, FMEA, Kaizen	Optimizing charge quantity and sizes, reducing heat duration losses, and improving furnace efficiency.	Reduced electricity consumption for Cast Iron and SG Iron, cost savings.	Optimization of furnace operations to reduce electricity consumption.	Implemented DOE to optimize charge quantity and sizes, reduced heat duration losses.	Annual savings in electricity cost of Rs. 34 lakhs for 3 furnaces.	Optimizing furnace operations can lead to significant energy savings.	Reduced electricity consumption, cost savings, improved furnace efficiency.	Implement similar optimization techniques in other foundries and manufacturing operations.	Performed an analysis of the influence of furnace optimisation on energy consumption.	Implemented furnace optimisation strategies to mitigate energy consumption.	Reduced energy consumption and emissions in foundry operations.

Initial Information					Quality Management Tools and Techniques Used			Unique Approaches and Breakthroughs			Leverage Potential			Implications		
Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
28	Manufacturing	Engineering	Reduce carbon emissions through problem solving tools to prevent CTRB cone honing losses in manufacturing .	GOAL 9, GOAL 12	Six Sigma DMAIC, PDCA, Brainstorming, Hypothesis testing (One sample t-test), Why-Why analysis	Used various high-end quality tools to identify and address the main causes of rejection in the gear line, specifically focusing on hobbing and handling damage. Implemented centralized oil filtration plant for honing operation, improved machine settings, and reduced stone change frequency.	Reduced rejection PPM from 1345 PPM to 1045 PPM, a 22% reduction. Reduced dirt content in oil by 93%, oil consumption by 60%, and total carbon emissions by 61.6%.	Studied heat treatment distortion and implemented corrections in the soft stage to nullify the distortion. Implemented centralized oil filtration plant and standardized preventive maintenance practices.	Provided lead correction in the hobbing operation, avoiding metal-to-metal contact to reduce handling damages. Connected machines with centralized oil filtration plant to reduce dirt content and oil consumption.	Eliminated teeth unwash concern and handling damages, improving customer satisfaction and making the hobbing process robust. Reduced carbon emissions from 2951 Kg Co2e to 1133 Kg Co2e, a 61.6% reduction.	Compensation in the soft stage can effectively address heat treatment distortion. Centralized oil filtration significantly reduces dirt content and oil consumption, leading to substantial carbon emission reductions.	Reduced rejection, improved quality, enhanced customer satisfaction, reduced energy consumption, and lower carbon emissions.	Apply similar strategies in other industries with similar processes like hobbing, heat treatment, and teeth grinding. Implement centralized oil filtration in other manufacturing operations to reduce oil consumption and emissions.	Study the impact of compensation in the soft stage on heat treatment distortion. Investigate the long-term benefits of centralized oil filtration on machine efficiency and carbon emissions.	Adopt lead correction techniques to nullify heat treatment distortion. Implement centralized oil filtration to reduce oil consumption and emissions.	Improved quality and reduced rejection in manufacturing processes. Reduced environmental impact through lower carbon emissions and oil consumption.
29	Manufacturing	Engineering	To attain carbon neutrality through carbon emission reduction in power consumption (purchased electricity)	GOAL 9	Six Sigma DMAIC, Why-Why Analysis, Scatter Diagram, Automation	Automation of coolant plant, installation of solar panels, live power consumption monitoring.	Reduced power consumption, carbon emission reduction.	Automation and renewable energy implementation to reduce carbon emissions.	Automation of coolant plant, solar panel installation, live monitoring system.	Reduction of 50,000 kg CO2e/year in carbon emissions.	Automation and renewable energy can significantly reduce carbon emissions.	Reduced power consumption, carbon emissions, cost savings.	Implement automation and renewable energy solutions in other manufacturing operations.	Investigate the influence of renewable energy and automation on carbon emissions.	Adopt automation and renewable energy solutions to reduce carbon emissions.	Reduced carbon emissions and improved sustainability in manufacturing operations .

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Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
30	Manufacturing	Mining	Reducing thermal coal usage by introducing bio-mass consumption in coal based boiler	GOAL 7, GOAL 12	QC story 7 Step methodology, Brainstorming, Cause & Effect Diagram, PDPC	Substitution of coal with biomass in coal-based boilers.	Reduced coal usage, CO2 emission reduction.	Use of biomass to reduce coal usage and CO2 emissions.	Introduction of biomass like spent coffee grounds, wood chips, rice husk in coal-based boilers.	Saved 5575 MT of coal, reduced CO2 emissions by 14588 T.	Biomass can effectively substitute coal and reduce emissions.	Reduced coal usage, CO2 emissions, cost savings.	Implement biomass substitution in other coal-based boiler operations.	Study the impact of biomass substitution on coal usage and emissions.	Reduced emissions and coal consumption by implementing biomass substitution.	Decreased emissions and coal consumption in steel manufacturing operations.
31	Manufacturing	Textile	Development of high tenacity olive green coloured industrial yarn with zero effluent discharge	GOAL 9, GOAL 14, GOAL 15	8 steps problem solving approach, DOE, Cause & Effect Analysis	Modified existing machineries to produce colored yarns without effluent discharge.	Zero effluent discharge, improved dye fastness properties.	Developed dope dyed yarns with zero effluent discharge.	Embedded dyes directly into the polymer at melt spinning stage.	Achieved zero effluent discharge in yarn dyeing process.	Dope dyed yarn manufacturing can significantly reduce effluent discharge.	Zero effluent discharge, improved product quality.	Implement dope dyed yarn manufacturing in other textile operations.	Study the impact of dope dyed yarn manufacturing on effluent discharge.	Adopt dope dyed yarn manufacturing to reduce effluent discharge.	Reduced effluent discharge and improved environmental sustainability in textile operations.
32	Manufacturing	Tyre	IoT enabled, digitally integrated air conservation using predictive analytics	GOAL 7	PDCA, Fishbone Analysis, IoT 4.0, Digital Dashboard	Identified and fixed losses and leakages in the air network using predictive analytics.	Reduced specific air consumption, CO2 emissions, and energy costs.	Utilized IoT and predictive analytics to optimize air consumption.	Implemented digital tools and simplified air network to reduce air consumption.	29% reduction in air specific consumption, 2935 TCO2 reduction annually.	Digital tools and predictive analytics can significantly reduce air consumption.	Reduced energy costs, CO2 emissions, and improved air network efficiency.	Implement IoT and predictive analytics in air networks in other industries.	Investigated the influence of predictive analytics and the Internet of Things on air consumption.	Adopted IoT and predictive analytics to optimize air consumption.	Decreased emissions and energy consumption in tyre manufacturing operations.
33	Manufacturing	Automotive	Sealer Conservation by 3R methodology	GOAL 12, GOAL 13	Fishbone Analysis, RRR method (Reduce, Recycle, Reuse)	Reduced sealer consumption by preventing additional sealer top-up, recycling waste sealer, and reusing recycled sealer.	Reduced sealer wastage and CO2 emissions.	Used 3R methodology to reduce sealer wastage and CO2 emissions.	Recycling waste sealer with sealer squeeze rolls and reusing recycled sealer in hidden areas.	91% reduction in sealer wastage.	3R methodology can significantly reduce sealer wastage and CO2 emissions.	Reduced sealer consumption, CO2 emissions, and hazardous waste.	Implement 3R methodology in other automobile industries.	Studied the impact of 3R methodology on sealer wastage.	Adopted 3R methodology to reduce sealer wastage.	Decreased sealer wastage and CO2 emissions in the automotive manufacturing industry.

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Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
34	Manufacturing	Automotive	Single Use Plastic Free Plant	GOAL 6, GOAL 7, GOAL 11	Root Cause Analysis, Kaizen	Eliminated single-use plastics from plant operations.	Reduced plastic pollution and greenhouse gas emissions.	Implemented a strategy of No Plastic, Less Plastic, and Better Plastic.	Banned single-use plastics and replaced them with sustainable alternatives.	100% elimination of single-use plastics from the plant.	Banning single-use plastics can significantly reduce plastic pollution and emissions.	Reduced plastic pollution, greenhouse gas emissions, and cost savings.	Implement similar strategies to eliminate single-use plastics in other industries.	Investigated the effects of the elimination of single-use plastics on emissions and pollution.	Implemented strategies to eradicate single-use plastics from manufacturing processes.	Reduced plastic pollution and emissions in automobile manufacturing.
35	Service	Non-Profit	PARALI MANAGEMENT: An Environmentally Sustainable Approach of Waste to Wealth	GOAL 3, GOAL 11, GOAL 13, GOAL 15	Root Cause Analysis, In-Situ Method, Ex-Situ Method	Transformed crop residue to valuable products and conducted awareness campaigns.	Reduced pollution from crop residue burning and improved soil quality.	Created a sustainable solution to manage crop residue and reduce pollution.	Used crop residue for making goods and as fodder, conducted awareness campaigns.	677 villages declared as Zero Parali Burning Villages.	Managing crop residue can significantly reduce pollution and improve soil quality.	Reduced pollution, improved soil quality, and additional income for farmers.	Implement similar crop residue management strategies in other agricultural regions.	Studied the impact of crop residue management on pollution and soil quality.	Managed agricultural residue in a way that reduces pollution.	Reduced pollution and improved soil quality in agricultural regions.
36	Manufacturing	Engineering	Improving Energy Efficiency in Compressed Air Systems	GOAL 9, GOAL 12, GOAL 13	Six Sigma DMAIC, Fishbone Analysis, Why-Why Analysis	Optimized compressed air system to reduce energy consumption.	Reduced energy consumption and CO2 emissions.	Implemented innovative solutions to improve compressed air system efficiency.	Re-routed intake air, improved cooling systems, and reduced air leakage.	Savings of 17.4 Lac Units/annum, preventing 1374 Mt-CO2e emissions.	Optimizing compressed air systems can significantly reduce energy consumption and emissions.	Reduced energy costs, CO2 emissions, and improved compressed air system efficiency.	Implement similar optimization techniques in compressed air systems in other industries.	Study the impact of optimizing compressed air systems on energy consumption.	Implement optimisation strategies to enhance the efficiency of the compressed air system.	The manufacturing process used less energy and produced fewer emissions.
37	Manufacturing	Textile	Reduction of air consumption in Take-up and Spinning section	GOAL 9, GOAL 12	Ishikawa diagram, 4W1H, TQM methodology	Changed air guide in Take-up section, identified root causes of air consumption using Ishikawa diagram and 4W1H.	Reduction in air consumption from 1874 NM3/MT to 1543 NM3/MT.	Implemented changes to air guides in the Take-up section to reduce air consumption.	Modified air guides to optimize air usage in the spinning process.	Annual air consumption savings of 52.47 Lac NM3.	Optimizing air guides can significantly reduce air consumption.	Reduced air consumption and cost savings.	Implement similar air guide optimizations in other textile manufacturing processes.	Investigated the effects of air guide optimisation on air consumption.	Reduced air usage by implementing air guide optimisations.	Reduced air consumption and emissions in textile manufacturing.

Initial Information					Quality Management Tools and Techniques Used			Unique Approaches and Breakthroughs			Leverage Potential			Implications		
Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
38	Manufacturing	Automotive	Phosphate Sludge (hazardous waste) generation reduction in Cabin pre-treatment line	GOAL 12	Six Sigma DMAIC methodology, Variable MSA (GRR study), Pugh matrix, Test of Hypothesis (2 sample t-test), Process capability studies, Variable Control charts, Risk analysis	Used Six Sigma DMAIC methodology to solve the problem. Performed Measurement system analysis (MSA) for titration checking method (Phosphate sludge measurement process) to verify whether the measurement system is capable.	Reduced Mean Phosphate sludge generation from 6.92 g/sq.m to 4 g/sq.m. Reduced annual sludge generation to 20 MT against the Govt. regulation of 24 MT for production volume of 1 Lakh cabins.	Installed drying bed to address high moisture content in Phosphate sludge, and researched and implemented 'compact & fine phosphate coating chemical'.	Installed drying bed and continued drying process to reduce moisture content in Phosphate sludge. Implemented new generation Pre-treatment Chemicals.	Reduced Mean Phosphate sludge generation to 4 g/sq.m. Estimated Annual sludge generation reduced to 20 MT against the Govt. regulation of 24 MT for production volume of 1 Lakh cabins.	Drying bed installation and new generation Pre-treatment Chemicals can significantly reduce hazardous waste generation.	Reduced hazardous waste generation, compliance with regulations, improved environmental impact, cost savings.	Implement similar drying processes and innovative chemicals in other manufacturing operations to reduce hazardous waste generation.	Studied the impact of innovative chemicals and drying processes on hazardous waste reduction.	Adopted drying bed installation and new generation Pre-treatment Chemicals to reduce hazardous waste generation.	Improved environmental impact through reduced hazardous waste generation and compliance with regulations.
39	Manufacturing	Tyre	Automobile Tyres: Sustainability through Fuel Efficiency	GOAL 7, GOAL 13	PDCA, Fishbone Analysis, IoT 4.0, Digital Dashboard	Identified and fixed losses and leakages in the air network using predictive analytics.	Reduced specific air consumption, CO2 emissions, and energy costs.	Utilized IoT and predictive analytics to optimize air consumption.	Implemented digital tools and simplified air network to reduce air consumption.	29% reduction in air specific consumption, 2935 TCO2 reduction annually.	Digital tools and predictive analytics can significantly reduce air consumption.	Reduced energy costs, CO2 emissions, and improved air network efficiency.	Implement IoT and predictive analytics in air networks in other industries.	Examined the effects of IoT and predictive analytics on air use.	Used IoT and predictive analytics to optimise air use.	Lesser pollution and energy use in the tyre production process.
40	Manufacturing	Automotive	Creating sustainable manufacturing processes through operational excellence, innovation & technology	GOAL 7, GOAL 13	Yamazumi charts, Debottlenecking, DOE, TPM methodology, Industry 4.0, Sankey Diagram, Six Sigma DMAIC, Kaizen	Implemented various quality management and operational excellence tools to enhance productivity, reduce emissions, and save costs.	Enhanced productivity, reduced carbon emissions, improved top and bottom lines, and deferred new capital expenditures.	Adopted frugal and innovative solutions like Cold Box Core Making and Waste Heat Recovery for operational excellence.	Implemented systematic waste segregation, recycling, and disposal mechanisms, and innovative projects for energy efficiency.	Significant reduction in carbon emissions and cost savings.	Innovative and frugal solutions can lead to significant operational improvements and sustainability.	Enhanced sustainability, cost savings, improved regulatory compliance.	Adopt Lean Manufacturing, 5S, and Kaizen in other industries to improve waste management and sustainability.	Studied the impact of Lean Manufacturing on waste reduction and sustainability.	Adopted Lean Manufacturing practices to reduce waste and improve resource efficiency.	Improved sustainability and reduced environmental impact in manufacturing operations.

Initial Information					Quality Management Tools and Techniques Used			Unique Approaches and Breakthroughs			Leverage Potential			Implications		
Case Study	Sector	Type of Industry	Project Title	UNSDGs Addressed	Tools/ Techniques Used	Description of Usage	Impact on Quality	Unique Approach	Description	Breakthrough Achieved	Key lessons learned	Potential Benefits	Leverage to Other Industries	For Research	For Practice	For Society
41	Manufacturing	Chemicals	Integrated Watershed Management Program	GOAL 1, GOAL 2, GOAL 6, GOAL 13	Participatory Rural Appraisal (PRA),Root Cause Analysis, Social Responsibility Index	Implemented IWM program to conserve rainwater, create changes in agriculture cropping patterns, and meet safe drinking water requirements through a participatory approach.	Improved water conservation, enhanced agricultural productivity, and increased access to safe drinking water.	Developed and implemented a participatory model involving local communities, NGOs, and government agencies.	Implemented various water conservation structures such as check dams, community ponds, and farm ponds.	Significant improvements in water conservation, agricultural productivity, and community access to safe drinking water.	Participatory approaches can effectively address water conservation and agricultural productivity challenges.	Improved water conservation, enhanced agricultural productivity, increased access to safe drinking water.	Implement participatory approaches in other water-stressed regions to improve water conservation and agricultural productivity.	Investigated how participatory methods affected agricultural output and water conservation.	Implement participatory approaches to improve water conservation and agricultural productivity.	Improved water conservation, agricultural productivity, and access to safe drinking water.

Appendix D: Sustainable Performance Dimensions (Source: Authors' Own Creation)

No.	Sustainable Performance Dimensions	Category
1.	Energy Efficiency: Implementation of energy-saving measures and transition to renewable energy sources.	Environmental Performance Factors
2.	Water Management: Efficient use and recycling of water, along with proper wastewater treatment.	
3.	Waste Reduction: Strategies for minimizing waste generation through process optimization and material recycling.	
4.	Emissions Control: Reduction of greenhouse gas emissions and pollutants to mitigate climate impact.	
5.	Biodiversity Conservation: Efforts to protect and restore biodiversity affected by manufacturing activities.	
6.	Employee Health and Safety: Ensuring safe working conditions and promoting health and wellness.	Social Performance Factors
7.	Diversity and Inclusion: Promoting a diverse workforce and inclusive work environment.	
8.	Community Engagement: Active participation in community development and support for local initiatives.	
9.	Human Rights and Labor Practices: Upholding human rights and fair labor practices throughout the supply chain.	
10.	Customer Satisfaction and Safety: Ensuring product safety and high levels of customer satisfaction.	
11.	Corporate Ethics and Transparency: Adherence to ethical business practices and transparent reporting.	Governance Performance Factors
12.	Board Diversity and Structure: Ensuring a diverse and effective governance structure.	
13.	Stakeholder Engagement: Mechanisms for engaging with and responding to stakeholders.	
14.	Compliance and Risk Management: Robust systems for regulatory compliance and risk assessment.	
15.	Sustainability Strategy and Reporting: Integration of sustainability into corporate strategy and detailed sustainability reporting.	
16.	Financial Stability and Growth: Maintaining financial health and ensuring sustainable growth.	Economical Performance Factors
17.	Market Competitiveness: Enhancing competitiveness through sustainability-driven innovation.	
18.	Investment in Sustainable Technologies: Allocating resources to sustainable practices and technologies.	
19.	Cost Management: Effective management of costs associated with raw materials, energy, and waste.	
20.	Value Creation: Generating long-term value for shareholders and stakeholders through sustainable practices.	
21.	Supply Chain Sustainability: Ensuring sustainability in procurement, production, and logistics.	Operational Performance Factors
22.	Product Lifecycle Management: Designing and managing products with consideration for their entire lifecycle.	
23.	Operational Efficiency: Streamlining operations to reduce resource use and improve productivity.	
24.	Technology and Innovation for Sustainability: Leveraging technology and innovation to enhance sustainability.	
25.	Resilience and Adaptability: Building resilience to environmental, social, and economic changes.	

Part 1: Sustainable Performance Dimensions (1-15) (Source: Authors' Own Creation)

	Environmental Performance Factors					Social Performance Factors					Governance Performance Factors				
Project Title	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**
Reduction in Rejection and Customer Complaints in Gear Line through Innovative Approach	NA	NA	Process optimization to reduce rejection	NA	NA	Improving safety by reducing handling damage	NA	NA	NA	Improved by reducing rejection rates and customer complaints	NA	NA	Involvement of internal stakeholders	NA	Integration of sustainability into process improvements and reporting
Customer Delight through Prompt Efforts to Resolve Synchro Parts Concern	NA	NA	Reducing internal transfer PPM and customer complaints	NA	NA	Improving process to reduce errors and improve safety	NA	NA	NA	Achieved zero customer complaints and enhanced satisfaction	NA	NA	Involvement of all stakeholders	NA	Integration of sustainability through process improvements
Electricity (KWH) Consumption Reduction by 25% in FY 23	Reduction by 25%	NA	NA	Reduction of 1600 tons of CO2	Protecting ~9580 trees	NA	NA	NA	NA	NA	NA	NA	Involvement of 400+ participants trained on Energy Efficiency modules	NA	Part of corporate strategy to become Carbon Neutral by 2040
Eco Friendly coating and sealing materials for new range of Automotive vehicles	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Involvement of internal stakeholders in the project	NA	NA
Digital and Sustainable transformation of transportation in Mines	NA	NA	Saving 50,000 papers a month	Reduction in carbon footprint	Saving 65 TEAK trees per year	Improvement in safety by reducing man-machine interface	NA	NA	NA	Improved through better operational efficiency	NA	NA	NA	Involvement of drivers, transporters, and local ecosystem	NA
Digital Bill of Material and Setup Checklist in Assembly Line for Process Improvement and Paper Consumption Elimination	NA	NA	Saving 36,000 A4 sheets/year	NA	Saving trees by reducing paper usage	NA	NA	NA	NA	NA	NA	NA	Involvement of shop floor associates in the development process	NA	NA
Autonomous Working of Air Compressor Bank Using Deep Learning	Energy reduction by 5%	NA	NA	Reduction in CO2 emissions by 78 tons	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Integration of AI solutions into sustainabil

	Environmental Performance Factors					Social Performance Factors					Governance Performance Factors				
Project Title	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**
															ity strategy
Utilization of Clean Energy Source More Than 50% and Optimize Energy Usages at Bosch Rexroth Ahmedabad Location	Increase in clean energy usage	NA	NA	Reduction in carbon footprint by 62%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Integration into corporate strategy to become CO2 neutral
Scrap to Art Work – Delivering a Green Sustainable Future	NA	NA	Repurposing end-of-life equipment	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Integration of sustainability through innovative reuse of materials	NA
JPH Improvement from 40 to 60 JPH, Energy Saving of 4200 kWh/Annum and CO2 Reduction of 4.2 Tons	Energy saving of 4200 kWh/annum	NA	NA	CO2 reduction of 4.2 tons	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Integration of energy-saving measures in production
Reduction in Waste Generation by Optimization of Raw Material Quantities	NA	NA	Reduction in waste generation by 23.8%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Integration of ESG practices for waste reduction	Cost savings in waste disposal
Best From Waste	NA	NA	Recycling of precious metals and copper from scrapped parts	NA	NA	NA	NA	NA	NA	NA	NA	Involvement of team members across multiple plants	NA	Integration of recycling into production processes	Cost savings of INR 2 Crores in FY 22-23
Elimination of Hazardous Lapping Process from NHA Manufacturing	Power saving of 6.98 MINR	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Involvement of cross-functional team in space optimization	NA	Reduction of waste by consolidation of manufacturing
Improvement of Net Station Heat Rate from 2519 kcal/kwh to < 2481 kcal/kwh	NA	NA	NA	Reduction of CO2 emissions by 87740 T	NA	NA	NA	NA	NA	NA	NA	Involvement of top management and team members	NA	Integration into energy efficiency and emissions reduction strategy	Financial savings through reduced energy charge under-recovery
Career and Competency	NA	NA	NA	NA	NA	NA	Focus on training marginaliz	Significant community engagement	NA	NA	NA	NA	Extensive involvement of	NA	Integration into hospital's

	Environmental Performance Factors					Social Performance Factors					Governance Performance Factors				
Project Title	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**
Development Program (CCDP)							ed and underprivil eged youth	through training programs					hospital staff and trainers		sustainabil ity and social responsibi lity strategy
A Big Sustainability Swing through Change in the Cable & Cable Drum Design	Significan t energy savings through innovative cable design	NA	Reduction in wood consumption for cable drums	Reduction of lead usage and CO2 emissions	NA	NA	NA	NA	NA	Improved cable durability and reduced faults	NA	NA	Involveme nt of multiple department s in design changes	NA	Integratio n into corporate sustainabil ity goals
Reduce carbon footprint in IB packaging process	Reduction of carbon emissions by 50%	NA	Reduction in plastic and carton waste	Significant reduction in carbon footprint	NA	NA	NA	NA	NA	NA	NA	NA	Involveme nt of multiple teams in waste reduction initiatives	NA	Integratio n of waste reduction in packaging strategy
Improvement in substitution of conventional energy by renewable energy	Use of biomass briquettes and solar power	NA	NA	Significant reduction in emissions	NA	NA	NA	NA	NA	NA	NA	NA	Involveme nt of multiple department s in energy substitution projects	NA	Integratio n into corporate energy policy
Adiabatic Smart Cooling Technology for Air-Cooled Chillers	Significan t reduction in energy consumpti on	NA	NA	Reduction in carbon footprint by 151 Tons	NA	NA	NA	NA	NA	NA	NA	NA	Involveme nt of multiple teams in implementi ng smart cooling technology	NA	Integratio n into corporate energy-saving strategies
Surge in recovery and quality of iron ore fines from hydrocyclone	NA	NA	Significant reduction in ore wastage	Improveme nt in quality and reduction in emissions	NA	NA	NA	NA	NA	Improved recovery and quality of iron ore fines	NA	NA	Involveme nt of multiple department s in recovery improveme nt initiatives	NA	Integratio n into corporate sustainabil ity goals
Reduction of Energy Consumption (Project-Sambhav)	Reduction in energy consumpti on from 305480 kWh to 289756 kWh	NA	NA	Reduction in CO2 emissions	NA	NA	NA	NA	NA	NA	NA	NA	Involveme nt of multiple teams in energy reduction initiatives	NA	Integratio n into corporate energy-saving strategies
Remote Wireless Operation of	NA	NA	NA	NA	NA	Improved h	NA	NA	NA	Enhanced safety and	NA	NA	Involveme nt of	NA	Integratio n into

	Environmental Performance Factors					Social Performance Factors					Governance Performance Factors				
Project Title	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**
Moving Machineries						safety of operators				well-being of operators			multiple teams in remote operation implementation		corporate safety and efficiency goals
Steel coil width reduction of 'Frame Side Member' through product parameter optimization	Reduction in energy consumption through optimized coil width	Reduction of water consumption by 191700 KL annually	Reduction of steel consumption by 462.88 Tons till May'23	Reduction in CO2 emissions by 533 TCo2e annually	Reduction in deforestation due to reduced mining	NA	NA	NA	NA	Improved product quality and reduced rejections	NA	NA	Involvement of multiple teams in optimization process	NA	Integration into corporate sustainability goals
Reduction in Natural Resources depletion through innovation in Cabin painting process	Power consumption reduction by 173 KWH/cabin	Reduction of water consumption from 18546 KL/year to 12046 KL/year	NA	Reduction in carbon footprints by 12997 MT till Mar`23	NA	NA	NA	NA	NA	Improved quality of painted cabins and reduced defects	NA	NA	Involvement of multiple teams in painting process optimization	NA	Integration into corporate sustainability and efficiency goals
Anti-toppling mechanism implementation in all HEMM	NA	NA	NA	NA	NA	Improved health and safety of operators	NA	NA	NA	Enhanced safety and well-being of operators	NA	NA	Involvement of multiple teams in remote operation implementation	NA	Integration into corporate safety and efficiency goals
Peninsula Salsette 27 Project	Significant energy savings through use of solar panels and energy-efficient lighting	Water efficient landscaping, rainwater harvesting, STP	Minimised concrete wastage and reuse of residual concrete	CO2 reduction by 360 tons during construction and 1402.11 tons annually	Use of native plant species and FSC certified wood	Improved health and safety through design and materials	NA	Significant community engagement in sustainability practices	NA	Improved living quality and reduced health risks	NA	NA	Involvement of multiple teams and stakeholders in sustainable construction practices	NA	Integration into corporate sustainability and green building certification goals
Electrical Energy Consumption Reduction for 6 Melting Furnace - Material Grade Combinations	Reduction in energy consumption for CI from 655 KWH/Ton to 646 KWH/Ton and for SG Iron from 690 KWH/Ton to 643 KWH/Ton	NA	NA	Reduction in CO2 emissions by optimizing furnace operations	NA	NA	NA	NA	NA	Improved furnace efficiency and reduced energy consumption	NA	NA	Involvement of multiple teams in energy reduction initiatives	NA	Integration into corporate energy-saving strategies

	Environmental Performance Factors					Social Performance Factors					Governance Performance Factors				
Project Title	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**
Reduce carbon emissions through problem solving tools to prevent CTRB cone honing losses in manufacturing	Significant reduction in energy consumption	NA	NA	Reduction in carbon emissions from 2951 Kg CO2e to 1133 Kg CO2e (61.6% reduction)	NA	NA	NA	NA	NA	Improved product quality and reduced rework	NA	NA	Involvement of multiple teams in implementing energy-efficient solutions	NA	Integration into corporate sustainability goals
To attain carbon neutrality through carbon emission reduction in power consumption (purchased electricity)	Significant reduction in energy consumption	NA	NA	Reduction in carbon emissions from 1,59,987 Kg CO2e/Year to 1,10,047 Kg CO2e (31.2% reduction)	NA	NA	NA	NA	NA	Improved product quality and reduced rework	NA	NA	Involvement of multiple teams in implementing energy-efficient solutions	NA	Integration into corporate sustainability goals
Reducing thermal coal usage by introducing bio-mass consumption in coal based boiler	Significant reduction in thermal coal usage	NA	NA	Reduction in CO2 emissions by 14588 TCO2	NA	NA	NA	NA	NA	NA	NA	NA	Involvement of multiple teams in implementing biomass usage solutions	NA	Integration into corporate sustainability goals
Development of high tenacity olive green coloured industrial yarn with zero effluent discharge	NA	NA	NA	NA	NA	NA	NA	NA	NA	Improved product quality and reduced rework	NA	NA	Involvement of multiple teams in implementing zero effluent solutions	NA	Integration into corporate sustainability goals
IoT enabled, digitally integrated air conservation using predictive analytics	Significant reduction in energy consumption	NA	NA	Reduction in carbon emissions by 2935 TCO2 annually	NA	NA	NA	NA	NA	Improved product quality and reduced rework	NA	NA	Involvement of multiple teams in implementing energy-efficient solutions	NA	Integration into corporate sustainability goals
Sealer Conservation by 3R methodology	NA	NA	Reduction in sealer waste by 91%	Reduction in CO2 emissions during disposal	NA	NA	NA	NA	NA	Reduced hazardous waste and improved efficiency	NA	NA	Involvement of team members in waste reduction initiative	NA	Integration into corporate sustainability goals
Single Use Plastic Free Plant	NA	NA	Elimination of 100% single-use	Reduction in greenhouse gas	NA	NA	NA	Significant engagement in	NA	Improved environmental practices	NA	NA	Involvement of multiple department	NA	Integration into corporate sustainabil

	Environmental Performance Factors					Social Performance Factors					Governance Performance Factors				
Project Title	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**
			plastic from the plant	emissions from plastic production and disposal				sustainable practices		and compliance			s in plastic elimination initiatives		ity and environmental goals
Parali Management: An Environmentally Sustainable Approach of Waste to Wealth	NA	NA	Reduction in parali/stubble burning waste	Reduction in air pollution and greenhouse gases	NA	Improved health and safety for communities	NA	Significant community engagement through awareness campaigns	NA	Improved environmental quality and health	NA	NA	Involvement of multiple stakeholders including farmers and agricultural experts	NA	Integration into corporate sustainability and climate action goals
Improving Energy Efficiency in Compressed Air Systems	Significant reduction in energy consumption	NA	NA	Reduction in CO2 emissions by 1374 Mt-CO2e annually	NA	Improved health and safety for operators	NA	NA	NA	Improved operational efficiency and reduced energy costs	NA	NA	Involvement of multiple teams in energy efficiency initiatives	NA	Integration into corporate sustainability goals
Reduction of air consumption in Take-up and Spinning section	NA	NA	NA	Reduction in air consumption by 17.67%	NA	NA	NA	NA	NA	Improved operational efficiency and reduced air consumption	NA	NA	Involvement of multiple teams in implementing air consumption reduction solutions	NA	Integration into corporate sustainability goals
Phosphate Sludge Generation Reduction	NA	Reduction of DM water consumption by 60 KL per annum	Reduction in phosphate sludge generation by 55%	Reduction in carbon footprint through reduced energy consumption	NA	NA	NA	NA	NA	Improved environmental compliance and efficiency	NA	NA	Involvement of multiple teams in implementing sludge reduction solutions	NA	Integration into corporate sustainability goals
Reduction of air consumption in Take-up and Spinning section	NA	NA	NA	Reduction in air consumption by 17.67%	NA	NA	NA	NA	NA	Improved operational efficiency and reduced air consumption	NA	NA	Involvement of multiple teams in implementing air consumption reduction solutions	NA	Integration into corporate sustainability goals
Phosphate Sludge Generation Reduction	NA	Reduction of DM water consumption by 60	Reduction in phosphate sludge generation by 55%	Reduction in carbon footprint through reduced energy	NA	NA	NA	NA	NA	Improved environmental compliance and efficiency	NA	NA	Involvement of multiple teams in implementing sludge	NA	Integration into corporate sustainability goals

	Environmental Performance Factors					Social Performance Factors					Governance Performance Factors				
Project Title	**1.**	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**
		KL per annum		consumption									reduction solutions		
Integrated Watershed Management Program	NA	Conservation and management of water resources in drought-prone areas	NA	NA	Conservation of natural resources and biodiversity	Improved health and well-being for communities	Inclusion of marginalized communities in project activities	Significant community engagement through participatory approaches	NA	Improved access to water and agricultural productivity	NA	NA	Involvement of multiple stakeholders, including NGOs and government agencies	NA	Integration into corporate sustainability and community development goals

Part 2: Sustainable Performance Dimensions (16-25) (Source: Authors' Own Creation)

Project Title	Economical Performance Factors					Operational Performance Factors				
	16.	**17.**	**18.**	**19.**	**20.**	**21.**	**22.**	**23.**	**24.**	**25.**
Reduction in Rejection and Customer Complaints in Gear Line through Innovative Approach	Reducing costs associated with rejections	Enhancing product quality and customer satisfaction	Using high-end quality tools and methodologies	Reducing rejection rates to save costs	Improved quality leading to better customer satisfaction	NA	NA	Improving process efficiency and reducing rejections	Utilizing Six Sigma, DOE, and other quality tools	Adapting processes based on quality analysis and improvement
Customer Delight through Prompt Efforts to Resolve Synchro Parts Concern	Cost savings achieved through reduced complaints and process improvements	Enhanced quality and customer satisfaction	Development of new inspection facilities and mistake-proofing	Achieving cost savings through process improvements	Enhanced customer satisfaction and process reliability	NA	NA	Reducing PPM and improving process reliability	Use of problem-solving tools and new inspection technology	Developing new inspection facilities and robust processes
Electricity (KWH) Consumption Reduction by 25% in FY 23	Cost saving of INR 2.34 crore in FY 23	NA	Implementation of IMR Control Charts and energy-efficient practices	Reduction in energy consumption	Significant reduction in carbon emissions and cost savings	NA	NA	Implementation of energy-efficient measures across multiple sites	Use of DMAIC, energy meters, smart meters, AI, and IoT	NA
Eco Friendly coating and sealing materials for new range of Automotive vehicles	NA	Enhanced through eco-friendly product innovation	Use of eco-friendly coating and sealing materials	NA	NA	NA	Integration of eco-friendly materials in product lifecycle	NA	Development of eco-friendly materials	NA
Digital and Sustainable transformation of transportation in Mines	Integration into corporate strategy for digital transformation	NA	Enhanced through improved operational efficiency and digital transformation	Use of RFID, GPS, telematics, and automation	NA	Significant reduction in turnaround time and improvement in safety	NA	NA	Improved through digitization and automation	Use of AI, quasi blockchain, and digital tools
Digital Bill of Material and Setup Checklist in Assembly Line for Process Improvement and Paper Consumption Elimination	NA	NA	Development of digital solutions for process improvement	Reduction in costs associated with printing and errors	Increased efficiency and reduction in human errors	NA	NA	Improved efficiency through digital solutions	Implementation of digital solutions and automation	Adaptation of digital solutions to other assembly lines
Autonomous Working of Air Compressor Bank Using Deep Learning	Energy savings leading to cost savings	NA	Implementation of AI and deep learning models	Reduction in energy costs	Significant energy savings and reduction in CO2 emissions	NA	NA	Improved efficiency through autonomous control	Use of AI and deep learning for energy management	NA

Project Title	Economical Performance Factors					Operational Performance Factors				
	16.	**17.**	**18.**	**19.**	**20.**	**21.**	**22.**	**23.**	**24.**	**25.**
Utilization of Clean Energy Source More Than 50% and Optimize Energy Usages at Bosch Rexroth Ahmedabad Location	Reduction in energy costs	Enhanced through the use of renewable energy	Implementation of solar and wind energy	Reduction in energy costs	Significant reduction in energy costs and carbon footprint	NA	NA	Improved efficiency through the use of renewable energy	Use of solar and wind energy technologies	NA
Scrap to Art Work – Delivering a Green Sustainable Future	NA	Development of innovative art pieces from scrap	NA	Enhanced aesthetic and cultural value through art	NA	NA	NA	Combining art and science for sustainability	NA	
JPH Improvement from 40 to 60 JPH, Energy Saving of 4200 kWh/Annum and CO2 Reduction of 4.2 Tons	NA	Improved productivity and efficiency	Investment in energy-saving technologies	Reduction in energy costs	Improved productivity and CO2 reduction	NA	NA	Improved line balancing and cycle time study	Use of lean manufacturing and PDCA	NA
Reduction in Waste Generation by Optimization of Raw Material Quantities	NA	Optimization of raw material quantities and recovery processes	Reduction in waste treatment costs	Significant reduction in hazardous waste generation	NA	NA	Improved process efficiency and waste management	Use of PDCA, lean tools, and waste minimization strategies	NA	
Best From Waste	NA	Recycling technologies for metal recovery	Reduction in raw material costs	Enhanced sustainability through recycling	NA	NA	Use of DMAIC for process optimization	Use of DMAIC methodology for recycling processes	Implementing recycling processes to address resource scarcity and waste management	
Elimination of Hazardous Lapping Process from NHA Manufacturing	Cost savings in power, AMC, and other variables	Improved space utilization and efficiency	Investment in lean and agile methodologies	Significant cost savings through space optimization	Improved efficiency through space optimization	NA	Improved manufacturing process efficiency	Use of lean tools, agile methods, and kaizen	Ability to reconfigure production processes and spaces to enhance efficiency and safety	
Improvement of Net Station Heat Rate from 2519 kcal/kwh to < 2481 kcal/kwh	NA	Investment in Six Sigma methodology and equipment upgrades	Reduction in fuel consumption costs	Significant reduction in CO2 emissions and energy costs	NA	NA	Improved operational efficiency and heat rate	Use of Six Sigma, DMAIC, and quality management tools	Maintaining operational efficiency under new regulatory norms and implementing energy-saving measures	
Career and Competency Development Program (CCDP)	NA	NA	Investment in training and development programs	Cost savings through improved employability of trained candidates	Enhanced employability and quality of education for rural youth	NA	NA	Improved employability and quality of education	Use of quality management tools, lean tools, and kaizen	Adaptability in creating customized training programs for rural youth
A Big Sustainability Swing through Change in the Cable & Cable Drum Design	Significant cost savings from reduced faults and maintenance	NA	Investment in new cable technologies and hybrid drum design	Cost savings through reduced material usage	Enhanced cable durability and reduced environmental impact	NA	NA	Improved cable design and durability	Use of sustainable materials and innovative design	Adaptability in implementing sustainable design changes in cable manufacturing
Reduce carbon footprint in IB packaging process	Cost savings from reduced packaging waste	NA	Investment in recyclable and reusable packaging materials	Cost savings through waste reduction	Enhanced sustainability through reduced packaging waste	NA	NA	Improved packaging efficiency	Use of TPM 7 Step methodology and ROTI approach	Adaptability in using recyclable and reusable packaging materials

Project Title	Economical Performance Factors					Operational Performance Factors				
	16.	**17.**	**18.**	**19.**	**20.**	**21.**	**22.**	**23.**	**24.**	**25.**
Improvement in substitution of conventional energy by renewable energy	Cost savings from reduced energy costs	NA	Investment in biomass briquettes and solar power plant	Cost savings through reduced energy consumption	Significant reduction in energy costs and emissions	NA	NA	Improved energy efficiency and sustainability	Use of DMAIC methodology and quality tools	Adaptability in implementing renewable energy solutions
Adiabatic Smart Cooling Technology for Air-Cooled Chillers	Cost savings from reduced energy consumption	NA	Investment in adiabatic smart cooling technology	Cost savings through reduced energy usage	Enhanced cooling efficiency and reduced carbon footprint	NA	NA	Improved cooling efficiency	Use of 7 QC tools and root cause analysis	Adaptability in implementing smart cooling technology
Surge in recovery and quality of iron ore fines from hydrocyclone	Cost savings from improved recovery and quality	NA	Investment in advanced hydrocyclone technology	Cost savings through improved recovery and reduced wastage	Enhanced recovery efficiency and reduced environmental impact	NA	NA	Improved recovery process efficiency	Use of SIP methodology and quality tools	Adaptability in implementing advanced recovery technology
Reduction of Energy Consumption (Project-Sambhav)	Cost savings of Rs. 1,10,068 per month	NA	Investment in energy-efficient technologies	Cost savings through reduced energy consumption	Enhanced sustainability through reduced energy usage	NA	NA	Improved energy efficiency	Use of 7 QC tools and quality management tools	Adaptability in implementing energy-efficient solutions
Remote Wireless Operation of Moving Machineries	Cost savings of Rs. 1.89 Crores through reduced overtime and operational detention	NA	Investment in remote wireless operation technology	Cost savings through reduced operational downtime	Enhanced safety and operational efficiency	NA	NA	Improved operational efficiency	Use of 12 steps of problem solving and quality management tools	Adaptability in implementing remote operation technology
Steel coil width reduction of 'Frame Side Member' through product parameter optimization	Cost savings of 3.15 Cr till May'23 through reduced material usage and rejections	NA	Investment in advanced statistical tools and optimization methodologies	Cost savings through reduced material usage and rejections	Enhanced sustainability through reduced material usage and improved quality	NA	NA	Improved process efficiency	Use of PDCA, DOE, and advanced statistical tools	Adaptability in implementing optimization methodologies
Reduction in Natural Resources depletion through innovation in Cabin painting process	Cost savings of INR 15.06 Cr till Mar'23 through reduced energy and material usage	NA	Investment in innovative fixtures and painting process optimization	Cost savings through reduced energy and material usage	Enhanced sustainability through reduced resource consumption	NA	NA	Improved painting process efficiency	Use of PDCA, DOE, and advanced statistical tools	Adaptability in implementing innovative painting process solutions
Anti-toppling mechanism implementation in all HEMM	Cost savings of Rs. 1.89 Crores through reduced overtime and operational detention	NA	Investment in remote wireless operation technology	Cost savings through reduced operational downtime	Enhanced safety and operational efficiency	NA	NA	Improved operational efficiency	Use of 12 steps of problem solving and quality management tools	Adaptability in implementing remote operation technology
Peninsula Salsette 27 Project	Cost savings through reduced energy and water consumption	NA	Investment in green building technologies and materials	Cost savings through reduced energy and water consumption	Enhanced sustainability through green building practices	Use of recycled and local materials	NA	Improved building efficiency	Use of IGBC guidelines, energy-efficient technologies, and sustainable materials	Adaptability in implementing green building practices and technologies
Electrical Energy Consumption Reduction for 6 Melting Furnace - Material Grade Combinations	Annual savings in electricity cost Rs. 34,00,000	NA	Investment in I-Melt software for power measurement and analysis	Cost savings through reduced energy consumption	Enhanced sustainability through optimized energy usage	NA	NA	Improved furnace operation efficiency	Use of Six Sigma DMAIC methodology and quality tools	Adaptability in implementing energy-efficient solutions

Project Title	Economical Performance Factors					Operational Performance Factors				
	16.	**17.**	**18.**	**19.**	**20.**	**21.**	**22.**	**23.**	**24.**	**25.**
Reduce carbon emissions through problem solving tools to prevent CTRB cone honing losses in manufacturing	Annual savings through the project INR 1,36,841.64	NA	Investment in centralised oil filtration plant for honing operation	Cost savings through reduced energy consumption and rework	Enhanced sustainability through reduced carbon emissions	NA	NA	Improved honing process efficiency	Use of Six Sigma DMAIC methodology and quality tools	Adaptability in implementing innovative honing process solutions
To attain carbon neutrality through carbon emission reduction in power consumption (purchased electricity)	Annual savings through the project INR 1,36,841.64	NA	Investment in centralised oil filtration plant for honing operation	Cost savings through reduced energy consumption and rework	Enhanced sustainability through reduced carbon emissions	NA	NA	Improved honing process efficiency	Use of Six Sigma DMAIC methodology and quality tools	Adaptability in implementing innovative honing process solutions
Reducing thermal coal usage by introducing bio-mass consumption in coal based boiler	Cost savings of INR 1.81 Cr through reduced coal usage	NA	Investment in biomass co-firing technology	Cost savings through reduced coal consumption	Enhanced sustainability through reduced fossil fuel usage	NA	NA	Improved boiler operation efficiency	Use of QC story 7 Step methodology and TQM tools	Adaptability in implementing biomass co-firing solutions
Development of high tenacity olive green coloured industrial yarn with zero effluent discharge	Utilisation of yarn spinning capacity from 70% to 100%	NA	Investment in dyeing process modification technologies	Cost savings through reduced effluent treatment costs	Enhanced sustainability through zero effluent discharge	NA	NA	Improved dyeing process efficiency	Use of 8 steps problem solving approach and DOE	Adaptability in implementing zero effluent solutions
IoT enabled, digitally integrated air conservation using predictive analytics	Annual savings through the project INR 1,36,841.64	NA	Investment in centralised oil filtration plant for honing operation	Cost savings through reduced energy consumption and rework	Enhanced sustainability through reduced carbon emissions	NA	NA	Improved honing process efficiency	Use of Six Sigma DMAIC methodology and quality tools	Adaptability in implementing innovative honing process solutions
Sealer Conservation by 3R methodology	Cost savings through reduced sealer consumption	NA	Investment in sealer squeeze rolls and reuse technologies	Cost savings through reduced waste generation	Enhanced sustainability through waste reduction and CO_2 emission reduction	NA	NA	Improved sealer application process efficiency	Use of Fishbone diagram and 3R methodology	Adaptability in implementing waste reduction techniques
Single Use Plastic Free Plant	Annual savings of Rs. 17 lacs through elimination of single-use plastics	NA	Investment in sustainable alternatives to single-use plastics	Cost savings through reduced plastic usage	Enhanced sustainability through plastic waste elimination	NA	NA	Improved operational efficiency	Use of 4R concept (Reduce, Reuse, Recycle, Recover) and Kaizen	Adaptability in achieving plastic neutrality and sustainable practices
Parali Management: An Environmentally Sustainable Approach of Waste to Wealth	Economic benefits through increased farm productivity and additional income for farmers	NA	Investment in mechanization and alternative uses for parali	Cost savings through reduced health costs and improved farm productivity	Enhanced sustainability through waste-to-wealth approach	NA	NA	Improved agricultural practices and reduced pollution	Use of root cause analysis, in-situ and ex-situ methods	Adaptability in implementing sustainable agricultural practices
Improving Energy Efficiency in Compressed Air Systems	Annual savings of 17.4 Lac Units of energy through the project	NA	Investment in energy-efficient technologies and retrofitting	Cost savings through reduced energy consumption and maintenance costs	Enhanced sustainability through improved energy efficiency	NA	NA	Improved compressed air system efficiency	Use of Six Sigma DMAIC methodology and quality tools	Adaptability in implementing innovative energy-efficient solutions
Reduction of air consumption in Take-up and Spinning section	Annual savings of 52.47 Lac through the project	NA	Investment in air guide technology	Cost savings through reduced air consumption	Enhanced sustainability through reduced air usage	NA	NA	Improved spinning process efficiency	Use of TQM methodology and quality tools	Adaptability in implementing air consumption reduction solutions

Project Title	Economical Performance Factors					Operational Performance Factors				
	16.	**17.**	**18.**	**19.**	**20.**	**21.**	**22.**	**23.**	**24.**	**25.**
Phosphate Sludge Generation Reduction	Financial benefit of INR 5.25 Million through reduced sludge generation	NA	Investment in drying bed and new pre-treatment chemicals	Cost savings through reduced sludge generation	Enhanced sustainability through reduced sludge and carbon footprint	NA	NA	Improved pre-treatment process efficiency	Use of Six Sigma DMAIC methodology and quality tools	Adaptability in implementing sludge reduction solutions
Reduction of air consumption in Take-up and Spinning section	Annual savings of 52.47 Lac through the project	NA	Investment in air guide technology	Cost savings through reduced air consumption	Enhanced sustainability through reduced air usage	NA	NA	Improved spinning process efficiency	Use of TQM methodology and quality tools	Adaptability in implementing air consumption reduction solutions
Phosphate Sludge Generation Reduction	Financial benefit of INR 5.25 Million through reduced sludge generation	NA	Investment in drying bed and new pre-treatment chemicals	Cost savings through reduced sludge generation	Enhanced sustainability through reduced sludge and carbon footprint	NA	NA	Improved pre-treatment process efficiency	Use of Six Sigma DMAIC methodology and quality tools	Adaptability in implementing sludge reduction solutions
Integrated Watershed Management Program	Economic benefits through increased agricultural productivity and water availability	NA	Investment in watershed management and irrigation technologies	Cost savings through improved water management and agricultural practices	Enhanced sustainability through improved water resources and agricultural practices	NA	NA	Improved agricultural practices and community well-being	Use of participatory rural appraisal, TQM, and quality tools	Adaptability in implementing watershed management and community development solutions

Appendix E: Quality Management Practices (Source: Authors' Own Creation)

No.	Quality Management Practices	No.	Quality Management Practices
1.	Leadership	17.	Commitment
2.	Strategic Planning	18.	Internal communication
3.	Customer Focus	19.	Employee motivation and involvement
4.	Process Management	20.	Work satisfaction
5.	Human Resource Management	21.	Reduced incidents, rejections, and complaints
6.	Information and Analysis	22.	Relationship with suppliers
7.	Environmental Sustainability	23.	Supplier selection
8.	Social Sustainability	24.	Relationships with authorities and other stakeholders
9.	Economic sustainability	25.	Customer satisfaction
10.	Knowledge creation	26.	Customer communication
11.	Knowledge sharing	27.	Customer relationships
12.	Knowledge application	28.	Product/service quality
13.	Waste reduction	29.	Internal organization and operations
14.	Improved innovation capability for supply chains	30.	Commitment in moving towards best quality practices
15.	Positive impact on environmental process innovations	31.	Employee-management relationships
16.	Improved teamwork	32.	Infrastructural framework to adopt and develop CSR policy, strategy, and activities

Part 1: (Dimensions 1-16) (Source: Authors' Own Creation)

Project Title	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
Reduction in Rejection and Customer Complaints in Gear Line	Clear leadership in implementing Six Sigma methodology.	Project aimed to reduce Gear soft line rejection PPM with detailed analysis and use of high-end tools.	Improved customer satisfaction by reducing customer complaints.	Six Sigma DMAIC approach, use of Pareto chart, DOE, and SOP modifications. Process improvements communicated to other plants.	Training provided to team members. Brainstorming sessions conducted.	Detailed data analysis using high-end quality tools like Pareto chart and Box Plot.	NA	NA	Improved efficiency leading to cost savings.	Developed new procedures for handling heat treatment distortion.	Improvements communicated to other plants and displayed corrections in gears.	Implemented new handling procedures to reduce damage.	Reduced rejection from 1345 PPM to 1045 PPM.	Innovations in handling gear lead correction.	NA	Collaborative efforts in problem-solving.
Customer Delight through Prompt	Focus on resolving customer complaint	Project aimed to resolve customer	Achieved zero customer complaints	Problem-solving tools used:	Training provided to stakeholde	Data analysis to find root	NA	NA	Cost savings of Rs. 29,983 per annum	Developed new inspection facilities	Results shared with Ennore	Implemented mistake-proofing	Reduced Inter Unit Transfer of	Innovations in inspection processes.	NA	Collaborative problem-

Project Title	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
Efforts to Resolve Synchro Parts Concern	s through strong leadership commitment.	complaints related to Synchro parts using various problem-solving tools.	in Apr'23 and May'23, improving customer satisfaction.	histogram, boxplot, fishbone diagram, brainstorming, why-why analysis. Standardized process improvements.	rs. Visual display and on-job training implemented.	causes of issues using problem-solving tools and visual output for groove checking.			and Rs. 1,00,000 on a one-time basis.	for groove checking.	Plant and visual displays and one-point lessons provided.	in programs and developed new inspection fixtures.	Synchro parts PPM from 69 PPM to 48 PPM to Zero PPM.			solving efforts.
Electricity (KWH) Consumption Reduction by 25% in FY 23 on baseline of previous year	Strong commitment from leadership to achieve carbon neutrality by 2040 as stated by Chairman Anand Mahindra. Implementation of energy efficiency modules and training for 400+ participants.	Project targeted a 25% reduction in electricity consumption in FY 23 compared to the previous year. Detailed project charter and planning, including the application of various methodologies like 4W-1H, 3G, and benchmarking.	Ensured processes were stable and capable through IMR control charts. Enhanced work-life balance and reduced mental stress by reducing waiting times.	Utilized DMAIC (Define, Measure, Analyze, Improve, Control) approach. Implemented 20 unique Kaizens across top 30 sites and established energy efficiency reviews.	Trained over 700 employees on energy efficiency. Implemented a dedicated recognition and reward program for employees driving energy efficiency improvements.	Detailed process maps and data analysis using Six Sigma tools. Conducted various statistical analyses, including normality tests, run charts, box plots, and histograms.	Reduced 1,638 tons of CO2 emissions, equivalent to conserving ~9,809 trees. Significant reduction in electricity consumption, leading to cost savings.	Improved employee motivation and involvement through training and recognition programs.	Achieved cost savings of INR 2.34 crore in FY 23. Horizontal deployment of initiatives across 400 sites, aiming for long-term savings.	Created and implemented IMR control charts, capability analysis, and other statistical tools to drive improvements.	Conducted knowledge series and training sessions for 700+ participants. Shared best practices and Kaizens across multiple sites.	Applied Six Sigma tools and DMAIC methodology to reduce energy consumption and improve process efficiency.	NA	Utilized AI and IoT for monitoring and controlling energy consumption.	Reduced CO2 emissions and energy consumption.	Collaborative efforts across various teams to achieve project goals.
Eco-Friendly Coating and Sealing Materials for New Range of Automotive Vehicles	Strong commitment to sustainability goals as part of Mahindra Group's larger sustainability initiatives.	Project aimed at developing eco-friendly materials for automotive vehicles. Alignment with multiple	Enhancements in product quality and customer satisfaction through eco-friendly innovations.	Focus on integrating eco-friendly materials into the manufacturing process.	Collaborative efforts by team members across various roles.	Detailed analysis and evaluation of materials for eco-friendliness and performance.	Significant focus on reducing environmental impact through sustainable materials.	Contributions towards health and well-being by reducing harmful emissions.	NA	Development of new eco-friendly coating and sealing technologies.	Sharing of project results and methodologies with other divisions and teams.	Implementation of eco-friendly materials in new automotive vehicle models.	Reduced environmental impact through sustainable material choices.	Innovations in material science and manufacturing processes.	Significant improvements in environmental sustainability through new materials.	Collaboration among team members to achieve project goals.

Project Title	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
		UN Sustainable Development Goals.														
Digital and Sustainable Transformation of Transportation in Mines	Leadership commitment to digital and sustainable transformation in mining operations.	Project aimed at transforming transportation in mines through digital solutions. Alignment with UN SDG 9: Industry, Innovation, and Infrastructure.	Enhanced efficiency and reduced turnaround time for trucks in mines.	Implementation of a digitally enabled e-log system for truck management. Automated processes for entry, loading, weighing, and dispatch.	Training and development for staff on new digital systems and processes.	Detailed analysis of current processes and identification of inefficiencies. Use of RFID and GPS for real-time tracking and management.	Significant reduction in paper usage and carbon footprint. Saving of approximately 50,000 papers per month, equivalent to saving 65 teak trees per year.	Improved safety and reduced potential for unsafe situations in mines.	Enhanced efficiency leading to cost savings and reduced turnaround time.	Development of digital solutions for mine transportation management.	Sharing of project results and methodologies with other mining operations.	Implementation of digital and automated processes in mine transportation.	Reduction in paper usage and associated waste.	Innovations in digital management of transportation.	Significant improvements in environmental sustainability through digital solutions.	Collaborative efforts across various teams to implement digital solutions.
Autonomous Working of Air Compressor Bank Using Deep Learning	Leadership commitment to energy reduction and sustainability goals.	Project aimed at reducing energy consumption by 5% using AI and deep learning models.	Enhanced customer satisfaction through efficient energy management.	Implementation of deep learning models for autonomous control of air compressors and cooling towers.	Training and development of staff on AI solutions and energy management.	Detailed analysis using decision tree matrix and regression models.	Significant energy savings and reduction in CO2 emissions by 78 tons.	NA	Savings of 0.8 MINR, with a payback period of 3.8 years.	Development of AI models for energy management.	NA	Implemented deep learning models for autonomous control of compressors and cooling towers.	NA	NA	NA	NA
Utilization of Clean Energy Source more than 50% and Optimize Energy Usages at Bosch Rexroth Ahmedabad Location	NA	Project objective to increase contribution of clean energy source more than 50% in total energy demand.	NA	NA	NA	NA	NA	NA	Reduce energy cost around 12 million INR per annum due to solar energy under Capex model and 2 million INR per annum due to wind energy sourcing	NA	NA	NA	NA	NA	NA	NA

Project Title	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
									under OPEX model.							
Digital BOM and Setup Checklist	Strong leadership in implementing digital solutions for process improvement and paper reduction, showcasing a commitment to sustainability and efficiency.	Project targeted achieving zero paper consumption in the assembly line by implementing digital solutions, aligned with Bosch's strategic goals.	Enhanced customer satisfaction through reduced errors and improved efficiency in assembly line operations.	Utilized team-oriented problem-solving, flow charting, and brainstorming to eliminate redundant processes and ensure digital solutions were effective.	Involved shop floor associates in the development and deployment of digital solutions, ensuring user acceptance and training.	Developed a digital bill of materials and setup checklist system that integrates with SAP and Bosch's drawing management system.	Achieved zero paper consumption in the assembly line, saving 36,000 A4 sheets per year and contributing to environmental conservation.	NA	Saved time and reduced errors, leading to economic benefits. Investment of 0.67 million INR.	Created digital solutions for bill of materials and setup checklists, integrating them with existing systems.	Shared digital solutions across multiple assembly lines, expanding the project's impact.	Applied digital solutions to eliminate paper use and improve process efficiency.	Eliminated paper waste in the assembly line.	Improved digital capabilities in the assembly process.	Reduced paper waste and environmental impact.	Collaborative development and implementation of digital solutions.
Digital BOM and Setup Checklist	Strong leadership in implementing digital solutions for process improvement and paper reduction, showcasing a commitment to sustainability and efficiency.	Project targeted achieving zero paper consumption in the assembly line by implementing digital solutions, aligned with Bosch's strategic goals.	Enhanced customer satisfaction through reduced errors and improved efficiency in assembly line operations.	Utilized team-oriented problem-solving, flow charting, and brainstorming to eliminate redundant processes and ensure digital solutions were effective.	Involved shop floor associates in the development and deployment of digital solutions, ensuring user acceptance and training.	Developed a digital bill of materials and setup checklist system that integrates with SAP and Bosch's drawing management system.	Achieved zero paper consumption in the assembly line, saving 36,000 A4 sheets per year and contributing to environmental conservation.	NA	Saved time and reduced errors, leading to economic benefits. Investment of 0.67 million INR.	Created digital solutions for bill of materials and setup checklists, integrating them with existing systems.	Shared digital solutions across multiple assembly lines, expanding the project's impact.	Applied digital solutions to eliminate paper use and improve process efficiency.	Eliminated paper waste in the assembly line.	Improved digital capabilities in the assembly process.	Reduced paper waste and environmental impact.	Collaborative development and implementation of digital solutions.
Best From Waste	Strong leadership commitment to sustainability and innovation in recycling precious metals	Project aimed at recycling precious metals and copper, aligned with Tata Motors' sustainability and	Enhanced customer perception through commitment to sustainability and responsible resource	Implemented methodologies for evaluating and recycling precious metals and copper	Collaborative efforts among team members to implement recycling processes.	Detailed analysis of recycling processes for precious metals and copper, ensuring	Significant reduction in environmental impact by recycling 90% of precious metals and copper,	Contributed to the well-being of communities by reducing environmental hazards associated	Generated financial benefits of about INR 2 crore in FY 22-23 through recycling processes.	Developed new methodologies for recycling precious metals and copper from vehicle	Shared recycling methodologies across five Tata Motors plants in India.	Applied recycling techniques to recover valuable materials from waste.	Reduced waste by recycling precious metals and copper, minimizing the need for new	Improved supply chain sustainability through recycling innovations.	Significant positive impact on environmental sustainability through reduced waste and resource	Collaborative implementation of recycling processes.

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	and copper from vehicle components.	environmental goals.	management.	from vehicle components.		high efficiency and effectiveness.	contributing to responsible consumption and production.	with waste disposal.		components.			resource extraction.		conservation.	
JPH Improvement from 40 to 60 JPH, Energy saving of 4200kwh / annum and Co2 reduction of 4.2 Ton	Leadership in improving productivity and efficiency while reducing energy consumption and CO2 emissions.	Strategic planning focused on improving productivity, efficiency, and sustainability.	Improved customer satisfaction through increased productivity and reduced environmental impact.	Implemented lean manufacturing and process improvements to enhance productivity and efficiency.	Engaged cross-functional teams in the project to achieve common goals.	Utilized data analysis and process optimization tools to achieve project goals.	Achieved energy savings and CO2 reduction, contributing to environmental sustainability.	Improved workplace safety and efficiency, benefiting employees.	Achieved cost savings through process improvements and reduced energy consumption.	Generated new insights into productivity and efficiency improvements.	Disseminated best practices and process improvements across the organization.	Applied lean manufacturing principles to enhance productivity.	Reduced waste through process optimization and lean manufacturing.	Enhanced supply chain efficiency through process improvements.	Reduced energy consumption and CO2 emissions.	Fostered teamwork through cross-functional collaboration.
Scrap to Art work – Delivering a green Sustainable Future	Strong leadership in promoting innovation and sustainability through art and science.	Strategic approach to transforming scrap into art, aligning with sustainability goals.	Project aimed at engaging and educating the community about sustainability.	Innovative process of transforming scrap into art, integrating science and creativity.	Involved team members in creating and promoting the Scrap to Art project.	Assessed equipment parts for suitability and reusability in creating art pieces.	Created environmentally themed art from scrap, promoting sustainability.	Project aimed at raising awareness and educating the community about sustainability.	Demonstrated cost-effective use of resources through creative repurposing.	Created innovative art pieces, merging science and creativity.	Promoted the Scrap to Art project as a model for sustainability.	Applied artistic and scientific principles to create meaningful art pieces.	Reduced waste by repurposing scrap materials into art.	Promoted innovative use of scrap materials, inspiring similar projects.	Created environmentally themed art, promoting sustainability.	Encouraged team collaboration in creating the Scrap to Art project.
Reduction in waste generation by optimization of raw material quantities	Leadership in committing to ESG principles and reducing hazardous waste.	Strategic focus on reducing waste generation and environmental impact.	Commitment to producing high-quality chemicals with reduced environmental impact.	Utilized principles of 4R (Reduce, Reuse, Recycle, Recover) to optimize waste management.	Engaged team members in continuous improvement and waste reduction initiatives.	Analyzed waste generation and implemented strategies to reduce it.	Reduced overall waste generation by 23.8%, contributing to environmental sustainability.	Improved community health and safety by reducing hazardous waste.	Achieved significant cost savings through waste reduction initiatives.	Developed and implemented waste reduction strategies.	Shared ESG practices and waste reduction strategies within the industry.	Applied waste reduction principles to minimize environmental impact.	Achieved a 23.8% reduction in waste generation.	Improved supply chain practices through waste reduction strategies.	Reduced hazardous waste and environmental impact.	Promoted teamwork in implementing waste reduction initiatives.
Career and Competency Development Program (CCDP)	Strong leadership in promoting skill development and employability among	Strategic approach to enhancing employability skills of rural youth, aligning with the	Focus on improving the employability and life skills of rural graduates, enhancing their	Implemented a comprehensive training program including soft skills, technical skills, and	Engaged experienced subject matter experts from various fields to deliver training	Conducted assessments and evaluations to measure the effectiveness of	NA	Enhanced social sustainability by providing employability skills to marginalized and	Provided economic benefits by improving the employability and earning potential	Created a curriculum for sustainable employment skills development tailored to	Shared best practices and training methodologies across multiple batches	Applied training methodologies to improve employability and life skills of rural graduates.	NA	NA	NA	Encouraged teamwork among training participants and facilitators to enhance

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	rural youth, showcasing a commitment to social sustainability and quality education.	goals of quality education and sustainable development.	quality of life and job prospects.	life skills to improve employability.	and share knowledge.	training programs and improve curriculum.		underprivileged youth.	of rural youth.	the needs of rural graduates.	and centers, impacting a large number of students.					learning outcomes.
A Big Sustainability Swing through change in the cable & cable drum design	Strong leadership commitment to sustainability through innovative changes in cable design and transportation.	Project aimed at reducing the environmental impact of cable production and transportation, aligned with Tata Power's sustainability and environmental goals.	Focus on delivering environmentally friendly and durable cable solutions, improving customer satisfaction with reliable and sustainable products.	Implemented changes in cable design and drum materials to reduce environmental impact and improve durability.	Engaged team members in collaborative efforts to redesign cable components and drum materials.	Analyzed the environmental impact of cable materials and developed sustainable alternatives.	Significant reduction in environmental impact by replacing lead additives and using hybrid cable drums, saving wood and reducing carbon footprint.	Improved community well-being by reducing environmental hazards associated with traditional cable materials.	Achieved cost savings and economic benefits by using sustainable materials and reducing the need for frequent cable replacements.	Developed new methodologies for sustainable cable production and transportation.	Shared sustainable cable design methodologies across the industry, promoting widespread adoption.	Applied sustainable design principles to improve the environmental footprint of cable production and use.	Reduced waste by using hybrid cable drums and eliminating harmful additives in cable production.	Improved supply chain sustainability through innovations in cable materials and drum design.	Positive environmental impact through reduced lead usage, wood consumption, and enhanced cable durability.	Fostered teamwork through collaborative redesign of cable materials and processes.
Reduce Carbon Footprint in IB Packaging Process	Strong leadership in reducing environmental impact through innovative packaging solutions.	Project aimed at reducing carbon emissions from packaging processes, aligning with sustainability goals.	Enhanced customer perception through commitment to sustainability and reduced carbon footprint.	Implemented methodologies to reduce plastic usage and improve packaging processes.	Engaged team members in problem-solving and waste elimination approaches.	Used TPM 7 Step methodology and ROTI approach for problem-solving.	Reduced carbon emissions by reusing plastic covers and optimizing packaging.	NA	Achieved cost savings by reusing packaging materials and reducing plastic consumption.	Developed new packaging methodologies to reduce environmental impact.	Shared best practices and results with packaging industries and e-commerce businesses.	Applied packaging solutions to reduce plastic consumption and carbon footprint.	Reduced plastic waste by reusing packaging materials.	Improved supply chain sustainability through innovative packaging solutions.	Positive impact through reduced plastic usage and carbon emissions.	Fostered teamwork through collaborative problem-solving and waste elimination.
Improvement in Substitution of Conventional Energy by Renewable Energy	Leadership commitment to sustainability by investing in renewable	Strategic focus on improving energy efficiency and increasing the use of renewable energy.	Improved customer satisfaction by providing products manufactured with renewable energy.	Converted boilers to biomass briquette fired and installed solar panels to replace conventio	Involved team members in energy audits and the implementation of renewable	Used DMAIC methodology with tools like check sheets and fish bone analysis	Significant reduction in environmental impact by substituting 76% of plant energy	Improved community well-being by reducing environmental hazards associated with	Achieved cost savings through reduced fossil fuel consumption and energy costs.	Created knowledge on renewable energy implementation and energy audits.	Shared renewable energy practices with other plants and industries.	Applied renewable energy solutions to replace conventional energy sources.	Reduced waste by using biomass briquettes and solar power.	Improved supply chain sustainability through renewable energy use.	Positive impact through significant renewable energy substitution and reduced emissions.	Fostered teamwork through collaborative energy audits and project implementation.

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	energy projects.			nal energy.	energy projects.	for root cause analysis.	with renewable sources.	conventional energy sources.								
Adiabatic Smart Cooling Technology for Air-cooled Chillers	Leadership in implementing energy-saving technology for improved environmental performance.	Strategic approach to reduce energy consumption and improve chiller efficiency using adiabatic cooling technology.	NA	Implemented adiabatic cooling to reduce air temperature entering chillers, improving efficiency.	Engaged team members in analyzing energy consumption and implementing cooling technology.	Used 7 QC tools, pie charts, and Why-Why analysis to understand energy consumption and reduce it.	Reduced carbon footprint by 151 tons through improved chiller efficiency.	Contributed to the environment by reducing carbon footprint and energy consumption.	Improved economic performance by reducing energy costs and enhancing chiller efficiency.	Created knowledge on adiabatic cooling technology and its benefits.	Shared technology and results within the Mahindra group.	Applied cooling technology to improve chiller efficiency and reduce energy consumption.	Reduced energy waste by improving chiller efficiency.	Improved supply chain innovation by implementing new cooling technology.	Positive environmental impact through reduced energy consumption and carbon footprint.	Improved teamwork through collaborative analysis and technology implementation.
Reduction of Energy Consumption (Project Sambhav)	Strong leadership commitment to energy efficiency and sustainability.	Project aimed at reducing energy consumption and carbon footprint, aligned with sustainability goals.	Enhanced customer perception through commitment to sustainability and reduced energy consumption.	Implemented energy-saving methodologies and optimized processes to reduce consumption.	Engaged team members in energy audits and implementation of energy-saving measures.	Used 7 QC tools, including fishbone diagrams and Pareto analysis, to identify and address energy consumption issues.	Significant reduction in energy consumption and CO2 emissions, contributing to climate action.	Improved social sustainability by reducing environmental impact and promoting energy efficiency.	Achieved cost savings and a significant return on investment through energy reductions.	Developed new methodologies for energy reduction and sustainability.	Shared energy-saving practices with other plants and industry partners.	Applied energy-saving measures to reduce consumption and improve sustainability.	Reduced energy waste through optimized consumption and improved processes.	Improved supply chain sustainability through energy efficiency measures.	Positive impact through reduced energy consumption and carbon emissions.	Fostered teamwork through collaborative energy-saving projects.
Surge in Recovery & Quality of Iron Ore Fines	Leadership in implementing innovative recovery techniques for iron ore fines.	Strategic focus on improving recovery rates and quality of iron ore fines, aligning with responsible consumption and production.	Improved product quality and sustainability, enhancing customer satisfaction.	Implemented new hydrocyclone technology and panels to improve recovery rates.	Engaged team members in pilot testing and implementation of new recovery technology.	Used SIP methodology and root cause analysis to implement recovery improvements.	Improved recovery rates and reduced waste, contributing to responsible consumption and production.	Improved community well-being by reducing environmental hazards associated with iron ore processing.	Achieved cost savings through improved recovery rates and reduced waste.	Created knowledge on hydrocyclone technology and recovery improvements.	Shared recovery technology practices with other Tata Steel plants and the industry.	Applied new recovery technology to improve product quality and reduce waste.	Reduced waste through improved recovery rates and reduced iron ore losses.	Improved supply chain sustainability through innovative recovery technology.	Positive impact through improved recovery rates and reduced environmental footprint.	Fostered teamwork through collaborative recovery technology implementation.
Remote Wireless Operation of Moving	Leadership in enhancing operational safety	Strategic approach to improving operator	NA	Implemented remote control technology for safer	Engaged team members in the developm	Used 12 steps of problem-solving in QC,	Enhanced safety and reduced operational	Improved health and safety of operators by	Achieved cost savings through reduced	Created knowledge on remote control	Shared remote control technology	Applied remote control technology to	Reduced operational waste through improved	Improved supply chain innovation through	Positive impact through enhanced safety and	Improved teamwork through collaborative

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Machineries	and efficiency through remote control technology.	safety and operational efficiency through remote control.		and more efficient operation of yard machines.	ent and implementation of remote control systems.	including Pareto diagrams and fishbone diagrams.	detention, contributing to sustainable mining practices.	removing them from hazardous environments.	operational detention and overtime.	technology for mining operations.	practices within the mining industry.	improve operational safety and efficiency.	control and monitoring of yard machines.	the implementation of remote control technology.	operational efficiency.	development and implementation of remote control systems.
Reduction in Natural Resources Depletion through Innovation in Cabin Painting Process	Strong leadership in reducing environmental impact through innovative painting solutions.	Project aimed at reducing resource consumption and improving sustainability in the painting process.	Enhanced customer perception through commitment to sustainability and improved cabin quality.	Implemented methodologies to optimize painting processes and reduce resource consumption.	Engaged team members in the development and implementation of innovative painting solutions.	Used various statistical tools, including regression analysis and DOE, to optimize processes.	Reduced water, energy, and propane consumption, significantly lowering carbon footprint.	Improved social sustainability by reducing environmental impact and promoting resource efficiency.	Achieved significant cost savings through reduced resource consumption.	Developed new methodologies for resource-efficient painting processes.	Shared best practices with other plants and industry partners.	Applied innovative solutions to reduce resource consumption and improve sustainability.	Reduced waste through optimized painting processes and resource efficiency.	Improved supply chain sustainability through resource-efficient painting processes.	Positive impact through reduced resource consumption and carbon emissions.	Fostered teamwork through collaborative process optimization and innovation.
Anti-toppling Mechanism Implementation in HEMM	Leadership in enhancing safety and operational efficiency through anti-toppling mechanisms.	Strategic focus on eliminating toppling incidents of HEMM, aligned with safety and operational goals.	NA	Implemented engineering solutions to prevent toppling incidents in HEMM.	Engaged team members in brainstorming and implementing anti-toppling mechanisms.	Used Pareto analysis and cause-and-effect diagrams to identify and address toppling causes.	Prevented toppling incidents, reducing equipment damage and environmental hazards.	Improved safety and well-being of operators by preventing toppling incidents.	Achieved cost savings by preventing equipment damage and downtime.	Created knowledge on anti-toppling mechanisms and their implementation.	Shared anti-toppling solutions across the mining industry.	Applied engineering solutions to prevent toppling incidents and improve safety.	Reduced waste by preventing equipment toppling and associated damages.	Improved supply chain safety through anti-toppling mechanisms.	Positive impact through enhanced safety and reduced environmental hazards.	Fostered teamwork through collaborative problem-solving and implementation of safety mechanisms.
Steel Coil Width Reduction of ‘Frame Side Member’ through Product Parameter Optimization	Leadership commitment to sustainability and optimization of steel usage.	Strategic approach to reduce steel consumption and optimize processes.	Enhanced customer satisfaction through reduced costs and improved product quality.	Optimized process parameters to reduce steel coil width without compromising quality.	Engaged team members in data analysis and process optimization.	Used hypothesis testing, regression analysis, and DOE to optimize steel coil width.	Reduced steel consumption, saving natural resources and reducing environmental impact.	NA	Achieved cost savings through optimized steel usage and reduced waste.	Created knowledge on optimizing steel usage through process parameter adjustments.	Shared optimization practices with other plants and industry partners.	Applied optimized process parameters to reduce steel consumption and improve quality.	Reduced steel waste through optimized coil width and process adjustments.	Improved supply chain sustainability through optimized steel usage.	Positive impact through reduced steel usage and associated environmental benefits.	Improved teamwork through collaborative data analysis and process optimization.
Electrical Energy Consumption Reduction for 6 Melting Furnace - Material Grade	Leadership commitment to energy efficiency and sustainability in foundry	Project aimed at reducing electricity consumption in melting furnaces, aligned with	Enhanced customer perception through commitment to energy efficiency and reduced	Implemented Six Sigma DMAIC approach to optimize energy consumption in	Engaged team members in process optimization and energy efficiency initiatives.	Used Six Sigma tools like DMAIC, regression analysis, and DOE to optimize	Significant reduction in electricity consumption and CO2 emissions in foundry	Improved social sustainability by reducing environmental impact and promoting	Achieved significant cost savings through reduced electricity consumption.	Developed methodologies for energy reduction and sustainability in foundry	Shared energy-saving practices with other foundry units and industry partners.	Applied Six Sigma DMAIC methodology to reduce energy consumption and improve	Reduced waste through optimized energy consumption and improved processes.	Improved supply chain sustainability through energy-efficient practices.	Positive impact through reduced energy consumption and CO2 emissions.	Fostered teamwork through collaborative process optimization and energy efficiency projects.

Project Title	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
Combinations in Foundry	operations.	sustainability goals.	operational costs.	melting furnaces.		processes.	operations.	energy efficiency.		operations.		sustainability.				
Reduce carbon emissions through problem-solving tools to prevent CTRB cone honing losses in manufacturing	Leadership in implementing sustainable manufacturing practices to reduce carbon emissions.	Strategic focus on reducing carbon emissions and improving manufacturing efficiency.	Improved product quality and sustainability, enhancing customer satisfaction.	Implemented process innovations and changes to reduce carbon emissions in honing operations.	Engaged cross-functional teams in reducing honing losses and carbon emissions.	Used Why-Why analysis, hypothesis testing, and Six Sigma DMAIC to identify and mitigate risks.	Reduced carbon emissions and improved oil consumption, contributing to environmental sustainability.	Improved health and safety by reducing machine setting losses and oil consumption.	Achieved cost savings through reduced rework, oil consumption, and improved machine availability.	Created knowledge on reducing honing losses and carbon emissions in manufacturing.	Shared process innovations and sustainability practices with the manufacturing industry.	Applied process innovations and risk mitigation strategies to reduce carbon emissions.	Reduced waste by improving oil filtration and reducing honing losses.	Improved supply chain sustainability through process innovations and carbon emission reductions.	Positive impact through reduced carbon emissions and improved oil consumption.	Fostered teamwork through collaborative problem-solving and process innovations.
Peninsula Salsette 27 Project	Leadership in promoting sustainable construction practices and eco-friendly technologies.	Strategic approach to sustainable construction and reducing the carbon footprint of the project.	Improved customer satisfaction through eco-friendly building practices and amenities.	Implemented sustainable construction practices and waste management strategies.	Engaged project team in sustainable construction practices and innovations.	Used sustainable building practices and IGBC certification guidelines to achieve project goals.	Reduced CO2 emissions, water consumption, and promoted use of recycled materials.	Enhanced social sustainability through improved living conditions and eco-friendly amenities.	Achieved cost savings through reduced energy consumption and sustainable building practices.	Developed sustainable construction methodologies and waste management practices.	Shared sustainable construction practices and IGBC certification guidelines with the construction industry.	Applied sustainable building practices and waste management strategies to the construction project.	Reduced construction waste and promoted recycling and reuse of materials.	Improved supply chain sustainability through the use of eco-friendly materials and practices.	Positive impact through sustainable construction practices and reduced environmental footprint.	Fostered teamwork through collaborative sustainable construction practices and innovations.
Carbon Neutrality through Power Consumption Reduction	Leadership commitment to achieving carbon neutrality through energy efficiency projects.	Project aimed at reducing carbon emissions by optimizing power consumption and incorporating renewable energy.	Enhanced customer satisfaction through commitment to sustainability and reduced carbon footprint.	Implemented automation and energy-efficient technologies to reduce power consumption.	Engaged team members in energy-saving initiatives and technology implementation.	Used Six Sigma DMAIC methodology and various quality tools to optimize power consumption.	Reduced carbon emissions by 50,000 kg CO2e/year through power consumption reduction and renewable energy use.	Improved social sustainability by reducing environmental impact and promoting energy efficiency.	Achieved cost savings through reduced electricity consumption and energy efficiency measures.	Developed methodologies for reducing power consumption and carbon emissions.	Shared best practices and results with other manufacturing units and industry partners.	Applied energy-efficient technologies and renewable energy solutions to achieve carbon neutrality.	Reduced energy waste through optimized power consumption and renewable energy use.	Improved supply chain sustainability through energy-efficient and renewable energy practices.	Positive impact through reduced carbon emissions and improved energy efficiency.	Fostered teamwork through collaborative energy-saving projects and technology implementation.
Reducing Thermal Coal Usage by Introducing Biomass	Leadership in reducing fossil fuel consumption and carbon	Strategic focus on reducing thermal coal usage by co-firing	Improved customer satisfaction through sustainable steel	Implemented biomass co-firing in coal-based boilers,	Engaged team members in biomass procurement, feasibility	Used QC story methodology, TQM tools, and risk	Reduced CO2 emissions by 14,588 tons through biomass	Improved community well-being by reducing fossil fuel consumpti	Achieved cost savings of INR 1.81 crore through reduced	Created knowledge on biomass co-firing and its benefits in	Shared biomass usage practices within the steel industry	Applied biomass co-firing techniques to reduce thermal	Reduced coal waste through biomass co-firing and	Improved supply chain sustainability through innovative	Positive impact through reduced fossil fuel consumption and	Fostered teamwork through collaborative biomass procureme

Project Title	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
Consumption	emissions through biomass usage.	biomass in coal-based boilers, aligned with sustainability goals.	production practices.	reducing coal consumption and emissions.	studies, and implementation.	assessment to implement biomass usage.	co-firing and reduced coal usage.	on and promoting renewable energy.	coal usage and biomass co-firing.	reducing fossil fuel consumption.	and presented at sustainability meets.	coal usage and emissions.	optimized boiler operations.	biomass usage and reduced coal consumption.	CO2 emissions.	nt and implementation projects.
Development of High Tenacity Olive Green Industrial Yarn with Zero Effluent Discharge	Leadership in promoting sustainable textile production with zero effluent discharge.	Strategic approach to developing environmentally friendly yarn production processes, reducing water pollution.	Improved customer satisfaction through environmentally friendly yarn products.	Implemented dope dyeing process to produce colored yarn without water discharge.	Engaged team members in process optimization and machine modification for sustainable yarn production.	Used 8-step problem-solving approach, DOE, and QC tools for process optimization.	Achieved zero effluent discharge in yarn production, significantly reducing water pollution.	Enhanced social sustainability by eliminating water pollution from dyeing processes.	Achieved cost savings through process optimization and reduced effluent treatment costs.	Developed sustainable yarn production techniques with zero effluent discharge.	Shared sustainable yarn production practices with the textile industry and customers.	Applied dope dyeing process to achieve zero effluent discharge in yarn production.	Eliminated dye waste and effluent discharge through sustainable yarn production techniques.	Improved supply chain sustainability through environmentally friendly yarn production techniques.	Positive impact through zero effluent discharge and reduced water pollution.	Fostered teamwork through collaborative process optimization and machine modification projects.
IoT Enabled Air Conservation Using Predictive Analytics	Leadership commitment to achieving carbon neutrality through energy efficiency projects.	Project aimed at reducing air consumption and energy costs using IoT and predictive analytics.	Enhanced customer satisfaction through commitment to sustainability and reduced carbon footprint.	Implemented intelligent flow control, network simplification, and digital tools to optimize air consumption.	Engaged team members in energy-saving initiatives and technology implementation.	Used PDCA cycles, pie charts, Pareto principles, fishbone, and why-why analysis for root cause identification and solutions.	Achieved a 29% reduction in air specific consumption, reducing CO2 emissions by 2935 tons annually.	Improved social sustainability by reducing environmental impact and promoting energy efficiency.	Achieved cost savings of INR 275.32 million annually through reduced energy consumption and avoided additional compressor costs.	Developed methodologies for reducing air consumption and improving sustainability.	Shared best practices and results with other manufacturing units and industry partners.	Applied IoT and predictive analytics to optimize air consumption and reduce energy costs.	Reduced air wastage through optimized consumption and digital tools.	Improved supply chain sustainability through energy-efficient practices and digital tools.	Positive impact through reduced energy consumption and carbon emissions.	Fostered teamwork through collaborative energy-saving projects and technology implementation.
Sealer Conservation by 3R Methodology	Leadership in reducing hazardous waste through innovative sealer conservation techniques.	Strategic focus on reducing waste sealant generation and carbon emissions through 3R methodology.	Improved customer satisfaction through reduced waste and improved sealer application quality.	Implemented the 3R methodology (Reduce, Recycle, Reuse) to conserve sealer and reduce waste.	Engaged team members in identifying and addressing root causes of sealer wastage using fishbone analysis.	Used fishbone methodology to identify root causes of sealer wastage and implemented engineering measures.	Reduced sealer wastage by 91%, significantly reducing hazardous waste and CO2 emissions.	Improved community well-being by reducing hazardous waste and supporting sustainable development goals.	Reduced costs per car through sealer conservation, enhancing economic sustainability.	Created knowledge on the 3R methodology and its application in sealer conservation.	Shared sealer conservation practices with other automotive plants and industries.	Applied 3R methodology to reduce sealer wastage and improve application processes.	Reduced sealer waste by 91%, promoting reuse and recycling of sealant.	Improved supply chain sustainability through innovative sealer conservation techniques.	Positive impact through reduced hazardous waste and improved sealer application quality.	Fostered teamwork through collaborative identification and reduction of sealer wastage.

Project Title	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
Single Use Plastic Free Plant	Leadership in promoting sustainable practices by eliminating single-use plastics in the plant.	Strategic approach to eliminating single-use plastics, promoting sustainability, and supporting government initiatives.	Improved customer satisfaction through sustainable practices and reduced plastic pollution.	Implemented strategies to remove, refuse, and rally against single-use plastics, promoting a circular economy.	Engaged employees in sustainable practices and the elimination of single-use plastics.	Used root cause analysis and Kaizen activities to identify and eliminate sources of plastic pollution.	Eliminated 100% single-use plastics from the plant, reducing plastic waste and greenhouse gas emissions.	Supported government initiatives like Swachh Bharat Abhiyan and promoted responsible consumption.	Achieved cost savings of INR 1.7 million annually by eliminating single-use plastics.	Developed knowledge on eliminating single-use plastics and promoting a circular economy.	Shared single-use plastic elimination practices with other facilities and the supply chain.	Applied strategies to remove, refuse, and rally against single-use plastics, promoting sustainability.	Eliminated single-use plastics from the plant, reducing plastic waste and pollution.	Improved supply chain sustainability through the elimination of single-use plastics and promoting a circular economy.	Positive impact through reduced plastic pollution and support for government sustainability initiatives.	Fostered teamwork through collective efforts to eliminate single-use plastics and promote sustainability.
Parali Management: An Environmentally Sustainable Approach of Waste to Wealth	Strong leadership in promoting sustainable agricultural practices and environmental conservation.	Project aimed at reducing stubble burning and transforming agricultural waste into valuable resources.	Enhanced community well-being by reducing air pollution and promoting sustainable agriculture.	Implemented in-situ and ex-situ methods for crop residue management, including mechanization and transportation.	Engaged farmers, agricultural experts, and community members in sustainable practices.	Conducted detailed surveys and root cause analysis to understand the problem and develop solutions.	Reduced air pollution by 30% in Punjab and 31% in Haryana, preventing significant greenhouse gas emissions.	Improved health and well-being of communities by reducing air pollution and promoting sustainable agriculture.	Generated additional income for farmers through alternative uses of crop residue.	Developed methodologies for sustainable crop residue management and pollution reduction.	Shared best practices with other regions and agricultural communities.	Applied sustainable crop residue management techniques to reduce pollution and enhance agricultural productivity.	Reduced crop residue waste through alternative uses and mechanization.	Improved supply chain sustainability through sustainable agricultural practices and waste management.	Positive impact through reduced air pollution and enhanced agricultural productivity.	Fostered teamwork through collaborative problem-solving and sustainable practices.
Improving Energy Efficiency in Compressed Air Systems	Leadership commitment to achieving energy efficiency and reducing carbon emissions.	Strategic focus on optimizing compressed air systems to improve energy efficiency and reduce emissions.	Improved customer satisfaction through commitment to sustainability and reduced operational costs.	Implemented Six Sigma methodology and various quality tools to optimize compressed air systems.	Engaged energy management team, engineers, and technicians in energy efficiency projects.	Used fishbone analysis, Six Sigma, and DMAIC methodology to identify and address inefficiencies.	Reduced CO_2 emissions by 1374 Mt-CO_2e through energy efficiency measures.	Improved operator health and safety through optimized working conditions and reduced fatigue.	Achieved cost savings of 17.4 Lac Units/annum and increased competitiveness.	Created knowledge on optimizing compressed air systems and improving energy efficiency.	Shared energy efficiency practices with other manufacturing units and industry partners.	Applied energy-efficient technologies and quality tools to optimize compressed air systems.	Reduced energy waste through optimized compressed air systems and improved efficiency.	Improved supply chain sustainability through energy-efficient practices and reduced emissions.	Positive impact through reduced energy consumption and carbon emissions.	Fostered teamwork through collaborative energy efficiency projects and technology implementation.
Reduction of Air Consumption in Take-up and Spinning Section	Leadership in promoting energy efficiency and sustainability in textile	Strategic approach to reducing air consumption and improving sustainabil	Improved customer satisfaction through reduced energy consumption and enhanced	Implemented TQM methodology and tools to reduce air consumption and improve	Engaged team members in process optimization and air consumption	Used 4W1H, Ishikawa diagram, and other TQM tools for root cause	Achieved a reduction in air consumption, leading to significant energy	Supported sustainable development goals by promoting responsible	Achieved significant cost savings through reduced air consumption and improved	Developed knowledge on air consumption reduction and sustainability in	Shared process optimization practices with other plants and	Applied TQM methodology to reduce air consumption and improve	Reduced air consumption and energy waste through process	Improved supply chain sustainability through energy-efficient practices	Positive impact through reduced air consumption and improved	Fostered teamwork through collaborative process optimization and sustainabil

Project Title	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
	manufacturing.	ity in spinning processes.	product quality.	process efficiency.	reduction initiatives.	analysis and process improvement.	savings and reduced emissions.	consumption and production.	process efficiency.	textile manufacturing.	industry partners.	process efficiency.	optimization.	and reduced air consumption.	process efficiency.	ity projects.
Phosphate Sludge Generation Reduction in Cabin Pre-treatment Line	Leadership in reducing hazardous waste and improving sustainability in the painting process.	Project aimed at reducing phosphate sludge generation to stay within regulatory limits and improve sustainability.	Enhanced customer perception through commitment to sustainability and reduced environmental impact.	Implemented Six Sigma DMAIC methodology to reduce phosphate sludge generation.	Engaged team members in process optimization and sludge reduction initiatives.	Used measurement system analysis, root cause analysis, and process capability studies.	Reduced phosphate sludge generation by 55%, reducing hazardous waste and environmental impact.	Improved social sustainability by reducing hazardous waste and promoting safer working conditions.	Achieved cost savings through reduced sludge generation and improved process efficiency.	Developed methodologies for reducing hazardous waste and improving sustainability.	Shared best practices and results with other plants and industry partners.	Applied Six Sigma DMAIC methodology to optimize sludge generation and improve sustainability.	Reduced hazardous waste generation through optimized processes and new chemicals.	Improved supply chain sustainability through waste reduction and process optimization.	Positive impact through reduced hazardous waste and improved environmental compliance.	Fostered teamwork through collaborative problem-solving and process optimization projects.
Automobile Tyres: Sustainability through Fuel Efficiency	Leadership in promoting fuel-efficient tyre manufacturing and reducing carbon footprint.	Project aimed at reducing tyre rolling resistance to improve fuel efficiency and reduce carbon emissions.	Improved customer satisfaction through fuel-efficient and environmentally friendly tyres.	Implemented technology roadmaps focusing on material, design, and construction to reduce tyre rolling resistance.	Engaged cross-functional teams in tyre development projects to achieve rolling resistance targets.	Used statistical tools, computer simulations, and joint developments with suppliers for tyre optimization.	Achieved a 37% reduction in product carbon footprint through reduced rolling resistance.	Supported cleaner mobility and reduced emissions, contributing to better air quality and public health.	Achieved cost savings through reduced fuel consumption and efficient tyre production.	Created knowledge on reducing tyre rolling resistance and improving fuel efficiency.	Shared tyre development and sustainability practices with other manufacturing units and industry partners.	Applied technology roadmaps and statistical tools to optimize tyre performance and reduce emissions.	Reduced tyre rolling resistance, leading to lower fuel consumption and emissions.	Improved supply chain sustainability through innovative tyre development and reduced emissions.	Positive impact through reduced rolling resistance and improved fuel efficiency.	Fostered teamwork through collaborative tyre development and sustainability projects.
Creating Sustainable Manufacturing Processes through Operational Excellence, Innovation & Technology	Leadership in operational excellence and sustainable manufacturing practices.	Project targeted reducing carbon emissions by leveraging operational excellence, innovation, and technology.	Improved customer satisfaction through sustainable manufacturing practices and reduced costs.	Implemented cold box core making, waste heat recovery, and energy-efficient technologies to reduce emissions.	Engaged team members in process optimization, energy-saving initiatives, and innovative projects.	Used DOE, regression analysis, and TPM methodologies for process optimization.	Reduced carbon emissions by 7341 tons/year through various operational and technological innovations.	Improved community well-being through reduced emissions and sustainable practices.	Achieved significant cost savings through energy efficiency and process optimization projects.	Developed knowledge on process optimization, energy efficiency, and sustainable manufacturing.	Shared process optimization and sustainability practices across M&M group companies and the industry.	Applied operational excellence, innovation, and technology to achieve sustainability goals.	Reduced waste through energy efficiency and innovative process improvements.	Improved supply chain sustainability through energy efficiency and sustainable manufacturing practices.	Positive impact through reduced emissions and energy-efficient technologies.	Fostered teamwork through collaborative process optimization and energy efficiency projects.
Integrated Watershed Management Program	Leadership in promoting sustainable water	Project aimed at improving water resource	Enhanced community well-being by improving	Implemented participatory rural appraisal	Engaged community members, NGOs,	Used socio-scientific studies, SDG	Increased water storage capacity, improved	Enhanced community well-being by improving	Improved agricultural productivity and	Developed knowledge on water management,	Shared water management and agricultur	Applied participatory rural appraisal and action	Reduced water waste and improved soil	Improved supply chain sustainability	Positive impact through improved water	Fostered teamwork through collaborative water

Project Title	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
	management and rural development.	management, agricultural productivity, and community well-being in drought-prone regions.	water availability, agricultural productivity, and health.	and action plans to manage water resources and improve agriculture.	and government agencies in water management and agricultural enhancement projects.	tracking, and regular monitoring to assess project impact.	irrigation, and reduced soil erosion, enhancing environmental sustainability.	water availability, agricultural productivity, and health outcomes.	income for farmers, contributing to economic sustainability.	agricultural practices, and community development.	al practices with other regions and stakeholders.	plans to improve water management and agricultural productivity.	conservation through watershed management.	through enhanced water resource management and agricultural productivity.	management and environmental conservation.	management and agricultural enhancement projects.

Part 2: (Dimensions 17-32) (Source: Authors' Own Creation)

Project Title	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.
Reduction in Rejection and Customer Complaints in Gear Line	High level of commitment to reducing rejections.	Regular updates and sharing of improvements.	Motivation improved through problem-solving and training.	Satisfaction from achievements in reducing rejection rates.	Significant reduction in gear line rejection.	NA	NA	NA	Customer complaints reduced, leading to improved satisfaction.	NA	Enhanced through better quality products.	Reduction in gear rejection improved product quality.	SOP and Control Plan updates enhanced internal operations.	Use of Six Sigma methodology showed increased commitment.	NA	NA
Customer Delight through Prompt Efforts to Resolve Synchro Parts Concern	High commitment to resolving quality concerns.	Improved internal communication through visual displays and training.	Motivation improved by achieving zero defects.	Satisfaction from improved quality assurance.	Achieved zero customer complaints and reduced rejection rates.	NA	NA	NA	Customer satisfaction improved with zero complaints.	NA	Enhanced through better product quality.	Achieved zero PPM in Synchro parts, improving product quality.	Updated related documents and procedures, enhancing operations.	Use of problem-solving tools and techniques demonstrated commitment.	NA	NA
Electricity (KWH) Consumption Reductio	High level of commitment to reducing	Regular updates and knowledge sharing	Motivation improved through recognit	Improved work-life balance and reduced	NA	NA	NA	NA	NA	NA	NA	NA	Improved energy efficiency and established stable	Continuous improvement through DMAIC	Improved through regular communication	Commitment to carbon neutrality by 2040

Project Title	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.
n by 25% in FY 23 on baseline of previous year	energy consumption and achieving sustainability goals.	through emails and training sessions.	ion programs and training.	mental stress for employees.									processes through statistical analysis.	approach and statistical tools.	and recognition programs.	and sustainable energy practices.
Eco-Friendly Coating and Sealing Materials for New Range of Automotive Vehicles	Strong commitment to sustainability and innovation.	Regular updates and collaboration among team members.	Motivation through involvement in sustainability projects.	Satisfaction from contributing to sustainability goals.	NA	NA	NA	NA	Improved through eco-friendly product offerings.	NA	Enhanced through better product quality and sustainability.	Significant improvements through the use of eco-friendly materials.	NA	Commitment demonstrated through the development and implementation of sustainable materials.	NA	Supports Mahindra Group's sustainability initiatives and goals.
Digital and Sustainable Transformation of Transportation in Mines	High level of commitment to digital transformation and sustainability.	Improved communication through real-time tracking and digital dashboards.	Motivation through involvement in innovative projects.	Satisfaction from improved efficiency and reduced manual processes.	Reduction in manual errors and improved safety.	NA	NA	Enhanced relationships through improved compliance and safety.	Improved efficiency and reduced turnaround time for transportation.	NA	NA	Enhanced through efficient and automated processes.	Improved through digitalization and automation.	Demonstrated through the implementation of digital solutions.	NA	Supports Tata Steel's commitment to sustainability and digital transformation.
Autonomous Working of Air Compressor Bank	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Project Title	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.
Using Deep Learning																
Utilization of Clean Energy Source more than 50% and Optimize Energy Usages at Bosch Rexroth Ahmedabad Location	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Digital BOM and Setup Checklist	Demonstrated strong commitment to sustainability and digital transformation.	Improved communication through digital systems, reducing errors and time delays.	Increased motivation through involvement in innovative projects and training.	Improved job satisfaction through reduced errors and streamlined processes.	Reduced human errors and improved quality control.	NA	NA	NA	Enhanced through improved efficiency and reduced errors.	NA	NA	Enhanced through error reduction and efficient processes.	Improved through digitalization and streamlined workflows.	Demonstrated through the use of digital solutions and continuous improvement.	NA	Contributes to Bosch's overall sustainability goals.
Digital BOM and Setup Checklist	Demonstrated strong commitment to sustainability and digital transformation.	Improved communication through digital systems, reducing errors and time delays.	Increased motivation through involvement in innovative projects and	Improved job satisfaction through reduced errors and streamlined	Reduced human errors and improved quality control.	NA	NA	NA	Enhanced through improved efficiency and reduced errors.	NA	NA	Enhanced through error reduction and efficient processes.	Improved through digitalization and streamlined workflows.	Demonstrated increased commitment through the implementation of	Improved relationships through collaborative development and deploym	The project provides a framework for digital transformation, supporting CSR

Project Title	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.
			training.	processes.										digital solutions that streamline processes and reduce paper waste, aligning with Bosch's quality and sustainability goals.	ent of digital solutions, ensuring involvement and training of shop floor associates.	initiatives by reducing paper consumption and promoting sustainability.
Best From Waste	Demonstrated strong commitment to environmental sustainability and resource conservation.	Improved communication through coordinated recycling efforts.	Increased motivation through involvement in innovative and impactful projects.	Satisfaction from contributing to significant environmental and economic benefits.	NA	NA	NA	Enhanced relationships through commitment to environmental sustainability.	Enhanced customer perception through demonstrated commitment to sustainability.	NA	NA	NA	Improved through recycling processes and sustainability initiatives.	Showcased a commitment to quality practices by developing and implementing methodologies for recycling precious metals and copper, reducing waste and environ	Enhanced relationships by involving team members in collaborative efforts to implement recycling processes, fostering a sense of shared responsibility.	Developed an infrastructural framework for recycling processes that align with CSR policies focused on sustainability and environmental responsibility.

Project Title	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.
														mental impact.		
JPH Improvement from 40 to 60 JPH, Energy saving of 4200kwh / annum and Co2 reduction of 4.2 Ton	Showed commitment to productivity, efficiency, and sustainability.	Enhanced communication through process improvements and lean manufacturing.	Boosted employee morale through productivity and efficiency improvements.	Increased job satisfaction through improved workplace efficiency and safety.	Reduced incidents and improved workplace safety through process improvements.	Improved supplier relationships through better process management.	NA	Improved stakeholder relationships through sustainability efforts.	Improved customer satisfaction through productivity and sustainability improvements.	Improved communication with customers about sustainability efforts.	NA	Improved product quality through process optimization and lean manufacturing.	Enhanced operations through process improvements and lean manufacturing.	Commitment to best quality practices is evident through the strategic focus on improving productivity and efficiency while reducing energy consumption and CO2 emissions.	Fostered better relationships through cross-functional collaboration and engagement in the project to achieve common goals.	Established a framework for process improvements that enhance productivity and efficiency, supporting CSR strategies related to environmental sustainability.
Scrap to Art work – Delivering a green Sustainable Future	Displayed commitment to promoting sustainability through art and science.	Fostered communication about sustainability through the Scrap to Art project.	Engaged employees in creating meaningful art pieces.	Increased satisfaction from involvement in a creative and impactful project.	NA	NA	NA	Promoted positive relationships through the Scrap to Art project.	Engaged and educated customers about sustainability through art.	NA	NA	NA	Improved internal organization through creative and innovative projects.	Increased commitment is displayed through the innovative approach of transforming scrap	Improved relationships by involving team members in creating and promoting the Scrap to Art project,	The Scrap to Art project creates an infrastructural framework for innovative use of scrap materials,

Project Title	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.
														into art, which aligns with sustainability and quality improvement practices.	encouraging teamwork and creativity.	promoting CSR activities focused on sustainability and community engagement.
Reduction in waste generation by optimization of raw material quantities	Demonstrated commitment to ESG principles and waste reduction.	Improved communication about ESG initiatives and waste reduction.	Motivated employees through engagement in sustainability initiatives.	Increased satisfaction from contributing to environmental sustainability.	Reduced hazardous waste incidents and improved safety.	Improved relationships with suppliers through sustainable practices.	NA	Enhanced relationships with authorities through ESG compliance.	Enhanced customer satisfaction through commitment to quality and sustainability.	Improved communication with customers about ESG initiatives.	NA	Enhanced product quality through sustainable practices.	Improved operations through waste reduction and ESG initiatives.	Commitment to best quality practices is shown through the reduction of waste generation by optimizing raw material quantities and adhering to ESG principles.	Strengthened relationships by engaging team members in continuous improvement and waste reduction initiatives, promoting a collaborative work environment.	Implemented waste reduction strategies that provide a framework for adopting and developing CSR policies focused on environmental sustainability and safety.
Career and Competency Develop	Demonstrated strong commitment to	Improved communication and	Increased motivation among	Improved job satisfaction for trainees	NA	NA	NA	Enhanced relationships with	Enhanced customer satisfacti	NA	NA	NA	Improved organizational effective	Demonstrated increased commit	Improved relationships through	The program provides a

Project Title	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.
ment Program (CCDP)	social sustainability and quality education for rural youth.	collaboration among trainers, trainees, and stakeholders.	trainees through skill development and job placement opportunities.	through enhanced employability and job placement.				educational institutions and employers through successful training and placement programs.	on by improving the employability of rural graduates.				ness through structured training programs and continuous assessment.	ment through the implementation of comprehensive training programs for employability skills.	collaborative training and development initiatives.	framework for social sustainability by enhancing employability and life skills of rural youth.
A Big Sustainability Swing through change in the cable & cable drum design	Demonstrated strong commitment to environmental sustainability through innovative cable design.	Improved communication through coordinated efforts to implement sustainable cable designs.	Increased motivation among employees involved in the sustainable redesign project.	Increased work satisfaction among employees through involvement in impactful sustainability projects.	Reduced cable failures and environmental incidents through improved cable design.	Improved relationships with suppliers through the adoption of sustainable materials and practices.	Encouraged the selection of suppliers who provide environmentally friendly materials.	Improved relationships with regulatory authorities and stakeholders through compliance with environmental standards.	Enhanced customer satisfaction through the delivery of durable and environmentally friendly cable products.	Improved communication with customers about the benefits of sustainable cable products.	NA	Improved product quality through the use of sustainable materials and innovative design.	Enhanced operations through the implementation of sustainable practices and process improvements.	Showcased commitment to best quality practices by developing and implementing sustainable cable designs.	Fostered better relationships through collaborative efforts to redesign cable components and drum materials.	Developed an infrastructural framework for sustainable cable production and transportation, supporting CSR initiatives focused on environmental responsibility.
Reduce Carbon Footprint in IB Packagin	Demonstrated commitment to sustaina	Improved communication through	Increased motivation through	Improved job satisfaction through	Reduced incidents through	Improved relationships through	NA	Enhanced relationships through	Enhanced customer satisfacti	NA	NA	Improved packaging quality	Enhanced operations through	Demonstrated increased commit	Fostered better relationships through	Provided a framework for sustaina

Project Title	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.
g Process	bility through reduced carbon footprint in packaging.	coordinated waste elimination efforts.	involvement in sustainability projects.	successful sustainability initiatives.	improved packaging processes.	sustainable packaging practices.		successful sustainability projects.	on through reduced carbon footprint.			through reduced plastic usage.	sustainable packaging practices.	ment through reduced carbon footprint and improved packaging.	collaborative waste elimination projects.	ble packaging and reduced carbon footprint.
Improvement in Substitution of Conventional Energy by Renewable Energy	Demonstrated commitment to sustainability through renewable energy projects.	Improved communication through coordinated renewable energy projects.	Increased motivation through involvement in renewable energy projects.	Increased work satisfaction through successful implementation of renewable energy projects.	Reduced environmental incidents through renewable energy use.	Improved relationships with suppliers through renewable energy practices.	Encouraged selection of suppliers providing renewable energy solutions.	Improved relationships through compliance with environmental standards.	Improved customer satisfaction on through renewable energy use.	Improved communication with customers about renewable energy benefits.	NA	Improved product quality through renewable energy use.	Enhanced operations through renewable energy implementation.	Showcased commitment through renewable energy substitution and sustainability practices.	Fostered better relationships through collaborative renewable energy projects.	Developed a framework for renewable energy use and sustainability initiatives.
Adiabatic Smart Cooling Technology for Air-cooled Chillers	Demonstrated commitment to sustainability through innovative cooling technology.	Improved communication through coordinated energy analysis and project implementation.	Increased motivation through involvement in energy-saving projects.	Increased work satisfaction through successful implementation of energy-saving technology.	Reduced energy consumption incidents through improved chiller efficiency.	Improved relationships through sustainable technology implementation.	NA	Improved relationships through contributions to environmental goals.	NA	NA	NA	NA	Enhanced operations through improved chiller efficiency.	Demonstrated commitment through innovative energy-saving technology.	Improved relationships through collaborative energy-saving initiatives.	Provided a framework for energy-saving technology and environmental sustainability.
Reduction of Energy Consumption	Demonstrated commitment to sustaina	Improved communication through	Increased motivation through	Improved job satisfaction through	Reduced incidents through	Improved relationships through	Encouraged selection of supplier	Enhanced relationships through	Enhanced customer satisfacti	NA	NA	Improved energy efficiency and	Enhanced operations through	Demonstrated increased commit	Fostered better relationships through	Provided a framework for sustaina

Project Title	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.
(Project Sambhav)	bility and energy efficiency.	coordinated energy-saving efforts.	involvement in energy-saving projects.	successful energy-saving initiatives.	improved energy management and process optimization.	sustainable energy practices.	s providing energy-efficient solutions.	successful energy-saving projects and compliance with sustainability goals.	on through reduced energy consumption and improved sustainability.			reduced environmental impact, contributing to better product quality.	energy efficiency and improved processes.	ment through the implementation of energy-saving measures and sustainability practices.	collaborative energy-saving projects.	ble energy practices and reduced carbon footprint.
Surge in Recovery & Quality of Iron Ore Fines	Demonstrated commitment to responsible consumption and production through improved recovery rates.	Improved communication through coordinated recovery technology projects.	Increased motivation through involvement in recovery technology projects.	Increased job satisfaction through successful recovery technology projects.	Reduced environmental incidents through improved recovery rates and reduced waste.	Improved relationships through innovative recovery technology.	Encouraged selection of suppliers providing innovative recovery technology.	Improved relationships through compliance with environmental standards and responsible production practices.	Improved customer satisfaction through better product quality and sustainable practices.	Improved communication with customers about recovery improvements and sustainability benefits.	NA	Improved product quality through better recovery rates and reduced waste.	Enhanced operations through improved recovery technology and waste reduction.	Showcased commitment to best quality practices by implementing innovative recovery technology.	Fostered better relationships through collaborative recovery technology projects.	Developed a framework for sustainable recovery technology and responsible production practices.
Remote Wireless Operation of Moving Machineries	Demonstrated commitment to safety and operational efficiency through	Improved communication through coordinated remote control technology	Increased motivation through involvement in safety and efficiency	Increased job satisfaction through improved safety and operational	Reduced operational incidents and improved safety through remote	Improved relationships through enhanced safety and efficiency	Encouraged selection of suppliers providing remote control technology and	Improved relationships through enhanced safety and operational	NA	NA	NA	NA	Enhanced operations through remote control technology and improved safety.	Demonstrated commitment to best quality practices through remote control	Improved relationships through collaborative safety and efficienc	Provided a framework for remote control technology and enhanced safety,

Project Title	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.
	innovative technology.	implementation.	projects.	efficiency.	control technology.	practices.	safety solutions.	efficiency, contributing to sustainable mining practices.						technology and improved safety.	y projects.	supporting CSR initiatives focused on operator health and safety.
Reduction in Natural Resources Depletion through Innovation in Cabin Painting Process	Demonstrated commitment to sustainability through resource-efficient painting processes.	Improved communication through coordinated process optimization efforts.	Increased motivation through involvement in innovative and impactful projects.	Improved job satisfaction through successful resource efficiency initiatives.	Reduced incidents and resource consumption through optimized painting processes.	Improved relationships through sustainable and resource-efficient practices.	Encouraged selection of suppliers providing sustainable and resource-efficient solutions.	Enhanced relationships through successful sustainability projects and compliance with environmental standards.	Enhanced customer satisfaction through reduced resource consumption and improved cabin quality.	Improved communication with customers about sustainability benefits and improved cabin quality.	NA	Improved cabin quality through optimized painting processes and reduced defects.	Enhanced operations through resource-efficient painting processes and improved capacity.	Demonstrated increased commitment through the implementation of innovative and resource-efficient painting processes.	Fostered better relationships through collaborative process optimization and innovation projects.	Provided a framework for sustainable painting processes and resource efficiency.
Anti-toppling Mechanism Implementation in HEMM	Demonstrated commitment to safety and operational efficiency through innovative	Improved communication through collaborative safety improvement efforts.	Increased motivation through involvement in safety improvement projects.	Increased job satisfaction through improved safety and operational efficiency.	Eliminated toppling incidents, improving safety and reducing equipment	Improved relationships through collaborative safety solutions.	Encouraged selection of suppliers providing safe and reliable equipment.	Improved relationships through compliance with safety standards and enhanced operati	NA	NA	NA	NA	Enhanced operations through improved safety and reduced downtime.	Showcased commitment to best quality practices by implementing safety mechanisms and improvi	Fostered better relationships through collaborative safety improvement projects.	Developed a framework for enhanced safety and operational efficiency through anti-toppling

Project Title	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.
	solutions.				damage.			onal efficiency.						ng operational efficiency.		mechanisms.
Steel Coil Width Reduction of 'Frame Side Member' through Product Parameter Optimization	Demonstrated commitment to sustainability through optimized steel usage.	Improved communication through collaborative process optimization projects.	Increased motivation through involvement in process optimization projects.	Increased job satisfaction through successful process optimization and cost savings.	Reduced rejections and complaints through optimized steel usage and improved quality.	Improved relationships through optimized steel usage and cost savings.	Encouraged selection of suppliers providing optimized steel products.	Improved relationships through compliance with sustainability standards and cost savings.	Improved customer satisfaction through reduced costs and improved product quality.	Improved communication with customers about cost savings and quality improvements.	NA	Improved product quality through optimized steel usage and reduced defects.	Enhanced operations through optimized process parameters and reduced waste.	Demonstrated commitment through optimized steel usage and process improvements.	Improved relationships through collaborative process optimization projects.	Provided a framework for optimized steel usage and sustainability practices.
Electrical Energy Consumption Reduction for 6 Melting Furnace - Material Grade Combinations in Foundry	Demonstrated commitment to energy efficiency and sustainability in foundry operations.	Improved communication through coordinated energy efficiency initiatives.	Increased motivation through involvement in energy efficiency and sustainability projects.	Improved job satisfaction through successful energy efficiency initiatives.	Reduced incidents through optimized energy consumption and improved processes.	Improved relationships through sustainable and energy-efficient practices.	Encouraged selection of suppliers providing energy-efficient and sustainable solutions.	Enhanced relationships through successful energy efficiency projects and compliance with sustainability goals.	Enhanced customer satisfaction through reduced energy consumption and improved sustainability.	Improved communication with customers about energy efficiency and sustainability benefits.	Improved customer relationships through commitment to energy efficiency and sustainability.	Improved product quality through optimized energy consumption and reduced defects.	Enhanced operations through optimized energy consumption and improved processes.	Demonstrated increased commitment through the implementation of energy-efficient and sustainable practices.	Fostered better relationships through collaborative energy efficiency projects.	Provided a framework for sustainable energy practices and reduced carbon footprint.
Reduce carbon emissions through	Demonstrated commitment to reducin	Improved communication through	Increased motivation through	Increased job satisfaction through	Reduced rework and machin	Improved relationships through	Encouraged selection of supplier	Improved relationships through	Improved customer satisfacti	Improved communication with	Improved customer relation	Improved product quality through	Enhanced operations through	Showcased commitment to best	Fostered better relationships through	Developed a framework for sustaina

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problem-solving tools to prevent CTRB cone honing losses in manufacturing	g carbon emissions and improving manufacturing efficiency.	collaborative process improvements and risk mitigation.	involvement in reducing honing losses and carbon emissions.	successful carbon emission reduction projects.	e setting losses, improving product quality.	collaborative process improvements and sustainability practices.	s providing eco-friendly materials and technologies.	compliance with environmental standards and sustainability goals.	on through reduced carbon emissions and improved product quality.	customers about carbon emission reductions and product improvements.	ships through commitment to reducing carbon emissions and improving product quality.	reduced honing losses and improved manufacturing processes.	reduced machine setting losses and improved process efficiency.	quality practices by reducing carbon emissions and improving manufacturing efficiency.	collaborative process improvements and sustainability projects.	ble manufacturing practices and reduced carbon emissions.
Peninsula Salsette 27 Project	Demonstrated commitment to sustainable construction practices and eco-friendly technologies.	Improved communication through coordinated sustainable construction practices.	Increased motivation through involvement in sustainable construction practices.	Increased job satisfaction through successful sustainable construction projects.	Reduced construction waste and improved living conditions, enhancing project quality.	Improved relationships through sustainable building practices and eco-friendly materials.	Encouraged selection of suppliers providing sustainable building materials and practices.	Improved relationships through compliance with IGBC certification and sustainable construction standards.	Enhanced customer satisfaction through sustainable building practices and eco-friendly amenities.	Improved communication with customers about sustainable building practices and project benefits.	Improved customer relationships through commitment to sustainable construction practices.	Improved service quality through sustainable building practices and enhanced living conditions.	Enhanced operations through sustainable construction practices and waste management strategies.	Demonstrated commitment to best quality practices through sustainable construction and IGBC certification.	Fostered better relationships through collaborative sustainable construction practices.	Provided a framework for sustainable construction practices and eco-friendly technologies.
Carbon Neutrality through Power Consumption Reduction	Demonstrated commitment to achieving carbon neutrality and promoting	Improved communication through coordinated energy-saving initiatives and	Increased motivation through involvement in energy-saving and sustaina	Improved job satisfaction through successful energy efficiency and sustaina	Reduced power consumption incidents through optimized energy usage.	Improved relationships through sustainable energy practices and renewab	Encouraged selection of suppliers providing energy-efficient and	Enhanced relationships through successful energy-saving projects and	Enhanced customer satisfaction through reduced carbon footprint and	Improved communication with customers about energy efficiency and sustaina	Improved customer relationships through commitment to energy efficien	Improved product quality through optimized power consumption and	Enhanced operations through optimized energy consumption and improve	Demonstrated increased commitment through the implementation of	Fostered better relationships through collaborative energy-saving and sustaina	Provided a framework for sustainable energy practices and reduced carbon

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	sustainability.	technology implementation.	bility projects.	bility initiatives.		le energy procurement.	renewable energy solutions.	compliance with sustainability goals.	improved sustainability.	bility benefits.	cy and sustainability.	reduced carbon emissions.	d sustainability practices.	energy-efficient and sustainable practices.	bility projects.	footprint.
Reducing Thermal Coal Usage by Introducing Biomass Consumption	Demonstrated commitment to reducing fossil fuel consumption and promoting renewable energy.	Improved communication through collaborative biomass usage and sustainability projects.	Increased motivation through involvement in biomass co-firing and emissions reduction projects.	Increased job satisfaction through successful biomass co-firing and emissions reduction projects.	Reduced coal consumption incidents through biomass co-firing and optimized operations.	Improved relationships through collaborative biomass procurement and usage.	Encouraged selection of suppliers providing biomass and renewable energy solutions.	Improved relationships through compliance with environmental standards and renewable energy targets.	Improved customer satisfaction through sustainable steel production practices.	Improved communication with customers about biomass usage and sustainability benefits.	Improved customer relationships through commitment to reducing fossil fuel consumption and promoting renewable energy.	Improved product quality through reduced fossil fuel consumption and optimized production processes.	Enhanced operations through optimized biomass co-firing and reduced fossil fuel consumption.	Showcased commitment to best quality practices by reducing fossil fuel consumption and promoting renewable energy.	Fostered better relationships through collaborative biomass usage and emissions reduction projects.	Developed a framework for sustainable biomass usage and reduced fossil fuel consumption.
Development of High Tenacity Olive Green Industrial Yarn with Zero Effluent Discharge	Demonstrated commitment to sustainable textile production and environmental protection.	Improved communication through coordinated sustainable yarn production practices.	Increased motivation through involvement in sustainable yarn production and process optimization projects.	Increased job satisfaction through successful sustainable yarn production and environmental protection projects.	Reduced effluent discharge incidents through sustainable yarn production techniques.	Improved relationships through sustainable yarn production and zero effluent discharge practices.	Encouraged selection of suppliers providing sustainable and environmentally friendly materials.	Improved relationships through compliance with environmental standards and sustainable production	Enhanced customer satisfaction through environmentally friendly yarn products.	Improved communication with customers about sustainable yarn production and zero effluent discharge benefits.	Improved customer relationships through commitment to sustainable textile production and environmental	Improved product quality through sustainable yarn production and zero effluent discharge.	Enhanced operations through sustainable yarn production practices and zero effluent discharge.	Demonstrated commitment to best quality practices through sustainable yarn production and zero effluent	Fostered better relationships through collaborative sustainable yarn production and process optimization projects.	Provided a framework for sustainable yarn production and zero effluent discharge practices.

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								practices.			protection.			discharge.		
IoT Enabled Air Conservation Using Predictive Analytics	Demonstrated commitment to achieving carbon neutrality and promoting sustainability.	Improved communication through coordinated energy-saving initiatives and technology implementation.	Increased motivation through involvement in energy-saving and sustainability projects.	Improved job satisfaction through successful energy efficiency and sustainability initiatives.	Reduced power consumption incidents through optimized energy usage and digital tools.	Improved relationships through sustainable energy practices and digital tool implementation.	Encouraged selection of suppliers providing energy-efficient and digital solutions.	Enhanced relationships through successful energy-saving projects and compliance with sustainability goals.	Enhanced customer satisfaction through reduced carbon footprint and improved sustainability.	Improved communication with customers about energy efficiency and sustainability benefits.	Improved customer relationships through commitment to energy efficiency and sustainability.	Improved product quality through optimized air consumption and reduced energy costs.	Enhanced operations through optimized air consumption and digital tools.	Demonstrated increased commitment through the implementation of energy-efficient and digital solutions.	Fostered better relationships through collaborative energy-saving projects and digital tool implementation.	Provided a framework for sustainable energy practices and reduced carbon footprint.
Sealer Conservation by 3R Methodology	Demonstrated commitment to reducing hazardous waste and supporting sustainable development goals.	Improved communication through collaborative sealer conservation projects.	Increased motivation through involvement in reducing sealer wastage and improving application processes.	Increased job satisfaction through successful sealer conservation projects and reduced hazardous waste.	Reduced sealer wastage incidents through improved application processes and root cause analysis.	Improved relationships through collaborative sealer conservation projects and sustainability practices.	Encouraged selection of suppliers providing sustainable sealer application materials and technologies.	Improved relationships through compliance with environmental standards and sustainable development goals.	Improved customer satisfaction through reduced hazardous waste and improved sealer application quality.	Improved communication with customers about sealer conservation and sustainability benefits.	Improved customer relationships through commitment to reducing hazardous waste and supporting sustainable development goals.	Improved product quality through reduced sealer wastage and improved application processes.	Enhanced operations through improved sealer application processes and reduced hazardous waste.	Showcased commitment to best quality practices by reducing hazardous waste and improving sealer application processes.	Fostered better relationships through collaborative sealer conservation projects.	Developed a framework for sustainable sealer conservation and reducing hazardous waste.
Single Use	Demonstrated	Improved	Increased	Increased job	Reduced	Improved	Encouraged	Improved	Enhanced	Improved	Improved	Improved	Enhanced	Demonstrated	Fostered better	Provided a

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Plastic Free Plant	commitment to sustainability by eliminating single-use plastics and promoting responsible consumption.	communication through coordinated efforts to eliminate single-use plastics and promote sustainability.	motivation through involvement in sustainable practices and eliminating single-use plastics.	satisfaction through successful elimination of single-use plastics and promoting sustainability.	plastic pollution incidents through the elimination of single-use plastics and promoting a circular economy.	relationships through sustainable practices and elimination of single-use plastics.	selection of suppliers providing sustainable and eco-friendly materials.	relationships through compliance with government initiatives and promoting responsible consumption.	customer satisfaction through sustainable practices and reduced plastic pollution.	communication with customers about the elimination of single-use plastics and sustainability benefits.	customer relationships through commitment to eliminating single-use plastics and promoting responsible consumption.	product quality through the elimination of single-use plastics and promoting sustainability.	operations through the elimination of single-use plastics and promoting sustainable practices.	commitment to best quality practices through the elimination of single-use plastics and promoting responsible consumption.	relationships through collective efforts to eliminate single-use plastics and promote sustainability.	framework for eliminating single-use plastics and promoting responsible consumption.
Parali Management: An Environmentally Sustainable Approach of Waste to Wealth	Demonstrated commitment to environmental sustainability and community well-being.	Improved communication through coordinated efforts and stakeholder engagement.	Increased motivation through involvement in sustainable practices and community projects.	Improved job satisfaction through successful community and environmental projects.	Reduced air pollution incidents through sustainable crop residue management.	Improved relationships through sustainable agricultural practices and waste management.	Encouraged selection of suppliers providing sustainable agricultural solutions.	Enhanced relationships through successful environmental projects and compliance with sustainability goals.	Enhanced customer satisfaction through reduced air pollution and improved agricultural practices.	Improved communication with customers about sustainability benefits and pollution reduction.	Improved customer relationships through commitment to environmental sustainability and community well-being.	Improved agricultural productivity and reduced pollution, enhancing product quality.	Enhanced operations through sustainable agricultural practices and waste management.	Demonstrated increased commitment through sustainable agricultural practices and pollution reduction.	Fostered better relationships through collaborative sustainable practices and community projects.	Provided a framework for sustainable agricultural practices and community well-being.
Improving Energy Efficiency in	Demonstrated commitment to energy	Improved communication through	Increased motivation through	Increased job satisfaction through	Reduced energy consumption	Improved relationships through	Encouraged selection of supplier	Improved relationships through	Improved customer satisfacti	Improved communication with	Improved customer relation	Improved product quality through	Enhanced operations through	Showcased commitment to best	Fostered better relationships through	Developed a framework for sustaina

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Compressed Air Systems	efficiency and reducing carbon emissions.	coordinated energy efficiency initiatives and quality tools.	involvement in energy efficiency and sustainability projects.	successful energy efficiency projects and improved working conditions.	incidents through optimized compressed air systems.	collaborative energy efficiency projects and sustainability practices.	s providing energy-efficient technologies and solutions.	compliance with environmental standards and sustainability goals.	on through reduced energy consumption and improved sustainability.	customers about energy efficiency and sustainability benefits.	ships through commitment to energy efficiency and sustainability.	optimized energy consumption and reduced emissions.	optimized compressed air systems and improved efficiency.	quality practices by optimizing compressed air systems and reducing emissions.	collaborative energy efficiency projects and technology implementation.	ble energy practices and reduced carbon footprint.
Reduction of Air Consumption in Take-up and Spinning Section	Demonstrated commitment to energy efficiency and sustainability in textile manufacturing.	Improved communication through coordinated process optimization projects.	Increased motivation through involvement in process optimization and sustainability initiatives.	Increased job satisfaction through successful air consumption reduction projects.	Reduced air consumption incidents through optimized processes and improved efficiency.	Improved relationships through sustainable practices and process optimization initiatives.	Encouraged selection of suppliers providing energy-efficient and sustainable materials.	Improved relationships through compliance with sustainability standards and promoting responsible consumption.	Improved customer satisfaction through reduced air consumption and enhanced product quality.	Improved communication with customers about air consumption reduction and sustainability benefits.	Improved customer relationships through commitment to energy efficiency and sustainability.	Improved product quality through reduced air consumption and enhanced process efficiency.	Enhanced operations through reduced air consumption and improved process efficiency.	Demonstrated commitment to best quality practices through reducing air consumption and improving sustainability.	Fostered better relationships through collaborative process optimization and sustainability projects.	Provided a framework for sustainable air consumption practices and process optimization.
Phosphate Sludge Generation Reduction in Cabin Pre-treatment Line	Demonstrated commitment to reducing hazardous waste and improving	Improved communication through coordinated sludge reduction and process optimiza	Increased motivation through involvement in process optimization and sustaina	Improved job satisfaction through successful sludge reduction and process optimiz	Reduced hazardous waste incidents through optimized processes and	Improved relationships through sustainable waste management and process	Encouraged selection of suppliers providing sustainable and innovative	Enhanced relationships through successful waste management and environ	Enhanced customer satisfaction through reduced hazardous waste and improve	Improved communication with customers about sustainability benefits and reduced	Improved customer relationships through commitment to sustainability and	Improved product quality through optimized sludge generation and reduced defects.	Enhanced operations through optimized sludge generation and improved process	Demonstrated increased commitment through optimized processes and reduced	Improved through collaborative efforts in reducing phosphate sludge generation,	Developed a framework for sustainable waste management practices, ensurin

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	environmental sustainability.	tion efforts.	bility projects.	ation projects.	new chemicals.	optimization.	chemicals.	mental compliance.	d environmental sustainability.	hazardous waste.	reduced hazardous waste.		efficiency.	hazardous waste.	fostering better teamwork and communication.	g compliance with environmental regulations and promoting community engagement.
Automobile Tyres: Sustainability through Fuel Efficiency	Demonstrated commitment to improving fuel efficiency and reducing emissions.	Improved communication through coordinated tyre development and sustainability initiatives.	Increased motivation through involvement in tyre development and sustainability initiatives.	Increased job satisfaction through successful tyre development and sustainability initiatives.	Reduced rolling resistance incidents through optimized tyre development.	Improved relationships through sustainable tyre development and reduced emissions.	Encouraged selection of suppliers providing sustainable materials and technologies.	Improved relationships through commitment to sustainability and reduced emissions.	Improved customer satisfaction through fuel-efficient and environmentally friendly tyres.	Improved communication with customers about fuel efficiency and reduced emissions.	Improved customer relationships through commitment to fuel efficiency and reduced emissions.	Improved tyre quality through reduced rolling resistance and improved fuel efficiency.	Enhanced operations through optimized tyre development and reduced emissions.	Showcased commitment to best quality practices by reducing tyre rolling resistance and improving fuel efficiency.	Enhanced by involving employees in tire optimization projects, fostering a sense of ownership and collaboration towards sustainability goals.	Created a structured approach to sustainability by integrating CSR initiatives with technology roadmaps and policy projects, ensuring long-term commitment to environmental goals.
Creating Sustaina	Demonstrated	Improved	Increased	Increased job	Reduced	Improved	Encouraged	Improved	Improved	Improved	Improved	Improved	Enhanced	Demonstrated	Strengthened	Developed a

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ble Manufacturing Processes through Operational Excellence, Innovation & Technology	commitment to achieving sustainability goals through operational excellence and innovation.	communication through coordinated process optimization and energy efficiency projects.	motivation through involvement in process optimization and energy efficiency projects.	satisfaction through successful process optimization and energy efficiency projects.	emissions incidents through optimized processes and energy-efficient technologies.	relationships through sustainable manufacturing practices and energy efficiency projects.	selection of suppliers providing energy-efficient and sustainable solutions.	relationships through compliance with environmental standards and sustainability goals.	customer satisfaction through sustainable manufacturing practices and reduced costs.	communication with customers about sustainability benefits and reduced emissions.	customer relationships through commitment to sustainability and reduced emissions.	product quality through optimized processes and energy-efficient technologies.	operations through optimized processes and energy-efficient technologies.	commitment to best quality practices	through involvement in energy efficiency and innovation projects, leading to better communication and teamwork.	robust CSR framework focused on energy efficiency, renewable energy, and waste management, aligning with corporate sustainability goals.
Integrated Watershed Management Program	Demonstrated commitment to improving water management and community well-being.	Improved communication through participatory rural appraisal and community engagement.	Increased motivation through involvement in water management and agricultural enhancement projects.	Increased job satisfaction through successful water management and community development projects.	Reduced water scarcity incidents through improved water management and agricultural practices.	Improved relationships through collaborative water management and agricultural enhancement projects.	Encouraged selection of suppliers providing sustainable agricultural and water management solutions.	Improved relationships through collaborative water management and agricultural development projects.	Enhanced customer satisfaction through improved water availability, agricultural productivity, and health outcomes.	Improved communication with customers about water management and agricultural productivity benefits.	Improved customer relationships through commitment to water management and community well-being.	Improved service quality through enhanced water management and agricultural productivity.	Enhanced operations through improved water management and agricultural practices.	Demonstrated commitment to best quality practices through integrated water management and rural development.	Improved through participatory approaches in watershed management, involving employees and community members in sustaina	Established a comprehensive CSR framework through the Integrated Watershed Management Program, enhancing commu

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															ble practices .	nity develop ment and environ mental conserv ation.