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Identifying the Critical Factors of Circular Economy Impacting the Furniture Design Industry of Pakistan

Junaid Siddiqui¹

M.Phil. Student, Department of Product & Industrial Design, University of Engineering & Technology, Lahore, Punjab, Pakistan

Fariha Saeed²

Assistant Professor, Department of Product & Industrial Design, University of Engineering & Technology, Lahore, Punjab, Pakistan

Correspondence Author: farihasaeed284@gamil.com

Aiman Amjad³

Lecturer, Department of Product & Industrial Design, University of Engineering & Technology, Lahore, Punjab, Pakistan

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Abstract

The transition from a linear to a circular economy presents new dilemmas for designers and requires new knowledge and approaches. The majority of studies on the design of the circular economy have been on a theoretical basis. Very minimal literature addresses the actual impact of creating to capture the circular economy in the furniture design industry in Pakistan. This paper examines the barriers that prevent the application of the principles of the circular economy by furniture designers in Pakistan. Interviews with designers were conducted. The findings indicate that inadequate awareness in relation to the circular economy, ineffective technologies, unqualified labourers, and ineffective policies are the greatest hindrances. The research contributes to knowledge by identifying priority drivers and challenges and providing strategy recommendations towards a sustainable transformation. The outcomes would assist policymakers, industry individuals, and scholars in creating a robust and sustainable furniture design sector in Pakistan.

Keywords: Circular Economy, Circular Design, Sustainability, Furniture Design Industry, Pakistan.



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Introduction

A production and consumption model known as the "circular economy" places a strong emphasis on sharing, renting, reusing, repairing, refurbishing, and recycling existing products and resources for as long as is practical. In this method, product life cycles are extended. Actually, it refers to reducing waste. When a product reaches the end of its useful life, its ingredients are kept for as long as it is economically feasible. These can be used frequently with success, adding even more value (Tikto, J., n.d).

The environment is renewed, and resources are never squandered in a circular economy. A circular economy maintains, reuses, refurbishes, remanufactures, recycles, and composts resources and products. The circular economy tackles pollution, waste, biodiversity loss, and climate change by decoupling economic activity from the use of finite resources (Alex Forrest et al., 2017). This deviates from the take-make-consume-throw-away rhythm of the traditional linear economic system model. Unlike this approach, the circular economy model shifts away from relying on large quantities of inexpensive and readily available materials and energy. Energy and resource usage would be reduced if product creation were made more sustainable and efficient from the start. Research shows that the design stage determines more than 80% of a product's environmental impact (Tikto, J., n.d).

Annually, more than 2 million tons of furniture are discarded in France; similarly, 10 million tons of furniture are discarded by European Union (EU) Member organizations and clients each year, most of which is intended for both waste disposal and recycling. Asia money is owed for around 60% of the sector's population, and Asian countries have ended up as global manufacturing hubs. The last two decades have visible China and India - Asia's biggest economies- experience fast growth, urbanization, industrialization, and related terrible environmental influences. The landfill in Vietnam's Da Nang town represents a larger Asian story. With the city's waste increasing by 16 % every 12 months, the landfill potential is getting used up quicker than the city government imagined. That is a reality mirrored throughout many principal cities in Asia.

In Pakistan, almost all the economic sectors observe the "take-make-waste" method of the linear economics model. For example, Pakistan's manufacturing has no synergy for the periodic sharing of numerous assets, inputs, and outputs. This has led the country towards an extreme scarcity of resources and environmental degradation. Pakistan is significantly plagued with the aid of extensive portions of mismanaged waste consisting of plastic, paper, metal, wood, and other stable waste (Silas A.K, 2019).

According to figures from the European Federation of Furniture Manufacturers (UEA), 80% to 90% of furniture waste is deflagrated or transferred to landfills, and ~ 10% is recycled. The reuse process in this field is considered to be low (Dix, M, 2021)

“What do you need to do while your furniture reaches the end of its useful existence?”

That's the main question. To treat this developing trouble in the furniture sector, there is a need to cope with each step of the product life cycle. The framework of the circular economy can produce opportunity pathways to lessen the end-of-life options that have a terrible influence on the environment. A trade pathway of the product lifecycle must be determined to deal with this environmental challenge (Navvaro, M, 2021). The major challenge for the furniture industry in the successful transformation of the linear economy into a circular economy is to redefine the

Product Life Cycle from raw/crude material to the design or production of the final product. Low-quality materials and design deficits in the manufacturing sector have been identified as key issues for the sector to move from a successive economic system to a round economic system. A design made by considering the principles of a circular economy is often called a Circular Design. Within the framework of the circular economy, design is reported as one of the key components through which true assets of sustainability can be achieved. A few points of interest are circular economic furniture, often having more consideration, and reducing the negative impact on the environment.

In modern times, growing demand from customers has forced the furniture industry to produce a wide variety of designs that can utilize many flawless processes in general. The integration of these new processes using a sequential approach, as described earlier, may not address the principles of sustainability and environmental challenges, while the circular economic framework works better to meet growing customer needs and to address adverse environmental challenges. Therefore, products that use a circular design are highly flexible because they minimize negative factors affecting the environment, and increase positives, which results in extending the period of the product (Forrest, A, et.al. 2017).

The aims and goals of this study are to have a look at the impact of the circular economy on the furniture industry. The research investigates the critical factor of circular economy-driven furniture design is to extend the product lifecycle by prioritizing the use of environmentally responsible materials that ensure long-term durability and performance. Equally important is designing products for easy disassembly, enabling component-level repair or replacement rather than full product disposal. Additionally, the principle of “material follows function” guides the selection and reformation of product components, ensuring that each material used is optimally suited to its intended functional requirements while minimizing environmental impact.

Literature Review

The concept of sustainability has emerged in the furniture industry over the last decade due to climate change, environmental impact, and the increasing percentage of waste production while designing furniture pieces. It became the topic of research for society and the sustainable specialist, and called for shifting the traditional model of linear economy based on “take-make-waste” approach towards a circular economic model that is based on “take-make-recover” which helps in reducing the waste produced during the design phase and after the end of the product life cycle. The diagram explaining the circular economy model is shown in Figure 01.

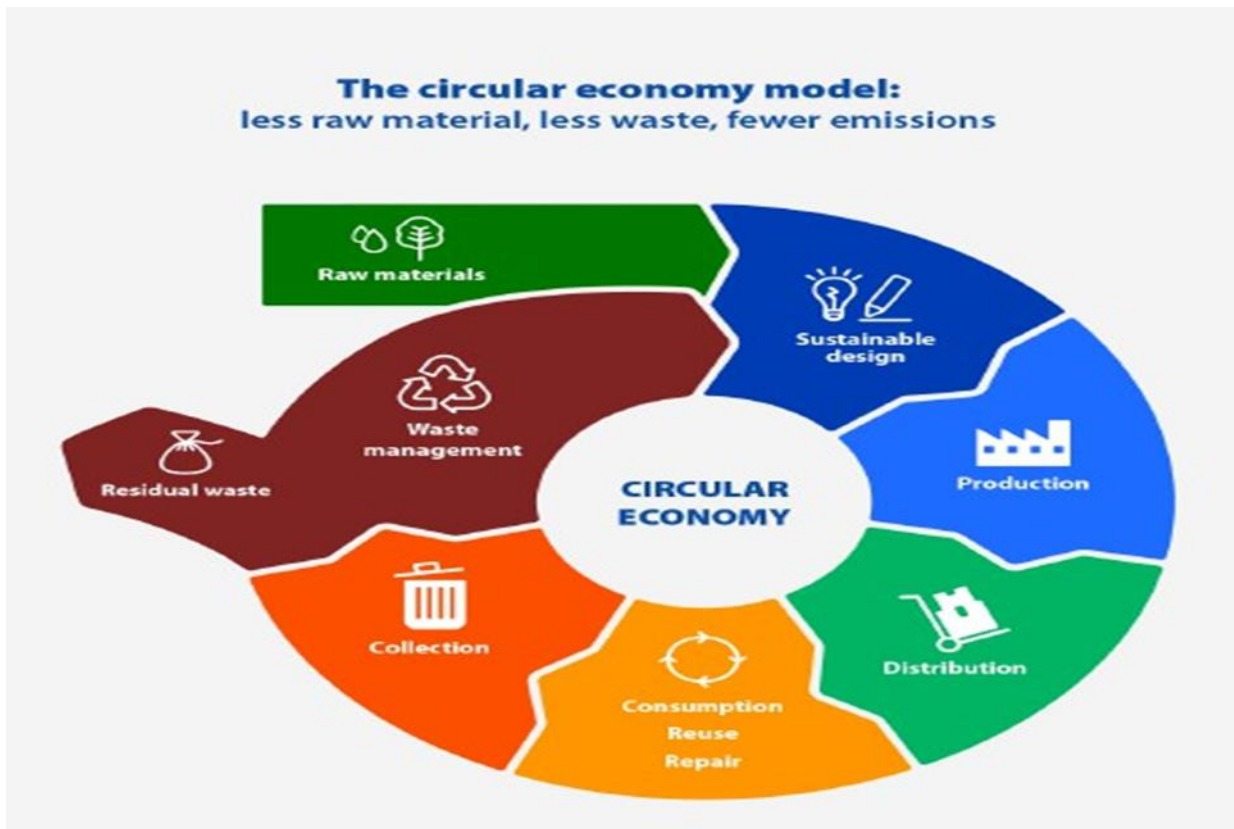


Figure 1: *The Circular Economy Model*

The extraction of raw materials, the comprehensive life cycle assessment of materials and models during manufacturing, the circular use of resources, and the use of a sustainable design approach are all linked to the adoption of circular economy principles. Approximately 80% of the environmental impact is determined during the design phase, according to the report.

One of the major issues of the traditional linear model is the production of waste material during the design process. In the wooden furniture industry, sawdust, particles of MDF, and chipboards are creating wood waste, which contributes the waste production and negative impact on the environment. Designers are focusing on transforming this waste into new products according to the circular economy business model.

Zhijun and Nailing (2007) agreed that designing for circularity is essential to a successful transition to a circular economy. They state that the design of circular products requires consideration of the entire product's life cycle, from the production of raw materials to its disposal, reducing negative externalities across these processes. Lieder and Rashid (2015) stated that the processes of a circular economy —reuse, development, and refinement —not only require further design in terms of product design but also the integration of information into the product in some way. They emphasize the importance of including information in the product from the beginning, so that, in time, it is available to those involved in the maintenance, reproduction, and/or recycling phase.

(Rebus, 2017) stated in his article about the challenges and critical factors that furniture designers are facing while implementing the circular economy design principles in the furniture industry,

providing an overview of the current state of the EU furniture industry, waste generation and treatment, and the challenges and opportunities for making the industry more circular. It also highlights key skills and competencies required for implementing circular business models in the furniture industry.

(Basit Ali, 2022) highlights the furniture industry in Pakistan, including trade, obstacles, and opportunities. It covers the raw materials used in the industry, imports, and various furniture products and their impact on environmental factors. The report also includes recommendations for the industry and how the Pakistani furniture industry transitions from a linear model to a circular model.

All over the world, especially in developing countries like Pakistan, people follow the practice mentioned above of taking, making, and wasting. That is, we take raw materials, convert them into furniture, use these materials, and dispose of them. However, there is a better way to end this vicious cycle of taking, making, and wasting, and that is the Circular Economy (CE). This new concept is about abandoning an old bad habit and replacing it with a new one to take, make, recycle, or reuse. This new strategy can help save our country's vital resources and can make a significant contribution to the development of the region as a whole.

State of Pakistan Furniture Sector

The estimated value of Pakistan's furniture market is \$3 billion (Pakistan & Gulf Economist, 2019). Over 15,000 small and medium-sized businesses are part of it nationwide. Pakistan's furniture industry offers a wide range of classic (Classical) furniture styles, such as Oriental, Mughal, Antique, and Chinioti. Modern (Italic) styles are becoming increasingly popular in the domestic furniture market. Modern MDF (medium-density fiberboard) furniture designs are more affordable than traditional (Antique & Chinioti) solid wood furniture. The round economic model offers a version for the furniture industry in which products are made from recyclable resources or while the object reaches its end. According to the global economic system, a company can construct sturdy purchaser relationships with the aid of recyclables while merchandise is returned for recycling, and with it, the environment and the economic system save resources and money. In businesses where reusing and remanufacturing are included, the obligation lies with the makers of the appropriate law. The furniture itself incorporates materials including chipboard, MDF, wood, metal and aluminum, plastic, and numerous fabrics, and even electric gadgets (for instance, in motor beds).

An extensive review of the article has been conducted through Google Scholar, journals, and existing research carried out. The summary of all these articles is also given in the form of a table. The aim is to study the existing processes and methods used to shift the furniture industry from a linear economic system to a circular economic system. Keeping in view these studies, it is concluded that there is a need to design such products based on a circular economy through which we can extend the lifespan of the product. Also, these products have a minimum negative impact on the environment.

Table 1: Literature Review Summary

Author	Year	Key Points	Relevance to research
Zhijun & Nailing	2007	Designing for circularity is essential for a successful transition to a circular economy. Product life cycles should be considered from production to disposal.	Highlights the importance of circular design and life cycle management in the furniture industry.
Lieder & Rashid	2015	Emphasizes that circular economy processes require design thinking and integration of information into products to support reuse, maintenance, and recycling	Focuses on the need for product design that facilitates recycling, which is crucial for implementing CE
Rebus	2017	Discusses challenges and competencies needed to implement the circular economy in the EU furniture sector. Focuses on waste treatment and opportunities for circular practices.	Provides insight into the challenges of implementing circular practices in the furniture industry.
Basit Ali	2022	Focuses on the furniture industry in Pakistan, covering trade, raw materials, and environmental impact. Discusses transitioning from linear to circular models.	Directly addresses the Pakistani furniture sector and offers recommendations for adopting the circular economy.
Jamil & Niazi	2020	Explores the challenges and opportunities for integrating CE principles in Pakistan's traditional furniture sector.	Relevant to understanding the cultural and practical challenges of adopting the circular economy in Pakistan.
Lieder & Rashid	2016	Emphasizes modular design, disassembly, and reusability to extend product life and reduce waste.	Directly applicable to implementing circular design in the Pakistani furniture industry.
Murray et al.	2017	Highlights the role of government policies such as extended producer responsibility (EPR) laws and tax incentives to encourage circular practices in industry.	Suggests policy recommendations to help Pakistan adopt circular economy practices in its furniture sector.

Circular economy within the furniture industry is also a recent concept, particularly in a country such as Pakistan. Most articles emphasize that the process of designing furniture should be in alignment with the circular model since it is more sustainable. This paper indicates that it is possible to utilize circular economy principles in furniture design to be greener, reduce environmental impact, and design with less waste.

Case Studies of Circular Economy in the Furniture Industry

The table below identifies different designers who worked on the concept of the circular economy implemented during the design phase. But it has been clear that, in Pakistan, there is still a need to implement the principles of the circular economy during the design process.

Table 2: *Analysis of Case Studies in the Furniture Industry*

CE Step	Circular Design Strategy	Furniture Example (Case Study)	Critical Analysis and Industry Challenges
Narrowing the Loop (Resource Efficiency & Design)	Design for resource conservation and efficiency	Bell Chair (Magis): Product design focused on reducing space during transportation, which narrows the loop by decreasing material and energy consumption in logistics ³³³ .	Focus on Materials: Current circular solutions, including using eco-friendly materials, are mostly concerned with products and resources. Nevertheless, this emphasis frequently hinders the creation of more all-encompassing sustainable solutions at the ecosystem and Product-Service System (PSS) levels. Although not yet widely used to promote component reuse, design for simple assembly and disassembly is essential.
Slowing the Loop (Product Life Extension)	Design for extending the product life (e.g., reuse, repair, refurbishment) and Design for PSS (Product-Service Systems).	OVO collection (Benchmark): Implementation of complementary services for maintenance and repair. Lyght Living / Circular Offices (Deskto): Companies applying a "furniture as a service" logic (renting/leasing) rather than selling ownership ¹⁰ .	Business Model Limitation: There is still little use of circular product design techniques in conjunction with circular business models, such as leasing. These service offerings are not competitive or varied enough in the industry. Operational Cost: Practices like refurbishment and repair are labor-intensive, difficult to automate, and require significant storage space, which results in higher costs for furniture companies.
Closing the Loop (Value Recovery)	Design for recycling and closing the resource loop	REVIVED Service (Gispen): Focuses on remanufacturing and refurbishing furniture products. Circular Hub (Ikea): An initiative that encourages consumers to bring back used furniture for repair, refurbishment, resale, or recycling ¹⁶ .	Lack of Priority for Reuse: The furniture industry has been slow to adopt CE practices, with reuse still not prioritized over recycling, incineration, and landfill. Waste Challenge: A substantial amount of furniture waste in Europe (between 80% and 90% in 2017) is still incinerated or sent to a landfill ¹⁸ .
Systemic & Behavioral Enablers	Design for encouraging circular consumption and	Circular Hub (Ikea): Involves consumers by offering them a discount for bringing back used	Underdeveloped Engagement: Increasing user engagement and participation is one of the most underdeveloped areas in circular initiatives.

behavior models and design for stakeholder collaboration	products, which helps guide their behavior towards circularity.	Consumer Skepticism: Users are often skeptical about the economic benefits of leasing/renting and prefer to possess furniture, which acts as a socio-cultural barrier to CE adoption.
	Opendesk: A model that bridges production and transportation to reduce environmental impact, often through distributed manufacturing..	

Research Methodology

The researcher will employ the qualitative approach and research what causes the furniture industry in Pakistan to implement the circular economy. Scholars employed both interviews and observations to come up with in-depth data. This was useful in understanding how interior designers consider and apply the concepts of a circular economy. They also consulted journals, books, and academic papers as background information. The primary information was obtained by interviewing furniture designers, which is why the data is more credible. The researchers examined the furniture designers in Lahore, Pakistan. The members were a great variety of different design fields, experience, and types of companies in Lahore. The authors selected individuals to work in the field of furniture design or with information on the topic of the circular economy. These respondents provided valuable responses regarding the research questions and ought to be aware of the difficulties and opportunities with the implementation of sustainable practices. They were used to sort the data with the help of thematic analysis, and the study did not violate ethical principles.

Data Analysis

The researchers employed thematic analysis to investigate interview data. They sought recurrent patterns, themes, and categories. The responses were categorized into themes and sub-themes. The interviews resulted in five dominant themes and their sub-themes. The interviewees have expressed their opinions on the major aspects of the circular economy that has an impact on the furniture industry in Pakistan.



Figure 2: *Thematic Analysis of the Study*

Material Choice and Impact on the Environment

The research shows that it is highly significant to pick sustainable and local materials when creating furniture to reduce the negative impact on the environment caused by mining, manufacturing, consumption, and disposal of the product. They all claimed that the usage of local materials decreases the ecological footprint. Most of them also recommended recycled or inert mixtures to be used over a long period of time. They added that the material choice varies the length of life of the product and the ease of repair, and they advise plywood and chipboard for straight cuts and solid on curved cuts. It is also demonstrated in the research that individuals prefer materials fighting eco-fight, such as cork, PVC sheets, bamboo, reclaimed wood, and even newspaper wood. This indicates an attempt to make production more sustainable for the planet and the Pakistani economy.

Before and After Easy Dismantling and Repair

The analysis reveals that there is an increase in the desire of people to have furniture that is easily disassembled and repaired. The ability to cut costs, waste, and align circular goals is a feature of all said repairable designs. They even regarded modular design as helpful and recommended the IKEA-like approach, centered on design, and incorporating the appropriate joints and hardware such that parts can be replaced or renewed. However, they mentioned issues like the lack of qualified personnel, excessive labor costs, and the lack of governmental assistance to small manufacturers. Such problems prevent the utilization of such green, modular concepts by many people.

Materials Follows Function Approach

The result expressed that the "Material Follows Function" approach is become one of the key things to improve furniture performance, efficiency, and longevity. Everyone said to pick materials mostly based on the needs of the function to make furniture durable and practical, and not extra fancy bits. They also called attention to the need for new materials, such as veneer sheets, artificial marble, high-gloss finish, and local and cheaper materials such as bamboo and palm that

can sprout innovation and significantly increase performance. Plus, everyone agreed that aesthetics and function have to be in sync with material choices shaping both the look and use of furniture to get designs that work well, look good, and fit the intended space.

Circular Economy in Practice

The circular economy idea is all about setting up a regenerative system where resources keep getting reused, products are made to last, and waste drops. In fact, what the Circular Economy is about is reducing consumption of limited resources, driving sustainability, and closing the loop on product life cycles. Designing for longevity means you don't need to replace stuff as often. Not only does it support being green, but it also often means it can be cheaper as you need to use sturdy materials and make designs repairable. All the students were on the same page that the smart use of resources during design is key to keeping costs low. They emphasized reducing the waste of materials and the most efficient use of the raw material that you actually have.

Challenges & Opportunities in the Pakistan Furniture Industry

Everyone said they came across a lot of roadblocks when trying to introduce circular economy ideas in furniture design in Pakistan. They felt that the shortage of know-how, equipment, and handymen in the design scene prevented them from doing it. According to the participants, the government also didn't support the local industry. Five of them said that the government should organize workshops for the workers and designers. They want training sessions around design principles of the circular economy so that people can use them in the local furniture scene.

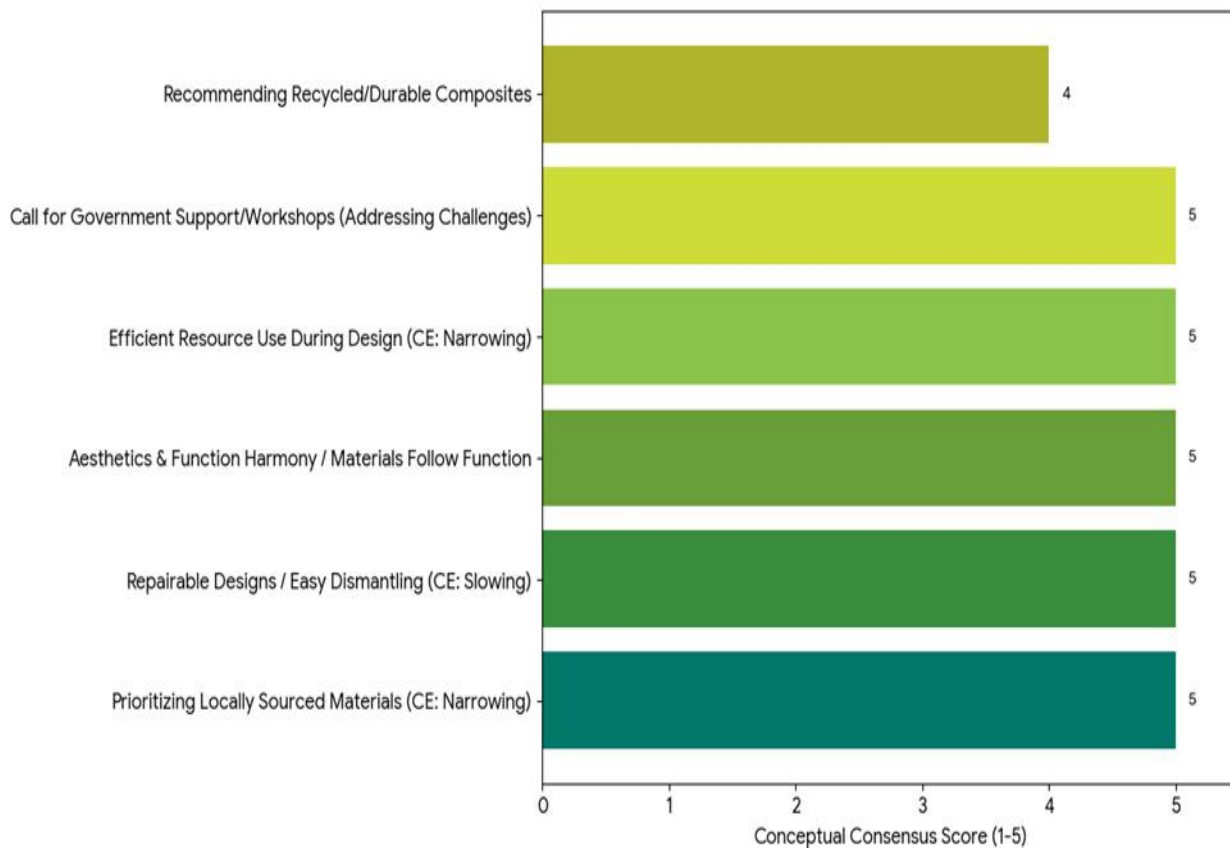


Figure 3: Consensus on Circular Economy Themes in the Pakistani Furniture Industry

The statistical image graph below helps to visualize the level of Conceptual Consensus of the participants across the major themes extracted from the analysis of the furniture industry and which principles of the Circular Economy (CE) are more agreeable or less agreeable.

Analysis of the Agreement on Circular Economy Themes

The graph converts the qualitative agreement (e.g. 'All participants', 'most participants') into the Conceptual Consensus Score (1-5) where 5 indicates everybody totally agrees and 4 indicates a strong majority ('most') consensus.'

1. Unanimous Consensus (Score 5/5)

Four basic principles of circular economy and one key challenge/solution were shown to receive the consensus of all the stakeholders through a highly agreed-upon position: This indicates the basis of circular economy thinking in the Pakistani furniture industry:

-Prioritizing Locally Sourced Materials (CE: Narrowing): Recognized as best practices for reducing the ecological footprint by reducing the impacts of transport.

-Repairable Designs/ Easy Dismantling (CE: Slowing): Everyone agreed that designs that allow for the replacement of parts and upgrades were critical to increasing product lifespan and reducing waste.

-Aesthetics & Function Harmony / Materials Follow Function. Everyone agreed that the selection of materials must consider functional requirements first (durability, practicality) and harmonize with aesthetics.

-Efficient Resource Use During Design (CE: Narrowing): Everyone agreed this is critical - both in terms of cost -effective, as well as minimizing material waste at the design start.

-Call for Government Support/Workshops (Addressing Challenges): The fact that one of five participants explicitly suggested that the government should organize training sessions and workshops indicates the urgent need for outside help to surmount the limits of the industry in terms of know-how, gear, and skilled labor

2. Strong Majority Consensus (Score 4 of 5)

The recommendations towards recycled/durable composites: Most of the participants mentioned eco-friendly, recycled, and durable composites, indicating a high, though not unanimous, commitment to closing the material loop and increasing long-term sustainability.

The high level of consensus across all themes, particularly those related to Narrowing the Loop (resource efficiency, localization) and Slowing the Loop (repairability, longevity), indicates a strong theoretical alignment with the Circular Economy model among industry participants in Pakistan.

Results and Discussions

This section presents the results from the responses to the Interview. In addition to following the themes, we distinguish general findings regarding designing for a circular economy, but also highlight the challenges that furniture designers are facing in implementing this practice in Pakistan's Industry.

Every participant concurs that the circular economy is central and emphasizes how the design

process has evolved to tackle the unique challenges encountered when creating for a CE. The participants understand that design projects related to the circular economy demand a broader understanding of materials and assessments of environmental impacts. Creating a circular solution aiming for a closed loop of resources generally demands additional design practices than normal to be incorporated into the design process. Environmental effects must be assessed throughout the entire (or several) lifecycle(s), and a more in-depth research phase is necessary to comprehend the system of which a product or structure is a component. All these aspects usually result in a design process that involves additional iterations and feedback cycles, which is typically “longer.”

According to the results of in-depth interviews, the design process becomes increasingly data-oriented in a CE setting in order to track materials and product lifecycles and assess environmental consequences. Furniture and interior designers thought that keeping track of the materials and product life cycle would help them better understand how items may contribute to the circular economy. All the participants agreed that the circular economy is a more sustainable way to design products and helps to maintain social and economic equilibrium. They also explained that with the help of a circular economy, companies can generate a zero-waste approach, which will ultimately reduce the negative impact on the environment. Furniture Designers are also in favor of using recycled and reused materials (wood, metal, and fabrics) to make new products, which will increase the lifespan of furniture products.

Studies have shown that there is a very limited investigation done by designers in the context of the circular economy, and to their knowledge, there is no furniture industry that has adopted circular economy principles in their design practices. The researcher addresses that previously, only linear models were adopted in the furniture design industry, but now industries are continuously working to adapt Circular Economy principles in their design practices. It has been suggested that, according to Pakistan’s waste generation percentage, more research is needed on Circular Economy design principles. According to the findings of interviews conducted, more emphasis is placed on developing business models that encourage circularity through the design of durable and modular products and disassembling products to support repair and maintenance processes and product service systems. In addition, there are still a few design agencies that have either finished their CE design project or have explicitly stated that they are working with circularity, as this is still a relatively new area.

Conclusion

To conclude, this research aims to contribute to the field of furniture design, particularly in the context of Pakistan's furniture design industry, by exploring the critical factors of the Circular Economy. Though the research is exploratory, the findings were gathered through qualitative data in the form of open-ended questions through interviews to get participant insights about implementing circular economy principles in furniture design. The collected data were analyzed using thematic analysis, and main themes along with their sub-themes emerged during the analysis process.

The study addressed the research objectives, providing valuable insights about shifting the linear economy to a circular economy approach in furniture design. Based on the observations made, it is concluded that there is a need to adopt this design practice in the Pakistani furniture industry. However, the scope of the Circular Economy is limited in Pakistan and has not been explored much in the field of furniture design. This research fills this gap by providing insights into the

integration of this approach in the furniture design field. Further, this research explores the potential benefits of adopting the Circular Economy in furniture design as it improves the economy and saves resources used during the design process. Many participants see this shift as beneficial in the field of furniture design. However, several challenges also emerged that limit the scope of adopting Circular Economy design practices in Pakistan, which involve the lack of skilled labor, limited latest machinery, and its unawareness among people in Pakistan. The study contributes valuable insights into the emerging role of the Circular Economy in furniture design in Pakistan and provides recommendations for future research in this field. There is a significant potential for shifting the linear economy approach to the circular economy approach in furniture design. Future research can focus on the client's perspectives when purchasing furniture, comparison between national and international implementation of Circular Economy Principle and its critical factor impacting furniture industry, explore Circular Economy in furniture design education, and many more.

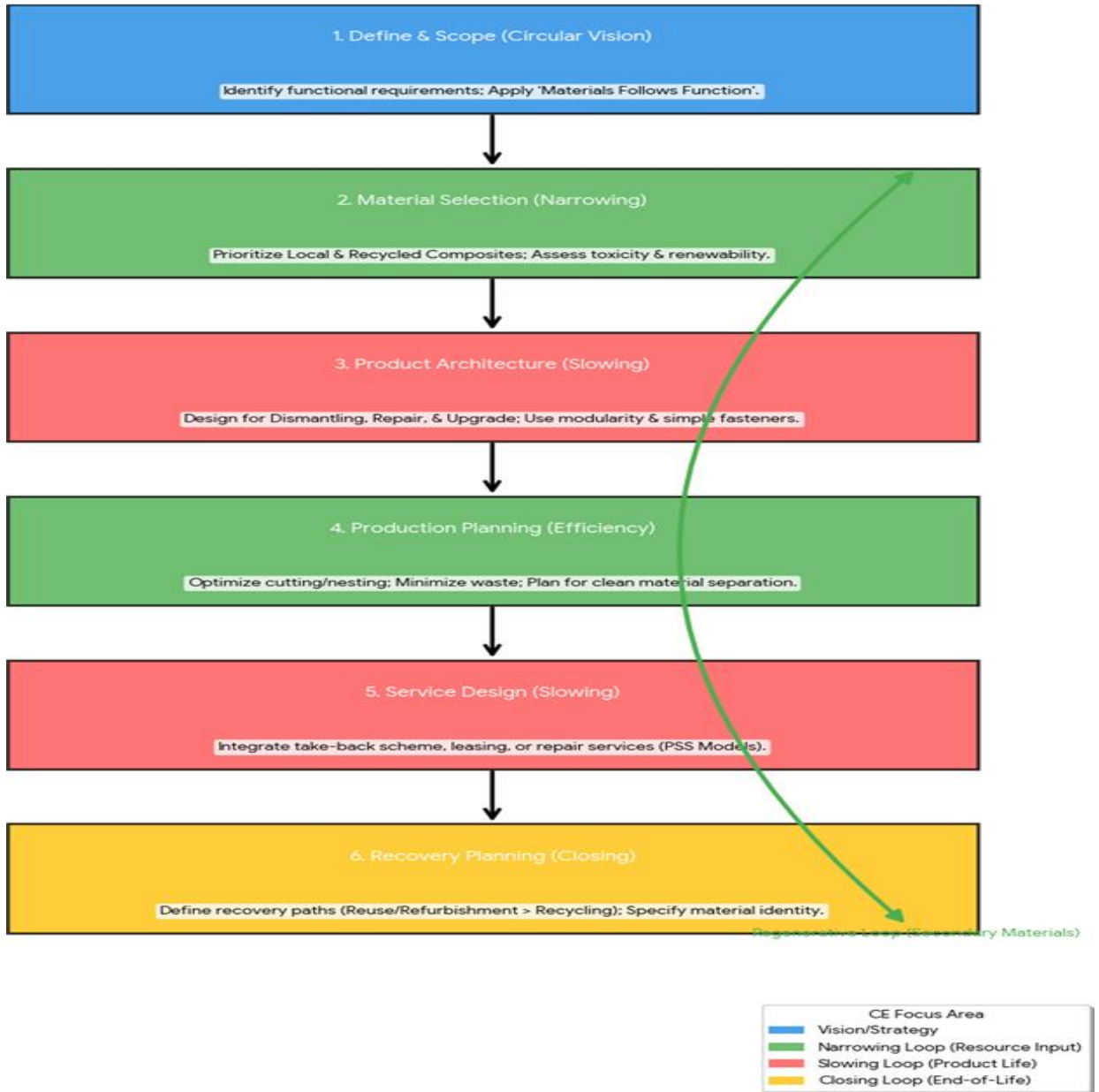
So, it can be concluded that this approach is still at an early stage in the field of furniture design in Pakistan, but through its exploration, this practice will soon be widely adopted and can play an important role in shaping the future of the Pakistan furniture design industry.

Recommendations

Based on the observations made, this part provides recommendations by the researcher on the research findings of the study for the incorporation of Circular Economy Principles in furniture design in Pakistan. The researcher suggested that there is a need for awareness sessions regarding the adoption of the Circular Economy, and sustainable design practices should be spread among designers and furniture manufacturers for the incorporation of this approach in Pakistan. The majority of people's knowledge about the Circular Economy is limited to the education sector; they are unaware of its scope, which incorporates design practices, especially furniture design. Few people are truly aware of the advantages of incorporating this approach and are working for its implementation, but its scope is still limited in Pakistan. The lack of understanding and knowledge about sustainable design practices, their importance, and implementation is a significant barrier for furniture designers in Pakistan. Therefore, training sessions and learning programs should be introduced, and workshops and seminars should be conducted around different cities of Pakistan to provide knowledge to furniture designers.

To implement this design practice into the Pakistan furniture industry during the design process of furniture making, the researcher proposed a flowchart on how the principles of the circular economy can be aligned with the selection of raw material, manufacturing, and recovery design to shift from the linear economy towards the circular economy.

Circular Design Process for Furniture: Integrating CE Principles



Conflict of Interest

The authors showed no conflict of interest.

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