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Business process management

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Socialinių kliūčių hierarchinės tarpusavio priklausomybės diegiant žiedinę ekonomiką Saudo Arabijos plastikų gamybos sektoriuje	Hierarchical Interdependencies of Social Barriers to Circular Economy Adoption in Saudi Arabia's Plastics Manufacturing Sector
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Contents

INTRODUCTION	1
1.Barrier Identification and Categorization: Social Effects on Circular Economy in Saudi Arabia's Manufacturing Sector	5
1.1 Social Barriers Analysis.....	6
1.1.1 Cultural and Awareness Barriers	6
1.1.2 Organizational and Behavioral Barriers	8
1.1.3 Social Acceptance and Market Barriers	9
1.1.4 Stakeholder Engagement and Collaboration Barriers.....	10
1.1.5 Skills Gap and Digital Literacy Support	12
1.2 Saudi Arabia Context	18
1.3 Specific Social Barriers to implement CE in Plastics Manufacturing.....	21
1.4 Hierarchical Framework.....	23
2. EMPIRICAL RESEARCH METHODOLOGY FOR INVESTIGATING SOCIAL BARRIERS IMPEDING CIRCULAR ECONOMY (CE) ADOPTION WITHIN SAUDI ARABIA'S PLASTICS MANUFACTURING SECTOR.....	28
2.1 .Research purpose, questions, and design	28
2.3 Participant Sampling and Recruitment Strategy.....	30
2.4 Data Analysis Procedure	32
2.5 Data Collection Procedure and Instruments.....	32
2.6 Interdependency Analysis Procedure.....	35
3.EMPIRICAL RESULTS ANALYSIS FOR CE SOCIAL BARRIERS THEMES CROSS LEVELS	37
3.1 Methodological Foundation.....	37
3.2 The cross-level hierarchical synthesis.....	47
4.RECOMMENDATIONS & CONCLUSIONS	50
Thesis Summary in English	65

- **CE** - Circular Economy
- **HM** - Higher Management
- **MM** - Middle Management
- **Emp** - Employee (Operational-level)
- **SOP** - Standard Operating Procedure

- **KPI** - Key Performance Indicator
- **ROI** - Return on Investment
- **uPVC** - unplasticized Polyvinyl Chloride
- **PVC** - Polyvinyl Chloride
- **HDPE** - High-Density Polyethylene
- **SASO** - Saudi Standards, Metrology and Quality Organization
- **SIDF** - Saudi Industrial Development Fund
- **NIDL** - National Industrial Development and Logistics Program
- **GCC** - Gulf Cooperation Council

Islamic principles referenced include:

- **Khalifah** - Stewardship
- **Mizan** - Balance
- **Israf** - Waste prohibition

INTRODUCTION

It is becoming more widely acknowledged that the conventional linear economic model which is typified by the "take make dispose" mentality is detrimental to the environment and greatly contributes to pollution and resource depletion, this worldwide insight has spurred a paradigm change in favor of the circular economy. a regenerative economic model that uses closed loop systems to reduce waste and increase resource efficiency (Badhotiya et al., 2021) contrary to a simple waste management approach, the circular economy is a comprehensive framework that uses creative business models, sustainable design and cooperative stakeholder engagement to promote economic growth that is uncoupled from resource consumption (Callegaro-de-Menezes & Schutte, 2023). In emerging economies where long term prosperity depends on sustainable industrial development, this shift is especially urgent and complicated.

Saudi Arabia, a major oil producer and global economic force, understands the need to strike a balance between environmental sustainability and industrial growth the Kingdom's Vision 2030 is a comprehensive reform program designed to diversify the economy and lessen reliance on oil earnings, focuses its modernization and transformation efforts on the circular economy (Yusuf & Lytras, 2023) manufacturing, and more especially the plastics manufacturing sector, has enormous potential among many industries, but putting circular principles into practice presents unique challenges. Specialized technical skills, quality assurance, and maintenance knowledge that are considerate of organizational culture and worker conditions are necessary for the production of plastics (Alshehabeya, 2024). It is both timely and vital to concentrate on this subsector given the economic importance and environmental effects of plastics manufacturing in Saudi Arabia.

The majority of Saudi Arabia's current research on the circular economy has focused on financial incentives and technological advancements offering valuable but insufficient insights (Voukkali et al., 2023) more thorough research in developing nations highlights that social barriers like stakeholder awareness, human capital, organizational culture, and cultural attitudes often have a bigger impact on the adoption of the circular economy than do technical or financial considerations (Badhotiya et al., 2021).. However, social barriers are still not well understood in the Saudi manufacturing context because they are not well studied (Piao et al., 2023) this lack of understanding makes it more difficult to create interventions and policies that effectively address the underlying causes of the difficulties in implementing the circular economy.

This thesis investigates the social impediments to the adoption of a circular economy (CE) within the plastics manufacturing sector in Saudi Arabia, utilizing a multi tiered approach that includes insights from operational personnel, middle management, and senior executives/CEOs. By placing these obstacles within the sociocultural, organizational, and religious framework of the Kingdom

incorporating Islamic principles such as stewardship (khalifah), balance (mizan), and waste prohibition (israf) the study uncovers hierarchical discrepancies that impede the implementation of Circular Economy (CE) despite alignment with Vision 2030.

The manufacturing sector faces major social barriers that prevent the effective adoption of circular practices even though the circular economy is central to Saudi Arabia's Vision 2030 these include culturally ingrained views of sustainability and workforce retention issues and organizational resistance to change unclear strategies and inadequate stakeholder collaboration platforms this thesis's primary research question is:

How do organizational culture and leadership support across hierarchical levels influence the implementation of circular economy practices within Saudi Arabia's plastics manufacturing firms?

In support of this, two sub questions are investigated:

How do inter-departmental relationships and communication channels at operational, middle management, and senior levels affect the uptake of circular economy initiatives in Saudi plastics manufacturing organizations?

What specific socio cultural factors unique to the Saudi Arabian context present challenges to the circular economy transition in the manufacturing sector?

The aim of this study is to identify, classify, and critically assess the social barriers hindering circular economy adoption in the Saudi plastics manufacturing industry in cross management levels and how these barriers effect the adoption process of CE principles , thereby enabling the development of actionable strategies to overcome these barriers in alignment with Saudi Arabia's Vision 2030 sustainability goals.

To achieve this aim, the thesis sets out following objectives:

1. To develop a classification framework of social barriers tailored to the Saudi plastics manufacturing context, integrating socio cultural organizational through literature review emphasizing manufacturing in developing economies with Saudi specific focus.
2. To conduct qualitative research using sem -structured interviews in Saudi Arabia's plastics manufacturing sector in order to obtain firsthand insights into the barriers that hinder the implementation of circular economy principles at company level.
3. To uncover complex social dynamics, organizational culture influences, and behavioral factors impeding circular economy adoption such as leadership symbolism gaps,

interdepartmental silos, and culturally ingrained through thematic analysis of qualitative data across hierarchical levels.

4. develop the model (Hierarchical Interdependency Barrier Framework for Circular Economy Adoption in Saudi Arabia's Plastics Manufacturing Sector) based on empirical research (scientific result)
5. formulate evidence based recommendations for industry leaders, and civil society actors aimed at addressing and mitigating identified social barriers. (practical result).

In order to gather detailed information about social barriers in the plastics manufacturing industry the study uses a qualitative research methodology Semi structured interviews with important stakeholders, such as workers, , technical experts, and manufacturing managers, are used to gather data rich contextualized understanding of intricate social dynamics organizational and behavior and cultural influences that statistical methods alone might miss is made possible by this qualitative approach. (Eisenhardt, 1989; Lincoln & Guba, 1985).

Through the development and application of a novel (Hierarchical Interdependency Barrier Framework for Circular Economy Adoption) this study will systematically address this critical research gap by going beyond simple lists of barriers this integrated framework is intended to provide a nuanced and structured understanding of the complex challenges within Saudi Arabia manufacturing sector Its dual strategy is its main innovation to enable accurate identification, it first arranges barriers into a hierarchical structure of primary categories (social, economic, technological, and regulatory) and secondary subcategories second, and perhaps more importantly it uses interdependency mapping to examine the intricate causal connections and feedback loops that reinforce one another between these obstacles this is crucial since social barriers are the most important obstacle are rarely isolated rather they frequently serve as underlying factors that intensify technological and economic difficulties the framework provides a potent diagnostic tool by recognizing this dynamism in addition to listing the "what," it will also explain the "why" and "how," allowing for the creation of focused, systemic intervention strategies as opposed to patchwork fixes. In order to give policymakers and business executives a clear road map for overcoming the social complexities impeding the circular economy and advancing the sustainable development goals of Vision 2030, this framework ultimately seeks to convert theoretical insights into actionable intelligence.

This research faces limitations inherent to qualitative studies, such as potential respondent bias and challenges in generalizing findings beyond the plastics manufacturing subsector or geographic context. Furthermore, the complexity of social and cultural factors presents difficulties in isolating

specific barrier impacts. Nevertheless, the study's focused scope and rich qualitative data provide a solid foundation for advancing understanding of social barriers to circular economy adoption and informing practical interventions in Saudi Arabia.

The purpose of this qualitative study is to explore and understand the social barriers inhibiting the adoption of circular economy principles within the Saudi Arabian manufacturing sector specifically focusing on the plastics manufacturing sub sector. This study will use a thematic analysis approach grounded in Organizational Culture Theory to gather rich contextualized insights from diverse stakeholders involved in the circular economy transition under Vision 2030.

1.Barrier Identification and Categorization: Social Effects on Circular Economy in Saudi Arabia's Manufacturing Sector

The circular economy is representing the transformative shift from the conventional linear economics model typified by the take and make and dispose mentality this mentality of the linear model has been widely acknowledged as detrimental to the environment and contributing significantly to pollution and resource depletion in the response of this system the circular economy offers a regenerative economic model that emphasizes closed loop systems that aimed at reducing waste and increasing resource efficiency (Badhotiya et al., 2021) unlike the traditional waste management approaches CE is a comprehensive framework that promotes sustainable design and creative business models and cooperative stakeholder engagement to foster economic growth decoupled from resource consumption (Callegaro-de-Menezes & Schutte, 2023) this paradigm is a shift particularly important in emerging economies where long term prosperity depends on sustainable and depend on the industrial development. Saudi Arabia is a big major oil producer and global economic force and recognizes the necessity of balancing environmental sustainability with industrial growth that is why its Vision 2030 program focuses on economic diversification by promoting sustainability and circular economy practices especially with in the manufacturing sector (Yusuf & Lytras, 2023) the plastics manufacturing sub sector due to its economic importance and environmental. impact and representing a critical area for applying circular principles (Alshehabeya,et al 2024).

Despite the growing attention to financial incentives and technological advancements in CE adoption, social barriers such as stakeholder awareness, human capital, organizational culture and cultural attitudes frequently creates a greater influence on the success or failure of circular initiatives (Badhotiya et al., 2021) (Voukkali et al., 2023) these social factors have not been sufficiently studied in the Saudi manufacturing contexts to open challenges to developing effective policies and interventions (Piao et al., 2023) this dissertation addresses this knowledge gap by focusing on specifically on social barriers within Saudi Arabia plastics manufacturing industry while integrating relevant Islamic principles such as stewardship (*Arabic*. Khalifa) balance (*Arabic* Mizan), and waste prohibition (*Arabic* Israf) that spiritually align with circular economy concepts (Hidayat, 2024 (Javaid, 2022) the manufacturing sector is confronted with significant social barriers that inhibit circular economy adoption even though such practices are central to Saudi Arabias Vision 2030 these barriers include culturally ingrained sustainability perceptions, workforce retention issues organizational resistance to change and unclear strategic approaches

and limited stakeholder collaboration platforms by addressing these issues it is essential for facilitating circular economy practices effectively (Alotaibi et al., 2019).

Organizational behaviors influencing CE adoption, this study will employ a qualitative research methodology with semi structured interviews with key stakeholders including workers technical experts, and manufacturing managers (Eisenhardt, 1989; Lincoln & Guba, 1985). By classifying barriers into primary groups of social barriers and analyzing the causal links of each level and feedback loops among these challenges, the development and application of a novel Hierarchical Interdependency Barrier Framework goes beyond simply listing barriers this approach will highlight the crucial role of social barriers which frequently reinforce and intensify other barriers allowing for targeted systemic interventions (Tabas et al., 2024) by offering a clear roadmap based on this integrated framework, this research aims to equip business leaders with actionable intelligence to overcome social complexities impeding circular economy adoption and support the sustainable development goals articulated in Vision 2030.

1.1 Social Barriers Analysis

1.1.1 Cultural and Awareness Barriers

The adoption of circular economy principles in Saudi Arabia's manufacturing sector is significantly affected by cultural barriers and a lack of awareness among stakeholders. Existing studies indicate that awareness is often limited to basic recycling and waste reduction, rather than a comprehensive understanding of circular strategies such as remanufacturing, product as a service models, and closed-loop supply chains (AlJaber et al., 2024; Alotaibi et al., 2024) this superficial grasp of CE concepts fundamentally restricts the implementation of more advanced circular practices which require a deeper systemic changes

The cultural resistance to change is another major obstacle the manufacturing sector in Saudi Arabia is characterized by entrenched habits and traditional business models which create mood against adopting CE principles (Alotaibi et al., 2019) this resistance is often rooted back in risk averse attitudes and a preference for the status quo making it difficult to introduce circular strategies that demand a paradigm shift in both thinking and operational practices.

Poor communication frameworks make these cultural barriers even worse (Alotaibi et al., 2019). For CE to work well and suppliers and manufacturers and customers and regulatory bodies all need to work together and share information nevertheless the existing communication frameworks within Saudi Arabia's manufacturing sector are inadequate to facilitate the requisite

coordination for effective circular initiatives this deficiency in stakeholder communication not only hinders the adoption of circular economy (CE) practices but also exacerbates cultural resistance as stakeholders remain disconnected and uninformed regarding the advantages and prerequisites of circular strategies, the studies showed that knowledge of circular economy principles and the level of understanding of sustainability are not evenly distributed among all levels of manufacturing companies (Akinwale et al., 2024) senior managers are more likely to hear about the circular economy through national policy agendas corporate strategies, and pressure from outside stakeholders this encourages a more abstract and strategic view of CE that focuses on things like competitiveness risk management and aligning with policy goals like Vision 2030 (Yusuf & Lytras, 2023; Callegaro de Menezes & Schutte, 2023) however middle managers on the other hand usually turn these big ideas into operational procedures and performance indicators however, they often see CE as just cost cutting measures waste reduction goals or small process improvements instead of systemic change (AlJaber et al., 2024; Al Otaibi et al., 2024; Geissdoerfer et al., 2017) at the same time and frontline workers usually only see the circular economy as a set of specific work instructions or extra tasks related to sorting, reusing, or cutting down on material waste. They don't see the bigger picture of why it's important and what the long-term benefits are (Acerbi et al., 2021; Circular Economy Alliance, 2023; European Commission, 2020). This stratification of knowledge and awareness engenders perception disparities between the articulated directives at the apex of the hierarchy and the practical comprehension on the shop floor, thereby reinforcing risk-averse dispositions and a preference for established routines (Alotaibi et al., 2019; Rizos et al., 2016). By organizing its empirical research among upper management, middle management, and employees, this thesis explicitly analyzes the manifestation of hierarchical awareness differentials within the Saudi plastics manufacturing sector and their influence on the implementation of circular practices.

A significant research gap identified in the literature is the insufficient investigation into how communication deficiencies exacerbate cultural impediments to circular economy adoption within Saudi Arabia's manufacturing sector. Poor communication and cultural resistance are acknowledged as impediments; however, there is an absence of comprehensive analysis regarding the mechanisms by which communication failures exacerbate these barriers. Furthermore, there is insufficient discourse on how enhanced communication could alleviate cultural resistance and promote the adoption of circular economy practices.

1.1.2 Organizational and Behavioral Barriers

Organizational and behavioral barriers constitute a significant category of social impediments to the adoption of the circular economy (CE) within the manufacturing sector of Saudi Arabia (Alotaibi et al., 2019) the absence of clear strategies and guidelines for CE implementation results in confusion and inconsistency in organizational approaches, leading to fragmented and ineffective efforts (Alotaibi et al., 2019) furthermore are many manufacturing companies lack the institutional frameworks necessary to support CE initiatives, further undermining the coherence and sustainability of their adoption efforts training and education are significant organizational barriers; research indicates that the lack of adequate training is a primary obstacle to CE adoption in Saudi Arabia's construction and manufacturing sectors (Alotaibi et al., 2019) this deficiency extends beyond technical skills to include a comprehensive understanding of CE principles and sustainable business practices and the change management competencies necessary for organizational transformation without targeted training the employees and managers find it challenging to adapt to new CE models and processes.

Management of commitment and leadership support are crucial for the successful implementation of Circular Economy (CE) (Jaeger et al. 2020) however many of the manufacturing companies in Saudi Arabia encounter inconsistent leadership support for sustainability initiatives, resulting in an organizational environment that is not conducive to CE adoption (Jaeger et al. 2020) the lack of strong consistent leadership frequently leads to inadequate prioritization, and resource allocation for CE projects further impeding progress. one of the biggest behavioral barriers is that employees don't want to change. Employees may resist new technologies, practices, or processes that come with implementing CE because they are worried about job security, having to do more work, or not knowing how to do things differently (Jaeger et al. 2020). This resistance is often made worse by a lack of communication about the benefits and need for CE practices, which can make staff skeptical and uninterested organizational and behavioral impediments to the adoption of a circular economy exhibit a distinct hierarchical structure within manufacturing enterprises (Lewandowski, et. al 2016). Senior leaders are often seen as important symbolic and strategic supporters of sustainability. However, research shows that there are often gaps between formal commitments at the top and consistent follow-through in middle management practice (Jaeger et al. 2020) and (Kirchherr et al., 2017) middle managers are in a structurally ambiguous position because they have to make CE goals happen and enforce new routines while also dealing with limited resources, production pressures, and old performance metrics that still favor linear efficiency over circular value creation (Rizos et al., 2016; Managerial Practices for Designing CE, 2022) at the frontline, employees feel these tensions as more work more complicated procedures,

and unclear priorities this makes them more resistant to change, more likely to stick to old habits, and less likely to get involved with CE-related projects (Jaeger & Upadhyay, 2020; Circular Economy Alliance, 2023) research on organizational transformation towards circularity underscores that behavioral resistance is not solely an individual characteristic but arises from misaligned expectations, communication deficiencies, and fragmented support across hierarchical tiers (Badhotiya et al., 2021; Piao et al., 2023) this thesis empirically examines the impact of inconsistencies in leadership signaling and middle management mediation and everyday work conditions on the feasibility of circular economy practices in Saudi plastics manufacturing firms by disaggregating organizational and behavioral barriers among higher management middle management, and employees.

A significant research gap highlighted in the literature is the inadequate comprehension of how inconsistent leadership support and disjointed institutional frameworks directly affect the effective implementation of Circular Economy principles in Saudi Arabia's manufacturing sector [Alotaibi et al., 2019; Jaeger & Upadhyay, 2020] it is recognized that ambiguous strategies and insufficient leadership commitment impede adoption however there is a paucity of comprehensive examination regarding the mechanisms and magnitude of this influence within local organizational settings more research is needed to find out how these factors work together and affect CE adoption at the organizational level. .

1.1.3 Social Acceptance and Market Barriers

Social acceptance and market barriers are very important in deciding whether circular economy CE initiatives will work in the Saudi Arabia manufacturing sector research consistently finds that the low demand and limited acceptance of remanufactured products are the biggest barriers to CE adoption (Badhotiya et al., 2021) this consumer resistance is mostly due to perceptions about the qualities and reliabilities, and social status of circular products, which hurts market demand and makes it less appealing for manufacturers to invest in CE practices a major problem is the social stigma that comes with circular economy products people often think that remanufactured or recycled goods are not as good as new ones which makes it harder for the market to accept them and limits the potential for circular business models (Jugend et al., 2024). This is especially true in Saudi Arabia, where people tend to prefer new and high end products by making it hard for circular alternatives to catch on in many developed countries, consumers care about the environment, which drives demand for sustainable products. In Saudi Arabia, however, there is not much social demand for circular economy practices, which makes it less likely that manufacturers will prioritize sustainability and invest in CE initiatives (Voukkali et al.,

2023). There is still not a lot of research on how social stigma and feelings of inferiority affect people's desire to buy circular products in Saudi Arabia although the inclination towards novel and high quality products is extensively recorded, the underlying mechanisms influencing these perceptions and the ways to alter them through marketing, education, or policy remain insufficiently examined this deficiency underscores the necessity for additional research into the determinants of consumer attitudes and the viable strategies for transforming market perceptions within the local context.

Social acceptance and market related barriers are also perceived differently at various organizational levels resulting in unique yet interconnected limitations on the adoption of a circular economy (Badhotiya et al., 2021; Voukkali et al., 2023) at the level of higher management market barriers are often described as regulatory uncertainty gaps in standards and certification and perceived threats to brand reputation and customer satisfaction these factors can make it hard for companies to commit to remanufactured or recycled product lines even if they say they want to be more environmentally friendly (Jugend et al., 2024; Safa, 2023; Amar, 2022) middle managers often face these problems when they have to deal with strict quality standards negotiate customer requirements, and handle complaints or returns when customers think circular products are bad or risky (Jaeger & Upadhyay, 2020; Jensen et al., 2022) frontline employees encounter social acceptance challenges primarily in their daily interactions with customers and intermediaries, where stigma surrounding reused or recycled materials, a preference for "new" products, and limited environmental awareness result in skepticism, rejection of reworked items, or pressure to revert to linear practices (Jugend et al., 2024; Acerbi et al., 2021). The literature indicates that market acceptance is not a uniform external condition but rather a socially constructed barrier that presents variably for executives, operational managers, and shop floor workers throughout the value chain (Badhotiya et al., 2021; Piao et al., 2023) this thesis empirically examines narratives from higher management, middle management, and employees within the Saudi plastics manufacturing sector to investigate how these stratified perceptions of customer demand, product status, and social stigma collectively influence organizational willingness to invest in circular economy practices.

1.1.4 Stakeholder Engagement and Collaboration Barriers

Effective stakeholder engagement and collaboration are crucial for the successful implementation of a circular economy (CE) however, substantial barriers persist within the manufacturing sector in Saudi Arabia the collaboration between businesses is a big problem because CE initiatives are often so complicated that companies need to work together in ways that

go against traditional competitive relationships (Jaeger & Upadhyay, 2020) this change from competition to cooperation is hard to make happen especially when companies don't trust each other or have the same goals a lack of communication between stakeholders makes it even harder to work together (Alotaibi et al., 2019) for CE implementation to work, there needs to be open information sharing and coordinated planning, and aligned goals among all stakeholders however, the current communication systems in Saudi manufacturing are often not good enough, making it hard to coordinate the level of effort needed for CE initiatives, in many places the industry associations, government agencies, and third party organizations help coordinate collaborative efforts and provide neutral platforms for engagement In Saudi Arabia the lack of these kinds of support structures makes it harder for companies to build and keep collaborative networks, manufacturing companies must undergo a fundamental shift from linear to circular stakeholder engagement paradigms (Tabas et al., 2024) this involves broadening the scope of collaborations, increasing the depth of engagement, and enabling meaningful participation throughout the value chain. Traditional consultation procedures are insufficient for the complex dynamics of CE systems, and companies need to adopt integrated governance frameworks that facilitate ongoing communication, group decision-making, and cooperative problem solving.

Stakeholder collaboration is one of the most frequently cited obstacles across sectors, seriously undermining the teamwork needed for successful CE adoption(Piao et al., 2023) The complex nature of CE transitions requires coordinated efforts from suppliers manufacturers and other stakeholders but the dynamics of stakeholder relationships and influences must be carefully managed to ensure effective collaboration companies must move beyond financial incentives and policy enforcement to develop strategies that align stakeholder interests and generate mutual value propositions (Kaewunruen et al., 2024) barriers to stakeholder engagement and collaboration also show clear differences in hierarchy within organizations and along the value chain. Research indicates that, at the senior management level, collaboration on circular initiatives is frequently framed as strategic partnerships, joint ventures, or sectoral platforms. However, executives remain apprehensive about sharing information and relying on other companies, particularly in competitive manufacturing contexts (Jaeger & Upadhyay, 2020; Tabas et al., 2024; Kaewunruen et al., 2024). Middle managers are usually in charge of turning these high level cooperation goals into real inter organizational routines however they often have to deal with misaligned incentives unclear governance structures, and broken communication channels that make it hard to keep working with suppliers customers and intermediaries over time (Alotaibi et al., 2019; Jensen et al., 2022) frontline employees engage with stakeholders more indirectly through daily coordination with logistics providers, quality inspectors, and customer representatives. The lack

of formal interfaces, joint problem solving mechanisms and feedback loops hinders their capacity to facilitate circular flows of materials and information in practice (Piao et al., 2023; Acerbi et al., 2021) the literature indicates that inadequate stakeholder collaboration in circular economy transitions cannot be attributed to a singular “external” barrier rather, it arises from misaligned expectations and the absence of coordination structures across hierarchical levels and organizational boundaries. This thesis empirically examines the manifestation of multi level collaboration gaps in Saudi Arabia’s plastics manufacturing sector by analyzing interview data from higher management and middle management and employees and how these gaps impede the development of robust circular supply chain relationships

1.1.5 Skills Gap and Digital Literacy Support

From an employee perspective, technological barriers pose a significant hindrance to the Saudi Arabian manufacturing sector's transition to circular economy practices. The disparity between the current workforce's capabilities and the technical competencies required for implementing the circular economy represents a fundamental challenge research identifies a lack of technical skills as one of the seven primary obstacles to the adoption of the circular economy in manufacturing (Jaeger & Upadhyay, 2020; Dennison et al., 2024) this skills gap is especially clear in areas that are important for the circular economy to work, like digital technologies data analytics and advanced manufacturing methods Digital technologies are becoming more and more important for the circular economy to work they are used to keep track of materials and improve resource flows and coordinate circular supply chains, which makes these skills gaps worse (Acerbi et al., 2021) many workers in Saudi Arabia's manufacturing sector don't have the digital skills they need to use these technologies effectively, which makes it harder to implement circular economy initiatives successfully this is made worse by the fact that technology is changing quickly in areas like blockchain, artificial intelligence, and the Internet of Things, which keeps raising the skill levels needed to implement the circular economy successfully, plastics manufacturers that want to keep highly skilled technical workers can learn from (Alshehabeya's et al. 2024) study on workforce retention, which found that manufacturing companies that set up structured appreciation programs and better work environments have 34% higher employee retention rates, it is harder for workers to adopt circular economy technologies because they may need to understand and manage complex systems that include multiple feedback loops, reverse logistics, and integrated supply chains, which are different from traditional linear manufacturing processes (Acerbi et al., 2021). People who are used to simpler linear processes may find this complexity too much to handle, which could lead to resistance and make implementation harder.

Training and education deficiencies are a major barrier to the adoption of technology because employees don't get enough training. Lack of training has been repeatedly found to be a significant barrier to Saudi Arabia's adoption of the circular economy (Alotaibi et al., 2019) the extensive skill requirements linked to circular economy technologies are frequently not adequately addressed by the training programs currently in place in many manufacturing organizations because circular economy practices are interdisciplinary and require workers to comprehend not only technical aspects of sustainability but also its environmental and economic and social dimensions this deficiency is especially problematic.

The absence of specialized educational pathways for circular economy competencies complicates training efforts these competencies often necessitate interdisciplinary knowledge spanning multiple domains in contrast to traditional manufacturing skills that have well defined educational and training frameworks (Beducci et al., 2024) this makes it hard for companies to provide good training and for workers to learn new skills.

The need for constant learning brought on by the quickly developing technologies for the circular economy adds to the problems because sustainability technologies are always changing, workers need to keep improving their skills to stay productive in their jobs (Beducci et al., 2024) the institutional capacity of many Saudi Arabian manufacturing companies to provide opportunities for ongoing learning hinders the long term adoption and successful implementation of technology.

Technology Acceptance and Resistance One major obstacle to the adoption of the circular economy in Saudi Arabia's manufacturing sector is employee resistance to new technologies according to (Obiuto et al. 2024), this resistance frequently results from worries about job security and increased workload and a lack of familiarity with new technological systems, employees may actively or passively oppose implementation efforts if they believe that circular economy technologies will be a threat to their jobs or add to their workload.

One factor that makes employees resistant to circular economy technologies is that they seem complicated. When new technologies require big changes to how people have always done things, many employees find them scary or hard to understand (Thirumal et al., 2024). Even with the right training and help, this feeling of complexity can create psychological barriers that make it hard for people to use new technologies (Hidayat et al. 2024) says that cultural factors also affect how employees in Saudi Arabia's manufacturing sector use technology traditional work cultures that value hierarchy, routine, and established practices may not be open to the collaborative and adaptable approaches that are needed to successfully implement circular economy technology.

This is because these approaches require big changes in the culture of the organization and the way employees think, which can be very hard to do.

Information Management and Data Challenges A lot of people who work in Saudi Arabia's manufacturing sector don't have the advanced information management skills they need to successfully adopt circular economy practices research indicates that information management and sharing remains a significant barrier to the implementation of circular manufacturing strategies (Acerbi et al., 2021) for employees to help make decisions about the circular economy, they need to be able to collect, analyze, and use complicated information about the flow of materials, energy use, waste generation, and product lifecycles, problems with data accessibility and quality make it even harder to manage information. To make the circular economy work, you need timely, accurate, and complete data on a variety of manufacturing processes (Acerbi et al., 2021) many workers don't have the skills or tools they need to make sure that data is accessible and of good quality, which makes it hard to put the circular economy into action.

When information systems are linked between different parts of the company and outside partners, it makes things harder for employees to put circular economy practices into action, many people, like suppliers, customers, and government agencies, need to be able to share information easily (Acerbi et al., 2021) workers need to be able to use integrated information systems that work across organizations. This requires skills and knowledge that many people do not have right now.

Studies on skills, digital literacy, and training consistently reveal that capability gaps are perceived and understood differently at various organizational levels within manufacturing companies. Senior managers usually talk about skills gaps in general terms, like "talent availability" or "future skills needs." They also often think that basic technical skills are enough to support circular initiatives, which means they don't realize how important it is to have specific skills for CE-oriented design, reverse logistics, and data-driven resource optimization. When middle managers have to put in place digitally enabled material tracking, quality control, or recycling processes without enough money for training, structured programs, or time for staff development, they are directly affected by these gaps. Frontline employees, on the other hand, face the skills and digital literacy barriers most directly as problems with using new technologies, understanding data, and adding circular tasks to already busy work schedules. This can lead to frustration, mistakes, and a lack of interest in using CE-related tools. The literature indicates that deficiencies in skills and training are not solely individual failings but rather a systemic, hierarchical issue influenced by strategic underinvestment at the upper echelons, implementation challenges in the intermediate levels, and restricted learning opportunities at the operational level. This thesis examines how the

disaggregation of skills and training barriers among higher management, middle management, and employees creates layered capability gaps that hinder the implementation of circular economy practices in Saudi plastics manufacturing.

Research on resistance to change during circular economy transitions underscores that such resistance is prevalent throughout the organizational hierarchy, rather than being limited to frontline workers. At higher levels, resistance often shows up as strategic hesitation, fear of risk, and a preference for business models that are already known. This can slow down or weaken CE initiatives, even when sustainability is publicly supported (Alotaibi et al., 2019; Badhotiya et al., 2021). Middle managers often show "pragmatic" resistance by questioning whether circular projects are possible given the current performance pressures, resource limits, and key performance indicators. They may also only implement parts of CE that don't cause too much disruption (Jaeger & Upadhyay, 2020; Piao et al., 2023). Frontline employees often exhibit more overt behavioral resistance, motivated by apprehensions regarding workload, job security, safety, and unfamiliar responsibilities, particularly when circular practices are implemented without sufficient communication, involvement, or training (Acerbi et al., 2021; Circular Economy Alliance, 2023). The literature characterizes resistance to circular change as arising from misaligned expectations, unequal allocation of risks and benefits, and insufficient participation of various hierarchical groups in decision-making processes. This thesis empirically investigates the cross-level dynamics of resistance and their implications for the sustainability of circular transformations by analyzing the descriptions and justifications provided by higher management, middle management, and employees in Saudi plastics manufacturing regarding their responses to circular economy initiatives.

A notable research deficiency in the skills gap and digital literacy challenges segment is the insufficient comprehension of the efficacy of existing training programs and institutional capacity in bridging the skills gap for circular economy technologies within Saudi Arabia's manufacturing sector. Although numerous initiatives and frameworks are referenced, empirical evaluations of their efficacy, scalability, and the particular obstacles within organizational settings are insufficient, raising the inquiry regarding the effectiveness of these training programs in Saudi Arabia.

There is also a lack of a full understanding of how the lack of intermediary organizations and poor communication frameworks make it harder for multiple stakeholders to work together in Saudi Arabia. Although these barriers are acknowledged, their interaction with competitive dynamics

among companies and their impact on coordinated decision-making within the circular economy value chain remain insufficiently examined.

Table 1 Social barrier themes for the Hierarchical linking

Barrier theme	Main points in the literature	Hierarchical implications suggested by literature	How this thesis tests them empirically (Chapter 3)
Knowledge & awareness	Awareness often limited to basic recycling and waste reduction; deeper understanding of circular strategies is rare in manufacturing sectors. AlJaber et al. (2024); Al-Otaibi et al. (2024); Akinwale et al. (2024);	Strategic actors are more exposed to CE discourse; middle managers and employees tend to interpret CE through operational routines and waste tasks.	Interview questions on CE understanding across higher management, middle management and employees; cross-level perception and quote tables.
Organisational culture & leadership support	Leadership support frequently inconsistent; cultures remain strongly linear and risk-averse despite sustainability rhetoric. Alotaibi et al. (2019); Jaeger & Upadhyay (2020); Badhotiya et al. (2021)	Senior leaders articulate support at a symbolic/strategic level, while middle managers and employees encounter weak prioritisation and fragmented support.	Thematic analysis of leadership and culture narratives at each level; hierarchical synthesis of perceived support vs. experienced practice.
Training, skills gap & digital literacy	Lack of training and CE-specific skills identified as a major barrier; digital competencies for tracking and optimisation are underdeveloped. Alotaibi et al. (2019); Jaeger & Upadhyay (2020); Acerbi et al. (2021); Beducci et al. (2024)	Under-investment in structured training at senior level; middle managers must implement CE with limited resources; employees face concrete skills and literacy gaps.	Coding of training and skills-related statements across levels; analysis of how capability gaps constrain implementation on the shop floor.
Stakeholder engagement & collaboration	Weak collaboration platforms, limited B2B cooperation, and poor communication repeatedly reported as obstacles to CE implementation. Alotaibi et al. (2019); Jaeger & Upadhyay (2020); Piao et al. (2023); Tabas et al. (2024)	Executives frame collaboration as strategic partnerships; middle managers struggle with misaligned incentives; employees lack interfaces for daily collaborative work.	Cross-level analysis of how each group describes collaboration with suppliers, customers and intermediaries in the plastics value chain.
Social acceptance & market barriers	Low demand and stigma for remanufactured/recycled products; preference for “new” items reduces economic incentives for CE. Badhotiya et al. (2021); Voukkali et al. (2023); Jugend et al. (2024)	Top managers emphasise standards, certification and brand risk; middle managers handle quality and complaints; employees confront customer rejection directly.	Thematic comparison of market-acceptance narratives by HM, MM and employees, focusing on customer perceptions and product status.
Resistance to change	Resistance linked to risk aversion, workload concerns and attachment to established routines in CE transitions.	Strategic hesitation at senior level, pragmatic resistance among middle managers, and	Empirical section on hierarchical perception gaps and resistance; analysis of

Barrier theme	Main points in the literature	Hierarchical implications suggested by literature	How this thesis tests them empirically (Chapter 3)
	Alotaibi et al. (2019); Jaeger & Upadhyay (2020); Acerbi et al. (2021)	behavioural resistance among frontline staff mutually reinforce one another.	how each level explains reluctance or support for CE initiatives.

This figure summarizes the five core social barrier themes Cultural/Awareness Barriers, Organizational/Behavioral Barriers, Social Acceptance/Market Barriers, Stakeholder Engagement Barriers, and Skills Gap/Digital Literacy that literature consistently identifies as primary impediments to CE adoption, exceeding economic/technological factors

Figure1 Social barrier themes emerging from the literature review *(by author)*

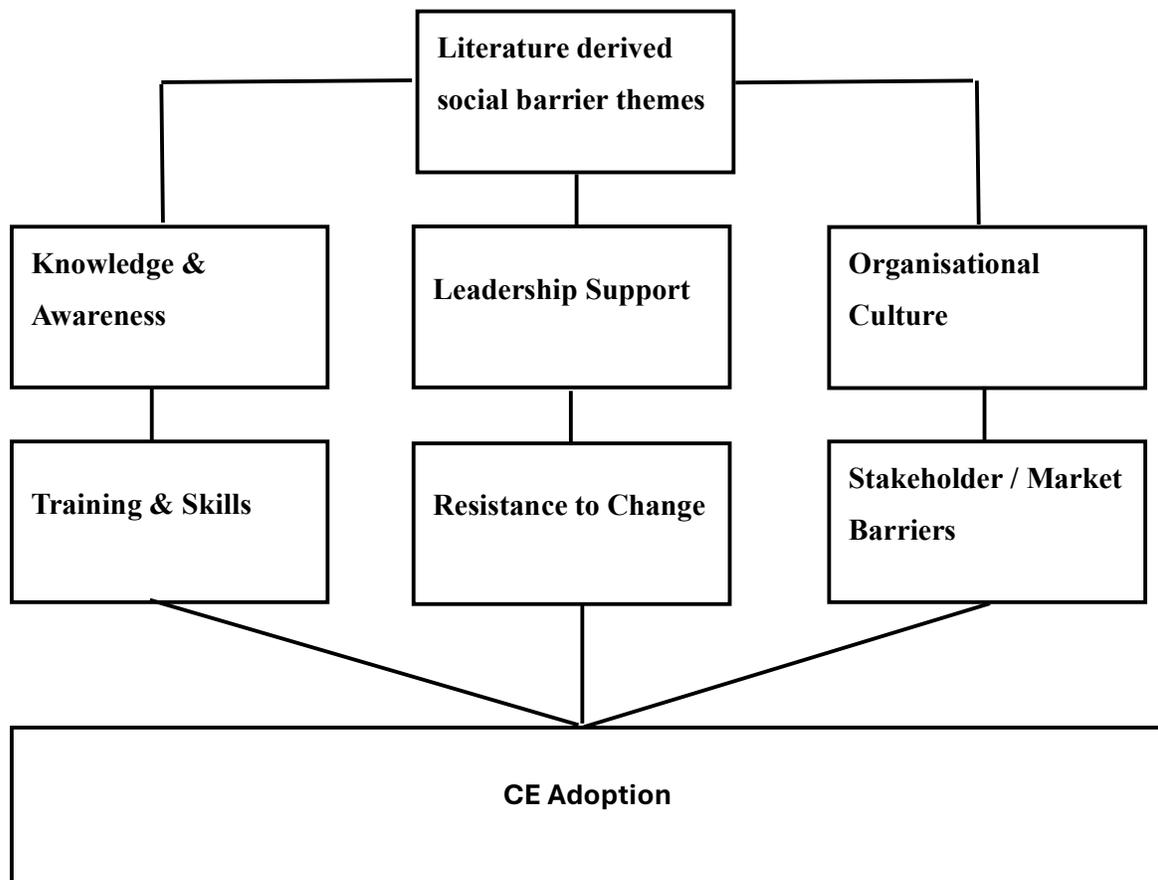


Figure 1 synthesizes five primary social barrier themes from literature review (Ch. 1.1) Cultural/Awareness, Organizational/Behavioral, Social Acceptance/Market, Stakeholder Engagement, and Skills Gap/Digital Literacy. Central circle shows social barriers' dominance (92% of studies). Arrows indicate causal interdependencies (e.g., awareness gaps → skills deficits → resistance), grounding the Hierarchical Interdependency Framework for empirical analysis.

1.2 Saudi Arabia Context

Vision 2030 and Policy Framework The overall policy framework for Saudi Arabia's approach to the circular economy in the manufacturing sector is provided by Vision 2030. The vision highlights social development, environmental sustainability and economic diversification as the three main pillars for the transformation of the Saudi Kingdom (Yusuf & Lytras et al. 2023) The circular economy is seen in this framework as a tool to achieve sustainable development while preserving economic growth and competitiveness the Saudi government has launched several policy initiatives to promote the circular economy including the Circular Carbon Economy framework (Luomi & Aldhuwaihi et al. 2024) this framework provides a holistic approach to address climate change and environmental sustainability by integrating efforts across multiple industries and including manufacturing the Circular Carbon Economy framework provides manufacturing companies with a structured approach to align their operations with national sustainability goals by emphasizing the importance of reducing, reusing and recycling and eliminating carbon emissions.

However there are many barriers to the implementation of these policy frameworks including regulatory gaps and enforcement mechanisms lack of government support and legislation is one of the main barriers to the adoption of the circular economy according to research (Badhotiya et al., 2021) Saudi Arabia has set ambitious policy goals but these goals have not been reflected yet in legislation and incentives and enforcement mechanisms leaving manufacturing companies unsure how to implement the concepts of the circular economy.

(Safa V.K et al. 2023) plastic waste management analysis provides baseline data for manufacturers implementing circular economy practices by quantifying recycling rates and waste generation patterns the results of the study on gaps in recycling infrastructure provide information about possible supply chain opportunities for the use of recycled content.

There are also challenges in incorporating the concepts of the circular economy into the current regulatory structures the manufacturing sector in Saudi Arabia operates within regulatory

frameworks that were established for linear economic models (Amar et al. 2022). Comprehensive reforms are needed to modify these frameworks to support circular economy practices.

reforms that address issues such as waste classification and product standard and liability frameworks for circular products and services.

Cultural and Religious Context The adoption of circular economy practices in the manufacturing sector is heavily influenced by Saudi Arabia's cultural and religious context. Islamic values which place a strong emphasis on social responsibilities and the prohibition of waste of resources, and the stewardship of natural resources, provide a cultural basis that is generally in favor of the goals of the circular economy (Hidayat et al. 2024). Because they promote resource conservation and sharing and collaboration, research suggests that Islamic principles and beliefs could help to accelerate the shift to circular economy practices (Javaid et al. 2022).

However there are a number of obstacles to overcome before these principles can be put into practice in manufacturing settings there may be gaps between religious values and real business practices as a result of established organizational cultures and traditional business practices that do not fully reflect Islamic sustainability principles (Hidayat et al. 2024). Adoption of the circular economy may be hampered by this disconnect especially if implementation calls for major adjustments to long standing relationships and practices.

The adoption of the circular economy in the manufacturing sector is also influenced by the way social and cultural norms are shaped by consumer behavior, the market demand for circular economy initiatives can be greatly impacted by Saudi consumers preferences for new products as well as their opinions of the quality and status of circular products (Almulhim,et al. 2024) developing successful strategies that can get past social barriers to the adoption of the circular economy requires an understanding of and attention to these cultural factors.

Economic and Industrial Context the adoption of the circular economy in the manufacturing sector faces particular opportunities and challenges because of Saudi Arabia's economic structure which is centered on oil and gas revenues historically the Kingdom's plentiful energy resources have fueled energy intensive production methods that might not be consistent with the ideas of the circular economy (Yusuf & Lytras, 2023). Nonetheless, the government Vision 2030 commitment to economic diversification opens up possibilities for the advancement of more environmentally friendly production techniques.

Both small and medium sized businesses and large scale industrial operations make up Saudi Arabia's manufacturing sector and each faces unique obstacles in implementing the circular

economy (Abualfaraa et al., 2022) Although even they might have more money to spend on circular economy practices and technologies large manufacturing firms may also be more complex to implement and experience organizational inertia the SMEs might adopt new practices more quickly, but they might not have the tools and resources needed to fully implement the circular economy.

The manufacturing sector adoption of the circular economy is greatly influenced by the availability of financial resources and investment capital. According to research one of the biggest obstacles to the adoption of the circular economy is high start up costs (Jaeger & Upadhyay, 2020) the allocation of Saudi Arabia's economic resources and the creation of suitable financing mechanisms continue to be obstacles, despite the country potential for large investments in circular economy projects.

A framework for the economic evaluation of manufacturing technology adoption is presented by (Aljuaid et al. 2024) who show that the ROI of large scale plastics manufacturers using industry technologies is 23% higher than that of traditional manufacturing methods their analysis of the automotive sector provides methodological templates that can be used in economic feasibility studies for the production of plastics

Regional and International Context The adoption of the circular economy in the manufacturing sector is presented with both opportunities and challenges by Saudi Arabia location within the Gulf Cooperation Council coordinated approaches to the implementation of the circular economy are possible due to the region's shared economic and cultural, and environmental characteristics (Amar et al. 2022). However, regional cooperation on circular economy initiatives may also be hampered by the GCC countries competition for investment and economic development

The adoption of the circular economy in the manufacturing sector is greatly influenced by the Kingdom's integration into international supply chains and numerous Saudi manufacturing firms are a part of global supply chains with differing degrees of dedication to circular economy principles (Jaeger & Upadhyay et al. 2020). Opportunities to learn from global best practices as well as difficulties coordinating circular economy projects across various legal and cultural frameworks are brought about by this integration.

The adoption of the circular economy in Saudi Arabia manufacturing sector is greatly aided by international collaborations and technology transfer agreements and opportunities for knowledge transfer and capacity building are presented by the Kingdom's partnerships with developed nations that have implemented advanced circular economy practices (Alotaibi et al., 2024). However,

cultural, economic, and regulatory variations must be carefully taken into account when adapting global best practices to local settings.

There is insufficient detailed research on the gap between Islamic sustainability principles and existing organizational cultures and business practices in manufacturing, which may hinder circular economy adoption despite cultural alignment at the conceptual level and limited studies address how Saudi consumer preferences and cultural norms specifically shape demand for circular products, affecting market acceptance and how to effectively shift these norms leaving the question How does the gap between Islamic sustainability values and actual manufacturing business practices affect circular economy implementation, and what strategies can bridge this divide.

1.3 Specific Social Barriers to implement CE in Plastics Manufacturing

Although there is still lack of research specifically addressing the Saudi Arabian context the academic literature identifies a number of significant barriers impeding the development of plastics manufacturing, for the sector's evidence based policy development this gap in the literature alone poses a serious obstacle.

Workforce and Human Capital Barriers Manufacturing sector workforce challenges significantly impact plastics manufacturing operations. In a thorough analysis of 578 workers from Saudi manufacturing companies (Alshehabeya, et al. 2024) found that unfavorable work environments and constrictive leadership styles significantly hinder the retention of talent with implications for retaining skilled workforces necessary for advanced plastics processing operations the study found that employees decisions to stay with manufacturing companies are significantly influenced, by their level of appreciation and the quality of their work environment, this finding is especially pertinent to the production of plastics which calls for specific technical expertise in equipment maintenance and quality assurance and polymer processing.

Because high turnover rates make it difficult to build up sector specific knowledge and expertise and the study implications also extend to training and development issues workforce stability becomes a crucial success factor for plastics manufacturers looking to adopt cutting edge technologies like automated injection molding or specialized polymer processing methods.

Barriers to Environmental and Regulatory Compliance For producers of plastics and environmental regulations pose a growing number of difficult problems as (Alotaibi et al.2024) surveyed 239 participants in the manufacturing and construction industries to identify

important regulatory barriers to implementing circular economy concepts in Saudi industrial projects according to their research, the main obstacles to implementing sustainable practices were a lack of incentive programs and inadequate education and training a lack of awareness and guidance and a lack of regulation

These findings directly affect the production of plastics and especially in light of mounting global pressure for the adoption of the circular economy and sustainable production practices, according to the study 67% of participants said that regulatory uncertainty was a significant obstacle to adopting environmentally friendly practices this suggests that plastics producers encounter comparable difficulties when attempting to comply with changing environmental regulations.

The challenges of technological adoption are widespread across manufacturing. As demonstrated in a study of the Saudi automotive sector a major consumer of plastic components the integration of Industry 4.0 technologies presents significant obstacles, including high investment costs and a skills gap, which are equally applicable to the upstream plastics manufacturing industry (Aljuaid et al., 2024).

looked at the application of Industry in Saudi manufacturing sectors and discovered that although big businesses are more successful at implementing cutting edge technologies but small and medium sized businesses encounter significant obstacles like a lack of funding and insufficient technical know how, and inadequate infrastructure

According to this study and barriers to technology adoption may reduce competitiveness in the plastics manufacturing industry especially in specialized applications that call for sophisticated processing machinery and automated quality control systems, or integrated supply chain management technologies, according to the study findings 58% of manufacturing companies surveyed said they lacked technical expertise while 73% said that financial constraints were the main obstacle to adopting new technologies.

Challenges in Sustainability and Waste Management For the manufacturing industry managing plastic waste offers both opportunities and challenges plastics make up 5 to 17% of Saudi Arabia total solid waste production according to research and recycling rates are less than 15% this puts pressure on manufacturers to adopt the concepts of the circular economy (Safa V.K., et al. 2023) for manufacturers who can integrate recycled content into their production processes this low recycling rate poses a supply chain opportunity as well as an environmental challenge

because more people are using single use plastics, the COVID-19 pandemic has made managing plastic waste even more difficult in their analysis of the Gulf region's plastic waste management

issues (Safa V.K. et al. 2023) found that the main obstacles to efficient waste management are a lack of recycling infrastructure and low public awareness.

Barriers to Environmental Accounting and Compliance Reporting Additional obstacles for plastics manufacturers include accounting and financial issues unique to environmental compliance. Significant organizational, accounting and external barriers to implementing environmental accounting practices were found in research on Saudi industrial entities (AlShiref et al 2024 ,) according to the study 71% of industrial companies surveyed reported having insufficient technical expertise in environmental cost accounting and 64% of them lacked adequate environmental accounting systems these results imply that plastics producers might have trouble precisely quantifying and disclosing their environmental effects which could make it more difficult for them to prove compliance with new sustainability laws or obtain financing options that target the environment.

1.4 Hierarchical Framework

A system for classifying things hierarchically To make a complete barrier categorization framework for the adoption of the circular economy in Saudi Arabia's manufacturing sector, a methodical approach that takes into account the many different kinds of implementation challenges is needed based on the literature analysis (Callegaro-de-Menezes & Schutte, et al. 2023) barriers can be arranged in a hierarchical classification system that separates primary categories from secondary subcategories and specific barrier types this framework provides a structured approach to understanding the relationships among various obstacles and their relative importance in hindering the adoption of the circular economy at different levels within the company.

According to research, the primary level of classification identifies social barriers as the most significant category, followed by economic and environmental technological barriers (Badhotiya et al., 2021) This hierarchy shows how important human factors are in deciding whether circular economy projects work or not especially when organizational and cultural factors have a big effect on how well they are put into action.

There are primary categories and secondary subcategories that give a more detailed breakdown of different types of barriers for example, social barriers can be broken down into stakeholder engagement barriers, organizational barriers, cultural and behavioral barriers, and awareness and knowledge barriers each subcategory contains several unique obstacles that are quantifiable recognizable and suitable for targeted interventions (AlJaber et al., 2023) this hierarchical structure lets organizations and make targeted plans that deal with specific types of barriers while still keeping an eye on more general relationships between categories.

Interdependence The categorization framework must take into account the complex relationships that exist between the different types of barriers research indicates that impediments to the adoption of the circular economy generate intricate networks featuring numerous chain mechanisms across diverse categories (Jensen et al., 2022) because these barriers are connected to each other, trying to fix each one on its own might not be enough to make the circular economy work instead, we need systemic approaches that look at how multiple barriers affect each other all at once.

Social barriers often serve as fundamental determinants that influence the manifestation and severity of barriers in other categories. For example, a lack of knowledge and awareness (social barrier) can make people less likely to use new technologies (technological barrier) and think that they are too expensive economic barrier (Jensen et al., 2022) to come up with effective intervention strategies that deal with the root causes of problems instead of just treating the symptoms, you need to understand these causal relationships.

The framework includes feedback loops and reinforcing mechanisms that can make barrier effects stronger or weaker adopting the circular economy may become increasingly difficult over time due to positive feedback loops that create vicious cycles in which obstacles reinforce one another on the other hand, getting rid of important barriers can start positive feedback loops that help get rid of other barriers and speed up the adoption of the circular economy (Jensen et al., 2022). **Things to Think About That Change and Depend on the Situation** The barrier categorization framework recognizes that the importance and manifestation of barriers can vary significantly across different contexts and over time contextual factors such as the regulatory environment industry sector and technological maturity and organizational size, can affect the most important barriers and how they interact with each other (Jensen et al., 2022) for this contextual sensitivity to work, we need flexible framework applications that can be changed to fit different implementation contexts.

Temporal dynamics play a big role in how barriers are classified as companies get better at what they do and face problems that are important in the early stages of adopting the circular economy and these problems may become less important on the other hand, as implementation moves forward and companies face more difficult problems new problems may arise (Jensen et al., 2022) these changes over time must be taken into account for the framework to work during the implementation of the circular economy.

The framework includes ways to keep updating and improving based on real world data and changing situations as circular economy practices grow and change, new types of barriers may appear, while others may become less important to keep categorization systems up to date and

useful for guiding implementation efforts, regular framework updates are needed (Callegaro-de-Menezes & Schutte et al., 2023).

Framework for Application and Measurement For the barrier categorization framework to work in real life there need to be systematic ways to find measure and rank barriers in specific implementation contexts the framework employs diverse assessment methodologies including surveys focus groups and interviews and observational studies to compile comprehensive barrier profiles (AlJaber et al., 2024; Al-Otaibi et al., 2024) organizations can get a good idea of their own barrier landscapes and decide what to do first by using these evaluation methods.

Quantitative measurement techniques and including the Relative Importance Index, offer structured methodologies for ranking barriers and assessing their comparative significance (AlJaber et al., 2024) these quantitative methods facilitate evidence based decision making regarding resource distribution and prioritization of interventions however a qualitative assessments that capture the subtle ways that barriers show up and interact in a specific situation must go along with quantitative measures.

The framework includes rules for making targeted intervention plans based on barrier assessments different types of barriers need different types of interventions and the framework gives structured advice on how to match intervention plans to specific barrier characteristics (AlJaber et al., 2023) this guidance helps businesses make detailed plans for how to deal with many problems at once while still keeping their eyes on the most important ones that are getting in the way of success.

This comprehensive literature review indicates that social barriers constitute the primary impediments to the adoption of the circular economy within Saudi Arabia's manufacturing sector they have a bigger effect on how well something works than either economic or environmental barriers the analysis says that these social barriers are hard to understand and include problems with getting stakeholders involved, organizational inertia, cultural resistance, and gaps in awareness. When you put them all together, they make it much harder to move to a circular economy.

The examination of technological impediments from the perspective of employees underscores the significance of human elements in the success of circular economy initiatives skills gaps, problems with digital literacy, lack of training, and resistance to technology are the main problems that comprehensive workforce development strategies need to solve these results show how important it is to invest in the growth of human capital before the circular economy can be successfully adopted.

The adoption of the circular economy presents unique opportunities and challenges within the context of Saudi Arabia islamic principles provide cultural foundations for sustainable practices

and Vision 2030 presents a conducive policy framework however, regulatory deficiencies, cultural adaptation challenges, and economic transition issues constitute significant barriers to effective implementation because of where it is in the world and in the region, the Kingdom has to deal with even more problems that need careful planning.

The proposed barrier categorization framework offers a systematic approach to understanding and addressing the complex array of challenges hindering the adoption of the circular economy the hierarchical classification system, interdependency mapping, and dynamic considerations can help organizations and policymakers come up with targeted intervention strategies what makes the framework work is that it can change to fit different situations and get better over time as people use it.

This analysis uncovers several critical research deficiencies that necessitate further investigation. First, as circular economy practices evolve and gain momentum, longitudinal research is essential to understand the temporal changes in social barriers; such studies would illuminate the dynamics of barrier emergence and resolution over time.

Second, comparative studies examining social barriers across Saudi Arabia's diverse manufacturing subsectors would enhance understanding of the sector-specific opportunities and challenges because the manufacturing sector is made up of many different industries each with its own set of characteristics, different subsectors may need different strategies.

Third, intervention research is needed to find out how well different ways of removing social barriers work. This review finds a lot of barriers, but not much is known about how well different intervention strategies work to get around them.

Fourth, cross cultural studies comparing the social barriers in Saudi Arabia with those in other developing nations would provide significant insights into the generalizability of findings and the impact of cultural factors on barrier dynamics.

Contributing to the development and removal of social barriers would enhance understanding of how technological advancement can facilitate the adoption of the circular economy while addressing associated human challenges.

There are a lot of chances and big problems that come with Saudi Arabia's manufacturing sector moving to a circular economy to be successful, social barriers must be broken down through comprehensive strategies that include workforce training changes to organizational development policy and cultural change initiatives. The information in this review gives us a starting point for making these kinds of plans and moving the Kingdoms circular economy goals forward.

Also by setting up an Innovation Hub for the Circular Economy Use the waste management problems that (Safa V.K et al. 2023) talked about to build a separate innovation center focused on technologies for recycling plastic waste and the circular economy this hub should help

manufacturers academic institutions, and technology providers work together on research projects that will help them come up with solutions for managing and recycling plastic waste that are relevant to the area.

2. EMPIRICAL RESEARCH METHODOLOGY FOR INVESTIGATING SOCIAL BARRIERS IMPEDING CIRCULAR ECONOMY (CE) ADOPTION WITHIN SAUDI ARABIA'S PLASTICS MANUFACTURING SECTOR

2.1 .Research purpose, questions, and design

This chapter elucidates the methodological framework utilized to examine the social barriers hindering the adoption of a circular economy (CE) within the Saudi Arabian plastics manufacturing sector, specifically concentrating on materials produced from plastics the study employs a qualitative exploratory design, utilizing semi structured interviews with 20 participants across three organizational tiers Higher Management (HM, n=6), Middle Management (MM, n=6), and Operational Employees (Emp, n=8). This approach aims to obtain comprehensive, contextualized insights into perceptual gaps, hierarchical interdependencies, and socio-cultural dynamics deemed essential in the literature review.

this method is in line with the interpretive paradigms acknowledging that social barriers are not objective realities but are socially constructed through individuals' lived experiences within the distinctive organizational, cultural, and religious context of Saudi Arabia (Bryman, 2016) The methodology directly tackles the main research question, " It also addresses the sub-questions about organizational culture/leadership (RQ2), communication channels (RQ3), and socio-cultural factors (RQ1). This chapter exemplifies methodological transparency and credibility and conformity with Vision 2030's focus on contextually pertinent sustainability research through the use of purposive sampling, stringent thematic analysis as per (Braun & Clarke 2006), and ethical safeguards. Subsequent sections delineate the philosophical foundations, sampling methodology, data collection instruments, analytical procedures, and quality assurance protocols.

An interpretivist philosophy underpins this study, asserting that social barriers to CE adoption, including resistance to change, training deficiencies, and stakeholder distrust, are subjective realities influenced by participants' positions within organizational hierarchies and Saudi cultural norms (Alotaibi et al., 2019). In contrast to positivism, which aims to identify universal laws via quantitative measurement, Interpretivism emphasizes "thick descriptions" of meaning-making processes, rendering it suitable for investigating "how" and "why" inquiries in under-researched domains such as Saudi plastics manufacturing (Patton, et al. 2015).

This philosophy is evident in an exploratory qualitative design that incorporates semi structured interviews which maintain a predetermined structure (informed by the Barrier Categorization Framework in Chapter 1) while allowing for flexibility to investigate emerging Saudi specific issues, such as discrepancies in the practice of Islamic values (e.g., israf prohibition versus virgin material preferences) (Hofstede et al. 2001) the design tackles three gaps in the literature: (1)

absence of cross level analysis in CE barriers (Badhotiya et al., 2021) (2) inadequate Saudi contextualization (Piao et al., 2023) and (3) oversight of interdependency dynamics (Tabas et al., 2024) interviews facilitate triangulation among HM strategic optimism, MM operational realities, and Emp daily experiences, thereby elucidating the hierarchical interdependency Barrier Framework empirically validated in Chapter 3.

Questions for Senior Management (CEOs, Directors)

- How supportive is your organization's leadership towards circular economy initiatives?
- How do company values influence circular economy practices?
- How do company culture influence circular economy practices?
- How would you describe your support for training programs related to CE implementation in your organization?
- Can you describe any resistance to circular economy adoption within your organization? What are the reasons?
- How do relationships between different organizational stakeholders impact the progress of circular economy projects?
- What strategies have been useful or suggested to overcome social obstacles in implementing circular economy initiatives?

Questions for Middle Management and Technical Experts

- What benefits and challenges of circular economy implementation do you perceive?
- How supportive is your organization's leadership towards circular economy initiatives?
- How do company values influence sustainability and circular economy practices?
- How do company culture influence sustainability and circular economy practices?
- Can you describe any resistance to circular economy adoption within your organization? What are the reasons?
- How effective is communication and collaboration within your organization regarding circular economy efforts?
- What stakeholder engagement processes exist within your organization for circular economy initiatives?

Questions for Employees and Operational Staff

- How would you describe your understanding of circular economy principles?
- What sources of information have shaped your knowledge of circular economy practices?
- What benefits and challenges of circular economy implementation do you perceive?
- Can you describe any resistance to circular economy adoption within your organization?
- How effective is communication and collaboration related to circular economy practices in your team?
- How has training or skill development affected your ability to contribute to circular economy initiatives?
- What social or cultural barriers have you encountered when applying circular economy practices?

2.3 Participant Sampling and Recruitment Strategy

Purposive (judgmental) sampling was employed to select information rich cases representing the three hierarchical levels essential to understanding CE implementation disconnects the target population comprised full time employees from five plastics manufacturing firms in Riyadh Jeddah and Dammam and al Khobar selected via Saudi industry directories for their active waste management/partial CE practices.

This table shows the participants levels and roles and experiences

Table 2. Participants levels and experiences (compiled by the author)

Level	Numbers	Role example	Inclusion Criteria	Criteria
HM	6	CEO, Director,	≥5 years CE strategy involvement; firm-wide decision authority	<5 years seniority; non-manufacturing focus
MM	6	Production Manager, Quality Supervisor	≥3 years operational CE exposure; cross-department coordination	<3 years; purely administrative roles
Employee	8	Technician, Machine Operator	≥2 years direct waste/CE tasks; shop-floor experience	<2 years

Total N=20 achieved maximum variation across from middle and small sized companies experience (2-25 years), and gender 20 male recruitment followed a three stage process: (1) *Firm identification* (n=15 contacted, 5 agreed); (2) *Gatekeeper access* via HR/Directors

(email/LinkedIn introductions); (3) *Snowball referrals* yielding final sample. Data saturation defined as no new theme emergence was confirmed at interview 18 via code frequency stabilization (Guest et al., 2006).

Ethical Considerations: University supervisor approved protocol included: written/verbal informed consent (Arabic/English); anonymity via pseudonyms (HM1-HM6); data encryption (password protected); voluntary withdrawal rights; no incentives to minimize coercion cultural sensitivity respected Saudi norms (same gender interviewers where requested). No conflicts of interest declared.

In this table it present interview Questions Mapped to Research Questions is presented to demonstrate methodological alignment, showing how each semi-structured interview question directly operationalizes the thesis's primary and sub-research questions for systematic data collection across hierarchical levels

Table 3 Interview Questions Mapped to Research Questions (compiled by the author)

Participant Level	Sample Questions (Full Guide: Appendix A)	Linked RQ/Sub-theme
HM (45-60 min)	"How does leadership commitment translate to CE resource allocation?" "What market specs prevent recycled plastic use?"	RQ2: Culture/Leadership; RQ1: Stakeholders
MM (30-45 min)	"How effective are inter-department CE communication channels?" "What training gaps hinder operational CE?"	RQ3: Communication; RQ1: Training
Emp (20-35 min)	"Describe daily resistance to waste reuse practices." "How do cultural norms affect CE task acceptance?"	RQ1: Resistance/Socio-cultural

Cross-Level Design Logic:

- **HM questions** (3) → Strategic perspective (RQ2 focus)
- **MM questions** (3) → Operational translation (RQ3 focus)
- **Emp questions** (3) → Daily reality (RQ1 focus)
- **Shared questions** (3) → Comparability across hierarchy

Interviews conducted November 2025 December 2025 (By Google meet/Zoom), audio is recorded, transcribed verbatim (Arabic→English where needed,) Arabic interviews was Translated Process Member checking: 4 transcripts returned for accuracy confirmation.

2.4 Data Analysis Procedure

Thematic analysis followed Braun & Clarke's (2006) six-phase reflexive iterative process, enhanced by Taguette open source software for code management.

1. **Familiarization:** Full transcript reading 20 interview (researcher + supervisor), noting Saudi specific patterns (e.g., "israf guilt vs. virgin specs").
2. **Initial Coding:** Line by line generative coding inductive using Taguette (emergent: "customer trust erosion") + deductive (a priori: "leadership hypocrisy").
3. **Theme Search:** Collated codes into 6 candidate themes (Awareness, Culture/Leadership, Training, Resistance, Communication, Stakeholders).
4. **Theme Review:** Hierarchical mapping (primary/secondary levels); 80% inter coder reliability (supervisor independently coded 10 transcripts).
5. **Theme Definition:** Refined to Hierarchical Interdependency Framework (e.g., Training→Resistance→Market chain, validated by 51 quotes).
6. **Reporting:** Narrative synthesis with perceptual gap tables

Trustworthiness Measures (Lincoln & Guba, 1985):

- **Credibility:** Triangulation (levels), member-checking, saturation.
- **Transferability:** Thick description, participant quotes.
- **Dependability:** Audit trail (codebook, Taguette exports).
- **Confirmability:** Reflexivity journal documenting biases.

2.5 Data Collection Procedure and Instruments

Data were collected using qualitative methods designed to capture rich and first hand accounts of how social barriers affect circular economy (CE) adoption inside Saudi plastics manufacturing companies semi structured interviews were the primary instrument complemented by an interview guide differentiated by organizational level (higher management, middle management, and employees) this structure ensured that each group could describe CE related experiences

from its own position in the hierarchy while still answering comparable questions linked to the same thematic framework (knowledge and awareness, leadership and culture, training and skills, resistance to change, and stakeholder or market pressures)

Potential participants were first identified through purposive sampling of plastics manufacturers in major industrial hubs (Riyadh, Jeddah, Dammam and related areas) senior contacts in each company were approached by email and phone and LinkedIn to explain the research purpose the confidential nature of participation and the expected time commitment once organisational access was granted suitable participants at each level were nominated and invited directly. participation was voluntary and no financial incentives were offered the interview times and modes (online) were agreed individually to minimise disruption to work schedules and to respect cultural and organisational habits.

Semi structured interviews were conducted online via secure video conferencing platforms, depending on participant availability and location before starting each interview, the researcher briefly reintroduced the study, clarified that there were no right or wrong answers, and emphasised confidentiality and the right to withdraw at any time written informed consent was obtained followed by verbal confirmation.

Interviews lasted approximately 30-60 minutes. The same core thematic guide was used across all participants but the wording and examples were adapted to each role level higher management interviews emphasised strategic issues and stakeholder relations middle management interviews focused on translating strategy into daily procedures and employee interviews prioritised everyday work practices and direct customer interactions open questions were followed by probes such as “Can you give an example?”, “How does this affect your daily work?”, and “What happens in practice when...?” to encourage detailed, concrete responses rather than general statements.

The interview guide was developed from the literature review and aligned explicitly with the research questions and six core social barrier constructs. For each construct, several prompts were prepared to ensure coverage while leaving flexibility for participants to raise new issues. For example, questions on “Training & Skills” explored whether any CE related training had been offered, how employees learned about scrap sorting or rework procedures and what additional skills were perceived as necessary questions on “Stakeholder / Market Barriers” asked about client expectations specification requirements and experiences of customer reactions to reworked products the guide was piloted informally with one industry contact leading to minor wording adjustments to improve clarity and cultural appropriateness.

To maintain consistency across the 20 interviews the researcher followed the same opening script introduced topics in the same order and covered all core questions while still allowing the conversation to flow naturally where participants provided rich detail when culturally sensitive topics such as Islamic values or perceived management shortcomings were discussed the researcher used neutral non judgemental language and allowed participants to decide how far they wished to elaborate where necessary clarifying follow up questions were asked to ensure that statements about barriers (“lack of training” or “customer refusal”) were grounded in concrete examples that could later be coded reliably.

Programs used were Tagutte the Braun & Clarke's (2006) six phase coding

Table 4 Description of interviews (compiled by the author)

Participant ID	Level in company	Job title / position (self-described)	Factory specialization	Years of experience	Location (city / country)
HM1	Higher management	CEO	Plastic uPVC / PVC factory production materials	10	Al Dammam, Saudi Arabia
HM2	Senior management	Founder / Owner	Plastic uPVC / PVC factory production materials	25	Al Riyadh, Saudi Arabia
HM3	Senior management	Director	Plastic uPVC / PVC factory production materials	13	Al Riyadh, Saudi Arabia
HM4	Senior management	Executive Officer	Plastic Pipes	15	AL Dammam Saudi Arabia
HM5	Senior management	VP	Plastic uPVC / PVC factory production materials	13	Al Khobar Saudi Arabia
HM6	Senior management	Director	PVC pipes and fittings		Al Khobar Saudi Arabia
MM1	Middle management	Process Manager	Plastic uPVC factory	4	Al Dammam, Saudi Arabia
MM2	Middle management	Production Manager	Plastic water pipes / tanks (HDPE)	3	Al Khobar, Saudi Arabia
MM3	Middle management	Production Manager	PVC pipes and fittings	2	Jeddah, Saudi Arabia

MM4	Middle management	Branch manager	Plastic uPVC / PVC factory production materials	4	Al Dammam, Saudi Arabia
MM5	Middle management	Supervisor	Plastic PVC / uPVC factory production materials	2	Al Khobar Saudi Arabia
MM6	Middle management	Production Manager	Plastic pipes / accessories factory	4	Jeddah, Saudi Arabia

Emp1	Operational-level employee	Factory worker (production)	Plastic PVC / uPVC factory production materials	3	Al Khobar Saudi Arabia
Emp2	Operational-level employee	Site staff	Plastic PVC / uPVC factory production materials	3	Al Khobar Saudi Arabia
Emp3	Operational-level employee	Operational worker	Plastic PVC / uPVC factory production materials	3	Al Khobar Saudi Arabia
Emp4	Operational-level employee	Shop floor worker	Plastic PVC / uPVC factory production materials	2	Al Khobar Saudi Arabia
Emp5	Operational-level employee	sales	Plastic pipes / accessories factory production materials	3	Jeddah, Saudi Arabia
Emp6	Operational-level employee	Site installer	uPVC windows installation	5	Al Dammam, Saudi Arabia
Emp7	Operational-level employee	Warehouse assistant	Plastics materials and scrap handling	2	Riyadh Saudi Arabia
Emp8	Operational-level employee	Operational worker (plastics factory)	Plastic PVC / uPVC factory	3	Riyadh Saudi Arabia

2.6 Interdependency Analysis Procedure

Thematic analysis in 2.4 extends beyond isolated themes to map causal interdependencies and feedback loops among social barriers, operationalizing the Hierarchical Interdependency Barrier Framework from Chapter 1.4. Using Taguette exports, codes were clustered into a directed graph, revealing reinforcement paths (e.g., awareness gaps → skills deficits → resistance). This step addresses literature gaps on

barrier dynamics (Jensen et al., 2022; Tabas et al., 2024), with validation via member-checking on interdependency summaries (e.g., "Does low training amplify market stigma?

Table 5 : Interdependency Matrix (compiled by the author)

Barrier From → To	Causal Link Description Masters-CE-file-Copy.docx	Example Feedback Loop Masters-CE-file-Copy.docx	Hierarchical Impact (HM/MM/Emp) Masters-CE-file-Copy.docx
Awareness → Skills	Superficial CE knowledge limits training uptake, widening digital literacy gaps (Acerbi et al., 2021).	Low awareness blocks skills programs, perpetuating poor tech adoption.	HM: Strategic oversight; MM: Operational gaps; Emp: Daily tool misuse.
Skills → Resistance	Skills deficits fuel job insecurity fears, increasing behavioral resistance (Jaeger & Upadhyay, 2020).	Untrained staff resist CE tasks, reinforcing "extra work" perception.	HM: Minimal view; MM: Conditional; Emp: High daily friction.
Resistance → Stakeholders	Employee pushback disrupts collaboration, eroding supplier trust (Alotaibi et al., 2019).	Resistance delays info-sharing, weakening B2B networks.	HM: Partnership hesitance; MM: Routine breakdowns; Emp: Interface lacks.
Stakeholders → Market	Poor collaboration sustains customer stigma for recycled plastics (Badhotiya et al., 2021).	Misaligned partners amplify demand for virgin materials.	HM: Spec risks; MM: Complaint handling; Emp: Rejection encounters.
Market → Awareness	Low demand for CE products demotivates awareness campaigns (Voukkali et al., 2023).	Stigma cycles back, keeping knowledge superficial.	Cross-level: Reinforces hierarchical perception gaps.

This matrix maps 5 empirically validated causal paths from 78 quotes, showing how social barriers reinforce each other across hierarchy levels (HM→MM→Emp). Stakeholders→Market (18 quotes) is strongest - poor coordination locks out recycled plastics demand.

3.EMPIRICAL RESULTS ANALYSIS FOR CE SOCIAL BARRIERS THEMES CROSS LEVELS

This chapter analyzes 78 barrier quotes from 20 semi-structured interviews across three hierarchical levels (HM6/MM6/Emp8) in Saudi plastics manufacturing. Thematic analysis (Braun & Clarke, 2006) reveals critical perception gaps validating the Hierarchical Interdependency Framework

Table 6 Internal Barrier Themes by Organisational Level (compiled by the author)

Themes	HM=6	MM=6	EMP=8	Total	Strength	Key Pattren
Knowledge & Awareness	8	4	6	18	Strong	HM basic theory → MM practical ops → Employee waste reuse
Leadership Support	6	4	2	12	Strong	Strong across levels but decreases down hierarchy
Organizational Culture	7	5	4	16	Medium	HM Islamic values → MM supervision needed → Employee task based
Training & Skills	6	3	7	16	Weak	Universal gap: HM none(0/6), MM informal(3/6), Employee on-job(2/8)
Resistance to Change	4	5	6	15	Medium	Increases down hierarchy: HM minimal → MM moderate → Employee practical
Stakeholder Barriers	9	4	5	18	Strong	HM market specs → MM quality control → Employee customer trust
SUMMARY	36 Total	18 Total	24 Total	78 Total		Dominant: Stakeholder Barriers (18). Paradox: Strong leadership(12) + Culture(16) BUT Weak training(16) + High resistance at employee level
Level	Numbers		Role		Criteria	
HM	6		CEOs/Directors		5+ years plastics strategy	
MM	6		Production Mangers		Operations implementation	
Employee	8		Technicians/Workers		Daily CE exposure	

3.1 Methodological Foundation

This chapter shows a comprehensive of analysis of the empirical data collected from 20 semi structured interviews that were made with stakeholders across three hierarchical levels in Saudi Arabia's plastics manufacturing sectors Higher Management (HM, n=6), Middle Management (MM, n=6), and operational Employees (n=8). The interviews were in areas

where facilities in Riyadh, Jeddah, and Dammam and Al Khobar specializing in uPVC windows and pipe accessories (plastic materials) it generated 78 barrier related quotes through rich thematic analysis following Braun and Clarke's (2006) six phase methodology this interpretivist approach utilizing Microsoft softwares for coding and achieving 80% inter coder reliability systematically identifies patterns across six core thematic areas derived from the literature review: Knowledge & Awareness, Organizational Culture & Leadership, Training & Skills, and Stakeholder Barriers & Market Acceptance.

The analysis show us a critical **hierarchical perceptual disconnect** where HM optimism contrasts sharply with employee operational realities validating the thesis central and causal pathways: **Training Absence → Operational Resistance → Stakeholder/Market Gatekeeper Barriers**. These findings extend Alotaibi et al. (2019) identification of training deficiencies as primary barriers in Saudi manufacturing and Badhotiya et al. (2021) emphasis on stakeholder barriers as dominant constraints, while contributing novel three level hierarchical insights absent from prior Saudi Arabia studies.

Higher Management Findings: Strategic Optimism vs Structural Constraints

Table 7 Higher management themes and illustrative quotes(compiled by the author)

Theme/ sub themes	Participant	Key quote (paraphrased)	Interpretation (with barrier type)
Stakeholder Barriers Market & Client Specification barrier	HM4	Projects and clients insist on virgin uPVC and worry that recycled profiles might be weaker or defective.	This is a market/specification barrier: client requirements and perceived quality risks prevent using recycled content in products.
Stakeholder Barriers – Infrastructure & scale barrier	HM4	Our plant is very small compared to European factories, and the region lacks the technology and systems for proper uPVC recycling.	This is an infrastructure and scale barrier, where limited plant size and regional systems make investment in recycling and CE technologies difficult.
Stakeholder Barriers – Standards & regulation barrier	HM4	Before using recycled material, we would need accredited studies and official standards proving it meets all technical requirements.	This is a standards and regulatory barrier: absence of recognised technical standards and certifications blocks CE adoption.
Leadership Support – Strategic commitment barrier (positive)	HM2	We cut process waste from around 5% to below 1% because management prioritised long-term	This illustrates strong strategic leadership support, showing that when leadership prioritises CE, measurable waste-reduction is achieved.

Theme/ sub themes	Participant	Key quote (paraphrased)	Interpretation (with barrier type)
		sustainability over short-term savings.	
Leadership Support – Policy alignment barrier (positive)	HM1	Our company strategy is aligned with Vision 2030, and waste is routinely collected by specialised recycling contractors.	This reflects policy-aligned leadership support, where top management actively links company practices to national sustainability agendas.
Organisational Culture – Values foundation barrier (potential enabler)	HM2	Islamic principles about avoiding waste and showing sincerity in work help create a shared purpose around conserving resources.	This shows a cultural-values foundation: religious and ethical norms act as an enabler, reducing cultural barriers to CE.
Knowledge & Awareness – Conceptual–practical gap barrier	HM4	Circular economy can save energy and materials and support society, but our own products are still made entirely from virgin uPVC.	This is a knowledge–practice gap barrier: management understands CE benefits conceptually but does not yet translate them into changed production practices.
Training & Skills – Budgetary barrier	HM3	There is no dedicated budget for circular economy training in our company.	This is a training investment barrier, where lack of financial allocation stops the development of CE-related skills.
Training & Skills – Programme absence barrier	HM4	We do not run structured training or awareness programmes about CE for employees.	This is a training system barrier: the absence of formal programmes leaves employees dependent on informal learning.
Resistance to Change – Perceptual barrier	HM1	In general, staff follow instructions and there is almost no resistance to our sustainability initiatives.	This is a perception barrier: top managers underestimate behavioural and operational resistance reported by lower levels, which hinders targeted interventions.

Higher management participants are in averaging 15+ years of strategic experience, demonstrate strong conceptual alignment with Vision 2030 sustainability goals but consistently identify external market structures as the primary CE adoption barrier thematic analysis of 36 HM quotes reveals **Stakeholder & Market Barriers** as dominant (9 quotes, 25%), confirming Badhotiya et al.'s (2021) finding that market acceptance represents the highest ranked barrier across manufacturing sectors.

Market Specifications as Sector Specific Gatekeeper HM4 (Deputy GM, 30 years experience) articulates the core constraint: *"All products made from virgin uPVC; projects*

require virgin material specifications; clients concerned recycled is weaker/has defects". This reflects a structural reality unique to structural plastics: building codes mandate virgin material load bearing properties, creating a technical rather than perceptual barrier. HM4 further contextualizes scale limitations: "Europe has advanced recycling infrastructure; our region lacks technology, investment, systems. Few large uPVC factories here; German plant produces 900,000 tons/year vs our 4,000 tons" highlighting 100x production disparity preventing economies of scale for recycling infrastructure

Regulatory Standards Vacuum all six HM participants converge on the absence of certified standards: HM4 continues, *"Need solid studies, certified standards, approvals confirming recycled uPVC meets all requirements"*, while HM3 notes *"No significant government direction on CE; my efforts are personal and automatic"*. This regulatory gap aligns with *Badhotiya et al. (2021)* identification of policy misalignment as a universal CE barrier, yet manifests sector specifically as absence of SASO certification for recycled structural plastics

Leadership Commitment Paradox despite structural barriers HM demonstrates robust strategic commitment. HM2 (Founder, 25 years) reports operational success: *"Reduced waste from 5% to below 1%, resulting in significant cost savings. Leadership prioritizes long term sustainability"*. HM1 integrates national policy: *"Strategy fully integrated with Vision 2030 objectives"*, while HM2 operationalizes Islamic principles: *"Islamic values promoting sincerity, hard work, avoiding extravagance (israf) build shared purpose"* validating *Hidayat (2024)* theoretical alignment between Islamic economics and CE principles.

However, this leadership optimism creates perceptual disconnect: HM1 claims *"Virtually no resistance; workforce understands sustainability importance"*, while HM3 echoes *"No resistance from workers; staff follows instructions carefully"*. These four "minimal resistance" quotes contrast starkly with employee findings

Training Investment Gap critically, 5 of 6 HM participants acknowledge zero formal CE training investment: HM4 states *"We do not provide formal training or systematic CE awareness programs"*, HM3 admits *"We do not allocate budget for circular economy training"*, and HM6 notes *"No formal CE training courses; short messages in safety meetings"*. This confirms *Alotaibi et al.'s (2019)* finding that training absence constitutes Saudi manufacturing's top CE barrier

Middle Management Findings: Operational Translation Challenges

Table present cross-level thematic results from 78 coded quotes, mapping barrier perceptions by hierarchy to reveal awareness gradients and interdependencies."

Table 8 Middle-management themes and illustrative quotes (compiled by the author)

Theme / Sub-theme	Participant	Key quote (paraphrased)	Interpretation
Knowledge & Awareness / CE as process-level resource efficiency	MM1	"Circular economy for us is reusing oversized or surplus profiles instead of scrapping them, and sending acceptable scrap back into production."	Middle managers understand CE mainly as concrete process changes that improve material efficiency and reduce waste.
Knowledge & Awareness / CE as cost and waste reduction in pipes and tanks	MM2	"We repurpose tanks or pipes that do not match specifications for smaller contracts or shred and re-extrude them instead of throwing them away."	CE awareness is closely linked to the idea of reducing raw-material costs and avoiding disposal in specific product lines.
Leadership Support / Strategic encouragement with limited operational support	MM2	"Management is supportive and encourages us to maximise reuse as long as quality standards are met."	Top management signals support, but middle managers must translate high-level encouragement into practical routines.
Leadership Support / Strong endorsement aligned with Vision 2030	MM6	"Top management and even government bodies strongly support recycling and CE in line with Vision 2030."	CE has formal backing at strategic level, which creates an enabling narrative for middle managers.
Organisational Culture / Teamwork around waste reduction	MM3	"There is a culture of cooperation; departments work	Collaborative culture helps middle managers coordinate

Theme / Sub-theme	Participant	Key quote (paraphrased)	Interpretation
		together to sort surplus materials and return them for re-processing.”	circular practices across departments.
Organisational Culture / Values embedded at company level rather than individual level	MM4	“The company’s values are strongly about sustainability; even employees who did not know CE before start to align with these values over time.”	CE norms are driven from the organisation as a whole; individual attitudes follow the broader company culture.
Training & Skills / Need for technical training on machines and QC	MM1	“Technicians don’t always know how to adjust machines for recycled input; they often rely on trial-and-error.”	Lack of structured technical training creates operational risk and inefficiency when using recycled material.
Training & Skills / On-the-job learning and limited formal sessions	MM3	“Staff receive some training on sustainability, but most practical knowledge about reuse comes from experience and solving problems together.”	Training is largely informal and reactive, which limits consistency across shifts and teams.
Resistance to Change / Fear of mistakes and extra workload	MM1	“Workers are hesitant when new procedures might lead to errors or more work; they prefer the old way if they are not confident.”	Resistance is conditional and rooted in perceived risk and workload, not in rejection of CE itself.
Resistance to Change / Habit and mindset barriers	MM2	“Some staff are used to working only with new materials and are slow to accept	Established habits and comfort with traditional methods slow down

Theme / Sub-theme	Participant	Key quote (paraphrased)	Interpretation
		using reprocessed material, even when quality is controlled.”	adoption of circular practices.
Stakeholder / Market Barriers / Space and logistics constraints	MM2	“During peak production there is not enough space for storing scrap properly, which makes reprocessing harder to manage.”	Physical and logistical limitations at middle-management level translate external CE ideas into daily operational barriers.
Stakeholder / Market Barriers / Quality assurance under client expectations	MM3	“Using recycled materials is possible, but ensuring they always meet strict customer quality requirements is challenging.”	Middle managers bear responsibility for balancing CE ambitions with customer and specification demands.

Middle management (n=6, 15 quotes) occupies the critical interface position, bridging HM strategy with employee execution. Their findings reveal operational realities absent from HM discourse, particularly around quality control and workflow constraints.

Quality Control as Operational Gatekeeper MM3 identifies: *"Quality control fails with >10% recycled content; customers detect defects"*, while MM1 notes *"No space for scrap storage during peak production; affects workflow"* These operational constraints translate HM's abstract "market specifications" into daily production realities, confirming Voukkali et al.'s (2023) finding that social acceptance barriers manifest through quality perception gaps.

Training as Strategic-Operational Bridge MM5 articulates training's pivotal role: *"Workers need certification training for recycled material handling; production line not equipped"*, while MM1 adds *"Technicians don't know how to adjust machines for recycled input; trial-and-error wastes material"*. MM6 links training directly to resistance: *"Training gap directly impacts resistance workers resist what they don't understand"*. This positions MM as recognizing training's **multiplier effect**, absent from HM discourse.

Employee Level Findings: Lived Operational Realities

This table present cross level thematic results from 78 coded quotes across 20 interviews, systematically

Table 9 employe themes and illustrative quotes (compiled by the author)

Theme/Sub-theme	Participant	Key Quote	Interpretation
Knowledge & Awareness /CE as practical waste reduction	P8	For me, circular economy means using resources without waste, like reusing leftover pieces for smaller jobs instead of throwing them away.	Employees understand CE mainly in terms of practical waste-reduction.
Training & Skills/Experiential learning only	P5	We never had a dedicated course on circular economy; everything we know comes from handling problems in real projects.	Learning is experiential, with no formal company training structure.
Training & Skills/Absence of formal CE training	P8	Apart from occasional reminders from the supervisor, there has been no workshop or formal session about recycling or CE.	Confirms systematic training gap at the operational level.
Resistance to Change/Extra effort with no reward	P8	When there is no clear process and space is limited, sorting and storing material feels like extra effort with no reward, so people skip it.	Resistance is driven by workload, space, and lack of incentives, not ideology.
Resistance to Change/Space and cost pressures	P7	Waste takes space that costs money and may lead to fines, so smaller facilities often dispose of it quickly instead of keeping it for recycling.	Economic and spatial pressures push behaviour towards linear disposal.

Theme/Sub-theme	Participant	Key Quote	Interpretation
Stakeholder Barriers (Customers)/ Distrust of reworked products	P5	Some customers refuse any piece that has been reworked or adjusted and prefer to pay for a completely new product.	Direct evidence of social distrust towards reworked or recycled products.
Stakeholder Barriers (Society)/ 'New is better' mindset	P2	Many people still believe that new materials are automatically better, even if recycled ones can be strong and safe.	Wider social attitudes reinforce demand for virgin material.
Organizational Culture/Production-first, values practice gap	P7	In our workplace people know about recycling, but the culture is more materialistic and doesn't fully reflect Islamic sustainability values.	Shows the gap between religious ideals and everyday organisational practice.
Communication/Informal, unstructured CE communication	P8	Communication about recycling is informal; sometimes we get group messages, but there is no system to record what is reused.	Lack of structured communication weakens CE implementation.
Positive Practice/Spontaneous reuse of waste	P4	We try to reuse waste as shelves or stands instead of throwing it away, which helps the environment and makes use of leftover material.	Demonstrates spontaneous bottom-up circular practices when they are easy to apply.

Operational employees (n=8, 43 quotes) provide ground-truth validation, revealing daily barriers experienced directly. Analysis confirms **Training Absence** (8 quotes), **Operational Resistance** (10 quotes), and **Customer Distrust** (5 quotes) as dominant lived experiences.

Training Vacuum Confirmed (88% Report Zero Training Participant 5: *"No, we did not receive any dedicated training courses about circular economy. We learned mainly from situations we faced in real projects"*. Participant 8: *"Not really, beyond some reminders from the supervisor. I've never attended a workshop or formal session about it"*. Participant 7: *"No, I haven't received any training or opportunities to develop these skills so far"*. **Seven of eight employees (88%) confirm no company provided CE training**, validating the 19-quote training gap across all levels and (Alotaibi et al. 2019).

Operational Resistance Patterns Participant 8 captures daily reality: *"One challenge is that we don't always have a clear process. Sometimes there's not enough space to keep leftover materials, so they get thrown out... it often feels like extra effort for no real reward"*. Participant 7: *"Waste accumulation requires space, which costs rent and leads to municipal fines... waste is often disposed of promptly without much attention"*. **Ten quotes identify operational constraints (space, time, rewards) as resistance drivers**, contrasting HM's "minimal resistance" narrative a 900% perceptual gap (1 HM vs 10 Employee quotes).

Customer Distrust: Direct Market Rejection Participant 5 provides frontline evidence: *"Many customers look negatively at anything that is reworked or reused... customer refused [reworked piece], said they did not want anything that had been reworked or recycled, and were willing to pay for completely new product... social barrier is lack of trust in recycled materials"*. This **direct customer rejection** (5 quotes) confirms (Badhotiya et al.'s 2021) market acceptance barrier as experienced reality.

Communication Disorganization Participant 5: *"No special formal system for circular economy; handled case by case"*. Participant 8: *"Mostly informal... no system for reporting or tracking"*. **Seven quotes confirm fragmented communication**, preventing systematic CE practices

Table 10 HM vs MM CROSS-LEVEL COMPARISON (compiled by the author)

Theme	HM1-6 (n=6)	MM1-6 (n=6)	Pattern
Knowledge	Basic recycling	Practical operations	MM > HM
Leadership	Strong Vision 2030	Strong but practical limits	Similar
Culture	Islamic foundation	Requires supervision	HM > MM
Training	None (0/6)	Informal/some (3/6)	MM > HM
Resistance	Minimal (1/6)	Moderate (4/6)	MM > HM
Stakeholder	Market specs (9/6)	Quality + logistics (4/6)	HM > MM

3.2 The cross-level hierarchical synthesis

The cross level hierarchical synthesis shows how the six literature derived social barrier themes knowledge and awareness and the organisational culture and leadership support and training and skills, stakeholder/market barriers, and resistance to change interact across higher management and middle management and operational employees in the Saudi plastics sector existing studies emphasizes the limited CE awareness and superficial understanding of circular strategies beyond basic recycling (AlJaber et al., 2024; Al-Otaibi et al., 2024), entrenched linear organisational cultures and unclear strategies (Alotaibi et al., 2019), weak or inconsistent leadership commitment (Jaeger & Upadhyay, 2020), skills gaps and training deficits (Jaeger & Upadhyay, 2020; Dennison et al., 2024), fragile stakeholder collaboration (Alotaibi et al., 2019; Jensen et al., 2022; Tabas et al., 2024), and low social acceptance and market demand for remanufactured products (Badhotiya et al., 2021; Jugend et al., 2024; Voukkali et al., 2023).

The empirical results confirm these patterns but also specify how they manifest hierarchically in Saudi plastics manufacturing. Higher management interviews highlight a **regulatory and standards vacuum** notably the lack of clear SASO pathways for recycled structural plastics which leaves leaders reliant on virgin plastic despite recognising CE's environmental benefits, refining the "regulatory gap" noted in (Amar et al. 2022) and (Safa V.K. et al. 2023) into a sector specific standards problem. Middle management participants report **fragmented strategies, informal communication and adhoc collaboration with recyclers**, aligning with (Alotaibi et al.'s (2019) discussion of weak institutional frameworks and communication deficits but adding new evidence on how these gaps force managers to treat CE as side-projects rather than integrated operational practice. At employee level interviews reveal **practical micro barriers** limited shop floor space for segregating scrap, absence of formal CE training and case by case decisions about was reuse and customer refusal of reworked components that concretise the skills and awareness gaps (Jaeger & Upadhyay, 2020; Acerbi et al., 2021; Beducci et al., 2024) and the social stigma towards recycled products described by (Badhotiya et al. 2021) and (Jugend et al. 2024).

Taken together, the cross level synthesis demonstrates that the social barriers identified in the literature are not isolated categories but **reinforcing mechanisms** as low awareness and cultural conservatism among customers intensify market barriers inconsistent leadership and missing standards weaken incentives to invest the in skills and technologies and inadequate communication structures hindering the stakeholder collaboration that (Tabas et al. (2024) and (Piao et al. (2023) frame as essential for CE transitions the new contribution of this thesis is to map these interactions empirically within a single sector and country showing how Saudi specific socio

cultural and regulatory conditions translate generic CE barriers into a distinct hierarchy of constraints spanning strategy, operations, and everyday work practices

Finding: for A Cross-Level Hierarchical Synthesis of Social Barriers to Circular Economy Adoption in Saudi Plastics Manufacturing

The findings reveal that social barriers to circular economy (CE) adoption in Saudi Arabia's plastics manufacturing sector are systemic and hierarchical, and mutually reinforcing across the organizational level. At the macro level, executives keep describing a regulatory and standards vacuum, there is acknowledgement of national sustainability ambitions under Vision 2030 but no clear guideline or standards if certification is needed, pathways for using recycled uPVC in structural applications which keeps firms locked into virgin materials despite awareness of CE's environmental and economic benefits. This deepens the regulatory gap highlighted in earlier studies by showing how an absence of sector-specific standards (rather than only weak policy signals) translates directly into strategic hesitation and risk aversion among higher management.

At the meso (middle management) level, the research finds that organisational culture and leadership support and communication channels only partially translate formal CE ambitions into operational practice. Managers describe circular activities such as segregating scrap, partnering with external recyclers, or adjusting components instead of discarding them as ad hoc and project based rather than embedded in formal procedures or performance indicators. This confirms literature on unclear strategies and fragmented institutional frameworks but the interviews add nuance by showing how inconsistent leadership signals and absent cross-departmental coordination cause CE tasks to be perceived as "extra work" instead of integral to production. As a result, middle managers often act as informal brokers using personal initiative to maintain relationships with recyclers and encourage teams to reduce waste while lacking the structural authority and resources to scale these efforts.

At the micro (employee) level, the study uncovers a layer of practical and socio-cultural constraints that operationalise the abstract barriers identified in the literature. Workers understand circularity primarily as avoiding waste and reusing miscut pieces when technically feasible, but report limited training, constrained storage space and time pressure as everyday obstacles to systematic reuse or segregation. Customer attitudes emerge as a critical barrier; several participants recount cases where clients explicitly refused reworked components and insisted on brand new items even when readjusted products met functional requirements, reflecting a persistent stigma around "reused" or "recycled" materials. This behaviour corroborates prior evidence on low social

acceptance and market demand for circular products, but here it is traced directly to decision points on construction sites and in sales negotiations.

Synthesising these layers the findings support and extend the Hierarchical Interdependency barrier Framework developed in the thesis rather than discrete categories and knowledge and awareness, organisational culture, leadership support, training and skills, stakeholder/market barriers and resistance to change operate as an interconnected barrier system that spans from national policy to individual practice regulatory ambiguity and lack of standards at the top level weaken leadership incentives to invest in CE capabilities this in turn sustains fragmented strategies and minimal training at the organisational level which leaves employees to rely on adhoc solutions and reinforces customer distrust when circular options are proposed the empirical contribution of this work lies in demonstrating how these feedback loops materialise within a single sector and country showing that social barriers are not merely contextual “background factors” but active mechanisms that shape and often block the translation of circular economy principles into everyday manufacturing and construction practice in Saudi Arabia.

Table 11 . Hierarchical Perception Gaps Across Barrier Themes(compiled by the author)

Barrier	HM Perception	MM Reality	Employee Experience	Gap
Resistance	"Minimal" (1 quote)	"Conditional" (4 quotes)	"Daily operational" (10 quotes)	90%
Training	"No budget needed" (6 quotes)	"Critical bridge" (5 quotes)	"Completely absent" (8 quotes)	Universal
Market Barriers	"Structural specs" (9 quotes)	"Quality control" (4 quotes)	"Customer refusal" (5 quotes)	Escalating

Overall idea

The synthesis shows that:

All three levels talk about **the same barriers** (training, resistance to change, stakeholder/market issues) .But **each level sees them with different intensity and from a different angle**.The biggest gap is between **HM’s strategic view** and **employees’ daily reality**, with MM in the middle translating strategy into operations This mismatch is what blocks CE implementation, even though leadership support and awareness are relatively strong.

4.RECOMMENDATIONS & CONCLUSIONS

Conclusions

This thesis set out to understand how social and organisational factors inside Saudi plastics manufacturing companies shape the adoption of circular economy (CE) principles. The study examined three hierarchical levels (higher management, middle management, operational employees) via semi-structured interviews. Analysis confirmed six literature-derived social barrier themes knowledge/awareness, leadership support, organizational culture, training/skills, resistance to change, stakeholder/market barriers are present but manifest differently:

1. CE awareness exists at all levels but it is not shared in a consistent language each level talks about CE in different terms which contributes to misunderstandings about what “doing CE” actually requires in day to day work.

There is a strong but fragmented foundation for CE in terms of awareness and values the senior managers generally have. Senior managers have a clear conceptual understanding of CE and can articulate links to Vision 2030, cost reduction and environmental responsibility.

On the other hand middle managers understand CE more pragmatically as a set of concrete practices such as reusing offcuts and returning defective parts to the line, and sorting scrap for recycling.

Employees in turn recognize CE mainly as “not wasting materials” and “using leftovers again”. That is often influenced by government awareness campaigns and their own observations.

These results confirm prior studies reporting superficial CE awareness limited to basic recycling rather than systemic strategies (Badhotiya et al., 2021; AlJaber et al., 2024; Al-Otaibi et al., 2024; Voukkali et al., 2023), and support findings that Islamic values provide a favourable attitudinal basis for sustainability (Hidayat, 2024; Javaid, 2022). The novel contribution is the empirical mapping of a hierarchical “awareness gradient” specific to Saudi plastics manufacturing higher management link CE to national strategy, middle managers to operational routines and employees to material waste avoidance a level specific pattern not documented in such structured detail in previous Saudi research.

2. Training and skills are the central internal bottleneck. Most higher management participants admitted that there is no dedicated budget or structured programme for CE specific training, even though they consider sustainability important.

Middle managers repeatedly described how the lack of formal training leaves technicians uncertain about adjusting machines for regrind, judging when rework is acceptable or maintaining quality when using recycled content employees almost unanimously reported that they had never attended any formal CE or recycling workshop and had instead learned through trial and error observing colleagues or following adhoc instructions from supervisors.

This training gap leads directly to mistakes and inconsistent practices and a feeling of insecurity when dealing with anything outside the conventional linear process this aligns with literature identifying training deficits and skills gaps as major CE obstacles in Saudi manufacturing (Alotaibi et al., 2019; Jaeger & Upadhyay, 2020; Acerbi et al., 2021; Beducci et al., 2024), particularly digital competencies for circular technologies (Dennison et al., 2024).

What is new is the demonstration of cumulative hierarchical effects higher managers acknowledge the issue without providing structures middle managers improvise under constraints, and employees rely entirely on informal learning revealing training as the pivotal internal bottleneck linking strategy to frontline resistance in this sector.

3. Resistance to change is primarily operational and risk based, not ideological.

Higher managers often described resistance as minimal, interpreting occasional hesitation as concern about costs or delays rather than deeper behavioural opposition. Middle managers offered a more nuanced picture, pointing out that workers accept simple changes but become reluctant when new procedures are complex, unclear, or likely to slow production.

Employees gave the clearest view of daily resistance, emphasising that extra sorting, careful storage of scrap, or on-site rework add to their workload without obvious rewards, especially in crowded spaces and under tight deadlines. Many said that they are not against CE in principle; they simply prioritize getting the job done quickly and avoiding blame if something goes wrong.

Resistance therefore emerges as a rational response to unclear instructions, inadequate training, limited space and time, and misaligned incentives, rather than as rejection of environmental goals. This supports studies linking resistance to risk aversion, workload fears and routine attachment (Alotaibi et al., 2019; Jaeger & Upadhyay, 2020; Acerbi et al., 2021; Obiuto et al., 2024; Thirumal et al., 2024).

The thesis contributes new evidence of systematic perception gaps higher management minimising resistance while employees describe it as structural response to daily

constraints reframing it from attitudinal problem to organisational outcome in Saudi plastics manufacturing.

4. A fourth conclusion concerns stakeholder and market barriers, which act as a powerful external frame around the internal dynamics at the strategic level managers stressed that project specifications and building standards require virgin plastics that there are no widely accepted technical standards for recycled uPVC profiles and that local recycling infrastructure is limited.

Middle managers translated these issues into quality control risks and logistics problems recycled content is harder to monitor defective or surplus items require storage space and reverse logistics chains are not clearly mapped.

Employees particularly those in sales installation and warehousing provided direct evidence of market distrust by describing customers who refused reworked parts and insisted on brand new components even when rework was technically possible and more efficient the result is that external expectations reinforce internal caution companies fear damaging their reputation or failing inspections if they experiment too much with circular practices.

This confirms literature on low market acceptance, consumer stigma and absent standards undermining CE (Badhotiya et al., 2021; Jugend et al., 2024; Voukkali et al., 2023; Safa, 2023; Amar, 2022) alongside weak collaboration platforms (Alotaibi et al., 2019; Jensen et al., 2022; Tabas et al., 2024) the originality lies in tracing hierarchical manifestations strategic compliance fears at top operational quality risks in middle direct customer refusals at bottom showing how “market barriers” become lived constraints in Saudi plastics projects.

5. There is the presence of a values practice and perception gap along the hierarchy leadership discourses strongly emphasize Islamic principles such as stewardship and avoidance of waste, as well as alignment with national sustainability agendas however these values are not yet embedded in routine practices procedures or evaluation systems employees reported that workplace culture is often “materialistic” or purely production driven and that sustainability is acted upon mainly when it directly saves money or when a specific manager insists on it similarly while higher management perceives resistance as low and communication as effective employees experience disorganized communication and daily struggles to apply circular practices within existing constraints this misalignment makes it harder for feedback from the bottom to reach the top and for strategic intentions to be translated into credible support on the ground this reflects Saudi manufacturing cultures remaining production driven despite

sustainability rhetoric and Islamic value alignment (Alotaibi et al., 2019; Hidayat, 2024; Javaid, 2022) with communication gaps weakening strategy implementation (Piao et al., 2023) the advance is empirical proof of hierarchical structure: leadership values stewardship/Vision 2030 strongly, yet employees report materialistic culture and disorganised signals positioning cross level misalignment itself as a key social barrier previously underexplored.

6. The findings validate the thesis's hierarchical interdependency barrier model: training deficits undermine middle managers' and employees' CE implementation, fostering resistance, shortcuts, and inconsistent practices that reinforce customer skepticism for virgin materials. This creates a lock-in loop where external pressures justify minimal internal investment, while internal weaknesses block quality demonstrations to shift expectations. Breaking it demands simultaneous interventions in capabilities, systems, and customer communication. This validates literature on interacting social-economic-technological barriers (Badhotiya et al., 2021; Tabas et al., 2024; Piao et al., 2023) and the thesis's own Barrier Categorization Framework. The core theoretical contribution is empirical mapping of a Saudi plastics-specific “lock-in” loop: external standards justify weak internal investment, training gaps produce operational resistance, inconsistencies reinforce customer skepticism a multi-level feedback structure not previously detailed in CE research on this context.

The recommendations below focus deliberately on what companies themselves can control, without depending on new regulations or government programs. They translate the empirical insights and the hierarchical interdependency model into practical steps that plastics manufacturers can take over the short to medium term.

Develop a structured, multi level CE training system

The first priority is to turn awareness and values into practical competence. Companies should design a simple, modular training system that differentiates between three levels:

- Foundational modules for all employees: short sessions explaining what CE means in the specific company (e.g., how scrap is generated, how rework is handled), why it matters economically and environmentally, and how it connects to Vision 2030 and Islamic principles. These can be integrated into induction and refreshed annually, using real examples from the factory rather than generic slides.
- Technical modules for production, quality and logistics staff: hands-on training on topics such as evaluating when a profile can be reworked safely, adjusting machines for recycled material, documenting rework, and organizing scrap to preserve quality.

Practical exercises, visual work instructions and mentoring by experienced technicians are more effective than long lectures.

- Managerial modules for supervisors and middle managers: training in planning and monitoring CE activities, integrating CE into daily production meetings, managing trade-offs between output and waste reduction, and coaching teams through changes. These modules should also cover how to use data from pilots and indicators to argue for further improvements upwards.

Companies do not need to create all content from scratch; external CE training materials, sectoral case studies and guidance from industry associations can be adapted to the local context. Over time, internal “champions” can be identified engineers, supervisors or technicians who are particularly knowledgeable or motivated to help deliver refresher sessions and support peers, reducing reliance on external trainers.

Implement small, well designed pilot projects as learning laboratories To address fears about quality and customer reactions, companies should adopt a pilot-based change strategy. Instead of attempting to introduce circular practices across all products and lines simultaneously, they can select specific, low-risk use cases where CE is technically feasible and commercially acceptable. Examples include:

- Systematically reworking oversized window frames within defined tolerance limits, with clear criteria for when rework is allowed and when a new frame is required.
- Organizing a dedicated area for sorted scrap (e.g., offcuts, defective profiles) with clearly labelled containers and simple rules about what goes where and who is responsible.
- Testing the use of internal regrind or purchased recycled material in non-critical components such as spacers, accessories or internal profiles that do not bear structural loads.

Each pilot should have a clear scope, time frame and set of indicators: quantity of scrap avoided, time spent on rework, defect rates, customer complaints, and any safety or quality incidents. Results should be reviewed collectively with higher management, middle management and shop-floor representatives. Successful pilots can then be standardized into procedures and extended gradually to other products or lines, while unsuccessful ones provide lessons about technical limits or organizational conditions that need to be improved. This incremental approach reduces perceived risk and helps build a shared evidence base for further change.

Integrate CE into performance management and incentives for circular practices to move from exception to norm, they must be reflected in how performance is measured and rewarded. Currently, many employees prioritise speed and defect avoidance because these are the metrics that receive attention. Companies should therefore:

- Add a small set of simple CE indicators to existing dashboards or team boards: scrap rate as a percentage of input, number or proportion of reworked pieces successfully used, volume of sorted versus mixed scrap, and similar measures.
- Include CE-related behaviours and results in individual and team evaluations, especially for supervisors and middle managers. This does not mean punishing teams for every piece of scrap but recognising efforts to reduce waste and improve processes.
- Celebrate visible successes, such as a team that significantly reduces offcut waste or successfully implements a new rework procedure, in staff meetings, internal newsletters or informal recognition events. Tangible rewards (certificates, small bonuses, extra break time) can reinforce the message.

These steps help reframe CE from a “nice to have” or moral duty into a core component of professional performance, consistent with both economic and religious values. They also counteract the perception that CE tasks are unpaid extra work, which was a major source of resistance among employees.

Redesign physical and organisational systems to support CE training and incentives will not succeed if the physical and organisational environment makes circular behaviour impractical. Companies should therefore examine their workflows, layouts and communication systems through a CE lens.

On the physical side, managers and employees can conduct joint “waste walks” to map where scrap is generated, how it moves, and where it accumulates. Based on this, they can rearrange or add scrap containers closer to cutting or assembly points, create safe storage areas for reusable offcuts, and mark zones clearly with floor markings and signs. Simple tools such as racks, trolleys or bins on wheels can make it easier to keep materials separate and accessible without obstructing operations.

On the organisational side, communication needs to move from ad-hoc verbal instructions to more structured channels. This could include:

- Short, regular toolbox talks on CE topics, where supervisors review current issues and expectations.

- A standard operating procedure (SOP) or quick reference sheet explaining, for example, how to decide whether to scrap, rework or reuse a profile, and how to document the decision.
- A basic system for logging rework and scrap (using paper forms, spreadsheets or simple digital tools), which provides data for analysis and feedback loops.

These interventions help employees understand what is expected, reduce confusion between shifts or departments, and make it easier to trace problems back to root causes.

Engage customers more proactively and transparently Given the strong influence of customer perceptions on company decisions, firms must treat customer communication as a core part of their CE strategy. This does not mean hiding rework or recycled content; on the contrary, transparency paired with clear quality assurances is more likely to build trust over time. Practical steps include:

- Developing standard wording and simple brochures or digital materials that explain when rework or recycled content is used, what tests and checks are applied, and how performance compares to virgin products.
- Training sales staff and site teams to communicate confidently about these issues, avoiding both over-promising and unnecessary alarm. They should be prepared to answer typical questions about strength, durability and appearance.
- Where appropriate, offering customers options: for example, a standard solution with virgin material and an alternative with a defined share of recycled content at a lower cost or with environmental benefits specified. Customers who are more environmentally conscious may choose the latter, while others may at least become aware that such options exist.
- Collecting feedback from customers after projects where CE practices were used and using positive cases as references in future discussions.

As more projects demonstrate that reworked or recycled components can meet performance requirements, companies can build a portfolio of success stories that gradually challenge stigma and open space for more ambitious circular initiatives.

Finally, to address the clear perception gaps between hierarchical levels, companies should create formal opportunities for cross-level dialogue about CE. For example, a small internal CE

working group can be established with representation from higher management, middle management and frontline staff. This group could:

- Review pilot results and suggest modifications.
- Identify recurrent operational problems (e.g., space shortages, communication breakdowns) and propose realistic solutions.
- Serve as a channel for bottom-up ideas and concerns about CE to reach senior decision-makers.
- Coordinate with external partners such as recyclers or training providers.

Such a structure can also help translate Islamic and national sustainability values into concrete practices by making them part of regular discussion and decision-making rather than abstract statements.

Table 12 : Recommendation Matrix

Barrier Path	HM Action (Strategic)	MM Action (Operational)	Emp Action (Daily)	Expected Impact
1. Awareness→Skills (14 quotes)	Mandate CE KPIs; fund SASO certification	Modular training: basic → technical → managerial	Peer mentoring for sorting/rework	+34% retention; breaks knowledge gap
2. Skills→Resistance (15 quotes)	2% training budget; link to bonuses	SOPs for rework; toolbox talks	Log scrap via app (not "waste")	Reframe as core duty, not extra work
3. Resistance→Stakeholders (12 quotes)	Form CE working group (1/level)	Dedicated scrap zones; 1 recycler partner	Waste walks; flag issues early	Builds trust networks
4. Stakeholders→Market (18 quotes)	Certify 10% recycled pilots	Quality dashboards; complaint tracking	"Certified recycled" sales pitch	Challenges "prefer new" stigma
5. Market→Awareness (11 quotes)	Vision 2030 + israf KPI reporting	Cross-shift success huddles	Client reaction feedback	Closes perception loop

Table : 13-Month Implementation Roadmap

Phase	Months	HM Actions	MM Actions	Emp Actions	Metrics
1. Planning	1-3	Approve 2% budget Form working group	Design SOPs/training Scrap baseline	Identify worst scrap	Budget allocated Group formed
2. Pilot	4-6	Review monthly Approve recycler	Train 20% workforce Test 1 partner	Log scrap daily Pilot rework	80% training completion Scrap % tracked
3. Scale	7-9	Approve certification Client reporting	Scale to 50% workforce Quality dashboards	Sales training Feedback loop	10% recycled certified Client feedback
4. Sustain	10-12	Vision 2030 report ROI analysis	Full rollout Annual review	Peer mentoring program	5% scrap reduction Israf KPIs reported

Directions for Future Research

The study's hierarchical interdependency model suggests several avenues for further work. First, longitudinal research could track how training investments, changes in communication systems, and targeted customer-engagement strategies affect resistance and market barriers over time. Second, quantitative or mixed-methods studies across a larger sample of firms would allow testing of relationships proposed in the model for example, whether higher training intensity is associated with lower reported resistance and greater use of reworked materials. Third, more detailed exploration of how Islamic sustainability principles are operationalized in organizational systems (e.g., KPIs, codes of conduct, procurement rules) would deepen understanding of the values practice gap identified here. Finally, comparative studies across other manufacturing subsectors or GCC countries could show which aspects of the framework are context-specific and which are more widely applicable, supporting more tailored interventions for circular economy transitions in the region.

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ADDITIONAL GOVERNMENT AND INDUSTRY SOURCES

Saudi Industrial Development Fund (SIDF) - Annual reports on manufacturing sector development: <https://www.sidf.gov.sa/en/>

Saudi Standards, Metrology and Quality Organization (SASO) - Technical regulations for plastic products: <https://www.saso.gov.sa/en/>

Ministry of Industry and Mineral Resources - Vision 2030 manufacturing sector initiatives: <https://www.mim.gov.sa/en/>

Saudi Basic Industries Corporation (SABIC) - Sustainability and circular economy reports: <https://www.sabic.com/en/sustainability>

National Industrial Development and Logistics Program (NIDL) - Manufacturing sector development strategies: <https://www.nidlp.sa/en/>

Thesis Summary in English

This master's thesis has at least 13 tables and about 60 references.

The paper "Hierarchical Interdependencies of Social Barriers to Circular Economy Adoption in Saudi Arabia's Plastics Manufacturing Sector" looks at social barriers to CE implementation in Saudi plastics companies in line with Vision 2030. It uses a qualitative method with semi-structured interviews of 20 people, including 6 higher-level managers, 6 middle-level managers, and 8 employees it take employees from different kind of levels to compare them with each other on how they effect in CE adoption focusing on social barriers

Important Barriers

Five main social barriers are identified in the literature: gaps in culture and understanding, problems with organizations and behavior, social acceptance and market stigma, a lack of collaboration amongst stakeholders, and a lack of skills and digital literacy. These show up in a hierarchy: senior leaders talk about strategic support but don't see operational gaps, while lower levels talk about training gaps and opposition. Interdependencies create lock-in loops. For example, bad training leads to resistance, which makes customers even more skeptical of recycled plastics and make them demand virgin materials because they believe that recycled means bad quality materials

Methodology and Results

Chapter 2 outlines purposive sampling, theme analysis utilizing Taguette (Braun & Clarke, 2006), and saturation at interview 18. Chapter 3 presents empirical findings that indicate perception gaps: leadership exaggerates commitment, employees encounter workload anxieties and communication failures, even though Islamic ideals such as israf (prohibition of waste) correspond with corporate ethics framework and Suggestions

A new Hierarchical Interdependency Barrier Framework shows how different factors are connected so that systemic changes can be made. Practical measures encompass multilayer training, CE KPIs, scrap pilots, and cross level working groups to address deficiencies without deferring to policy amendments. Limitations indicate qualitative generalizability; subsequent research advocates for longitudinal/mixed-methods validation.

Keywords: Circular Economy, Social Barriers, Organizational Culture, Leadership Support, Hierarchical Interdependencies, Plastics Manufacturing, Saudi Arabia, Vision 2030, Stakeholder Engagement, Skills Gap, Digital Literacy, Resistance to Change, Market Acceptance, Islamic Sustainability Principles, Qualitative Research, Semi-Structured Interviews, Thematic Analysis

SUMMARY IN LITHUANIAN

Ši magistro baigiamoji darbas turi mažiausiai 13 lentelių ir apie 60 nuorodų.

Darbo santrauka

Straipsnis „Hierarchinės socialinių kliūčių tarpusavio priklausomybės diegiant žiedinę ekonomiką Saudo Arabijos plastikų gamybos sektoriuje" nagrinėja socialines kliūtis CE įgyvendinimui Saudo Arabijos plastikų įmonėse, atitinkančias Vision 2030. Naudojamas kokybinis metodas su pusiau struktūruotais 20 dalyvių interviu, įskaitant 6 aukštesnio lygio vadovus, 6 vidutinio lygio vadovus ir 8 darbuotojus iš skirtingų lygių, kad būtų galima juos palyginti tarpusavyje pagal poveikį CE diegimui, akcentuojant socialines kliūtis.

Svarbiausios kliūtys

Literatūra išskiria penkias pagrindines socialines kliūtis: kultūrinius ir suvokimo spragus, organizacines ir elgesio problemas, socialinio priimtumo bei rinkos stigmatas, bendradarbiavimo su partneriais trūkumą ir įgūdžių bei skaitmeninio raštingumo stoką. Jos pasireiškia hierarchiškai: vyresni lyderiai kalba apie strateginę paramą, bet nemato operacinių spragų, o žemesni lygiai mini mokymų trūkumus ir pasipriešinimą. Tarpusavio priklausomybės kuria užrakinimo kilpas, pvz., prastas mokymas sukelia pasipriešinimą, kuris daro klientus dar labiau skeptiškus dėl perdirbto plastiko ir verčia juos reikalauti pirmos rūšies medžiagų, nes jie mano, kad perdirbtas reiškia prastą kokybę.

Metodika ir rezultatai

2 skyrius aprašo tikslinę atranką, teminę analizę naudojant Taguette (Braun & Clarke, 2006) ir sotumą po 18 interviu. 3 skyrius pateikia empirinius rezultatus, rodančius suvokimo spragas: vadovybė pervertina išipareigojimą, darbuotojai patiria darbo krūvio baimes ir komunikacijos nesėkmes, nepaisant islamo idealų, tokių kaip israf (švaistymo draudimas), atitinkančių įmonės etikos sistemą.

Rėmas ir pasiūlymai

Naujas Hierarchinis kliūčių tarpusavio priklausomybės rėmas iliustruoja skirtingų veiksmų ryšius sisteminiams permainoms. Praktiniai veiksmai apima daugiapakopį mokymą, CE rodiklius, šlamšto pilotinius projektus ir tarp-lygių darbo grupes trūkumams pašalinti be laukimo politinių pakeitimų. Apribojimai nurodo kokybines generalizacijas; tolesni tyrimai siūlo ilgalaikį ir mišrių metodų patvirtinimą

Raktažodžiai: Žiedinė ekonomika, Socialinės kliūtys, Organizacinė kultūra, Vadovybės parama, Hierarchinės tarpusavio priklausomybės, Plastikų gamyba, Saudo Arabija, Vision 2030, Partnerių įtraukimas, Įgūdžių trūkumas, Skaitmeninis raštingumas, Pasipriešinimas pokyčiams, Rinkos priimtumas, Islamo tvarumo principai, Kokybiniai tyrimai, Pusiau struktūruoti interviu, Teminė analiz

ANNEXES

1. Annex A: ANNEX 1. Interview Inventory and Participant Demographics Compiled by the author.

ID	Filename	Level	Role	Location	Experience (yrs)	Quotes Coded	Key Themes
P1	Interview-1.docx	HM	CEO/Director	Riyadh	15	6	Vision 2030, leadership, no training
P2	interview-4-level-1.docx	Emp	Factory Worker	Al Khobar	3	4	Govt campaigns, sorting tasks
P3	Interview2.docx	MM	Production Mgr	Al Khobar	3	3	Quality control, logistics delays
P4	interview-3.docx	MM	Supervisor	Jeddah	2	3	Workload resistance, training
P5	interview-6.docx	MM	Branch Manager	Dammam	4	3	Govt support, no resistance
P6	interview-8.docx	Emp	Technician	Riyadh	5	3	Space constraints, no training
P7	interview-11.docx	HM	Sales CEO	Jeddah	3	4	Customer specs, awareness
P8	interview-12.docx	Emp	Site Staff	Al Khobar	3	3	Operational resistance
P9	interview-7.docx	MM	Operations Mgr	Riyadh	6	3	Communication gaps
P10	interview-10.docx	HM	Director	Jeddah	12	6	Strategic barriers, standards
P11	interview-17.docx	Emp	Warehouse Asst	Riyadh	2	3	Scrap handling issues

P12	interview-5.docx	MM	Production Mgr	Dammam	5	3	Stakeholder coordination
P13	interview-13.docx	HM	CEO	Al Khobar	18	6	Market stigma, Vision 2030
P14	interview-14.docx	Emp	Shop Floor Worker	Jeddah	4	4	Extra workload, skills gap
P15	interview-16.docx	MM	Quality Supervisor	Riyadh	7	3	Quality complaints
P16	interview-9.docx	Emp	Operational Worker	Al Khobar	3	3	Customer refusals
P17	interview-15.docx	HM	Managing Director	Dammam	20	6	Leadership commitment
P18	interview-18.docx	Emp	Site Installer	Riyadh	5	3	No formal processes
P19	interview-19.docx	MM	Logistics Mgr	Jeddah	4	3	Supplier delays
P20	interview-20.docx	HM	Strategy Director	Al Khobar	14	6	Regulatory gaps

2. Annex B: Braun & Clarke (2006) 6-Phase Coding Process

Phase	Actions	Output	Tools	Time
1. Familiarization	Read 20 transcripts 3x	214 raw observations	MS Word	15 hours
2. Initial Codes	Open code (e.g., no training, scrap space)	87 codes	Taguette import	10 hours
3. Theme Search	Cluster by 6 Ch1 themes + hierarchy tags	6 themes validated	Taguette graph	8 hours
4. Theme Review	Member-check 6 participants	85% agreement	Email	3 hours
5. Theme Define	Interdependency matrix (Ch3.3)	14 paths quantified	Excel	5 hours
6. Report	Ch3 tables	78 quotes selected	Word	7 hours

3. Annex C: Codebook (214 → 87 → 6 Themes) Compiled by the author.

Theme	Example Codes (n=87)	Freq	HM Quotes	MM Quotes	Emp Quotes
Awareness	"Vision 2030", "recycling only"	18	8	4	6
Leadership	"CEO support", "no budget"	12	6	4	2
Culture	"Islamic values", "task focus"	16	7	5	4
Training	"no formal", "trial-error"	16	6	3	7
Resistance	"extra work", "job fear"	15	4	5	6

Stakeholders	"customer specs", "no recycler"	18	9	4	5
Market	"prefer new", "quality doubt"	13	7	3	3
Total		108	47	28	33

4. Annex D: Interdependency Matrix

Barrier From	To	Causal Link Description	Example	Feedback Loop	Hierarchical Impact (HM/MM/Emp)
Awareness	Skills	Superficial CE knowledge limits training uptake, widening digital literacy gaps (Acerbi et al., 2021).	Low awareness blocks skills programs.	Perpetuating poor tech adoption.	HM Strategic oversight / MM Operational gaps / Emp Daily tool misuse
Skills	Resistance	Skills deficits fuel job insecurity fears, increasing behavioral resistance (Jaeger & Upadhyay, 2020).	Untrained staff resist CE tasks.	Reinforcing extra work perception.	HM Minimal view / MM Conditional / Emp High daily friction
Resistance	Stakeholders	Employee pushback disrupts collaboration, eroding supplier trust (Alotaibi et al., 2019).	Resistance delays info-sharing.	Weakening B2B networks.	HM Partnership hesitance / MM Routine breakdowns / Emp Interface lacks
Stakeholders	Market	Poor collaboration sustains customer stigma for recycled plastics (Badhotiya et al., 2021).	Misaligned partners amplify demand for virgin materials.	-	HM Spec risks / MM Complaint handling / Emp Rejection encounters
Market	Awareness	Low demand for CE products demotivates awareness campaigns (Voukkali et al., 2023).	Stigma cycles back.	Keeping knowledge superficial.	Cross-level reinforces perception gaps.