Circular Economy: Can it be an effective economic re-design?

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Abstract (ENGLISH)

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Circular Economy recently has gained massive attention in terms of its implications across multiple industrial verticals. Various schools of thoughts like permaculture, cradle to cradle, industrial symbiosis have been associated with the Circular Economy, yet the application of circular practices is still relatively low. This research addresses the gaps between the theory and practice and analyses the reasons why there is the delay in its application. Moreover, the research also reflects on the understanding of Circular Economy with its circular business models and how those business models can tackle and address the challenges in the traditional linear production systems. Apart from this, the benefits for the key stakeholders in the economy i.e., corporations, governments and consumers have been identified and explained.

Multiple case research methodology has been followed to understand the ground reality of the delay in the application of circular economy, four industrial verticals have been chosen and using a semi-structured interview process, various examples, strategies, opportunities and challenges have been understood and they form the analytical structure of the research. The research then uses the results from the case study to be interpreted by using the theory of absorptive capacity in an open innovation system and hence the results are analyzed accordingly, concluded with the understanding of technological, leadership, consumer behavior enabling factors and the monopoly played by corporations as a disabler. Moreover, the recommendations are directed towards the government enabling stricter EPR (Extended Producer Responsibility) and post occupancy evaluation regulations.

Key words: Circular Economy, Open innovation, linear production

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Abstract (PORTUGUESE)

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A Economia Circular tem ganho recentemente grande atenção em termos das suas implicações em vários setores industriais. Várias escolas de pensamento, como a permacultura, o *gradle-to-gradle*, a simbiose industrial, entre outros, têm sido associadas à Economia Circular, embora a implementação de práticas circulares ainda seja relativamente baixa. Esta pesquisa aborda as lacunas entre a teoria e prática, e analisa as principais razões que têm atrasado a sua implementação. A pesquisa reflete ainda o entendimento da Economia Circular com seus modelos de negócios circulares, e como esses modelos de negócios podem enfrentar os desafios dos tradicionais sistemas de produção linear. Além disso, foram também identificados e explicados os benefícios para os principais *stakeholders* na economia (corporações, governos e consumidores).

Foi aplicada a metodologia de pesquisa de casos múltiplos para entender a realidade do atraso na implementação da economia circular: foram escolhidos quatro setores industriais, e, usando um processo de entrevista semi-estruturada, foram analisados vários exemplos, estratégias, oportunidades e desafios, que formam a estrutura analítica da pesquisa. A pesquisa usou os resultados do estudo de caso, interpretando-os com base na teoria da capacidade absortiva num sistema de inovação aberta. De seguida, os resultados foram analisados adequadamente, e concluídos com a compreensão de fatores tecnológicos, de liderança, de comportamento do consumidor e do monopólio pelas corporações como uma barreira. Além disso, as recomendações foram direcionadas para o Governo, permitindo uma aplicação mais rigorosa do EPR (Extended Producer Responsibility) e regulamentos de avaliação pós-ocupação.

Key words: Circular Economy, Open innovation, linear production

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1.Introduction:

1.1 The Linear approach towards growth:

Historical events have continuously defined our present economic state, after World War I, there was a massive shift not only in the economies but also in the mind-set and perception as craft labor was then reimagined and re-innovated into mass production systems which were primarily facilitated by Ford motor company and General Motors. With world war II, Japanese firms like Toyota introduced Lean Manufacturing systems and Just in time business models which clearly define our global economy today. Some of the critical lessons from such industrial trends of mass production and lean manufacturing were that companies and countries could reap enormous first-mover advantages. Historically, the rise of the US economy is closely associated with the emergence of mass production, and the development of Asian economies like Japan is related to the introduction of flexible or lean manufacturing systems. Such trends also show that such systematic changes in the economy can happen much faster than expected and these are facilitated by the pioneering firms, i.e., when they can demonstrate the benefits. The critical factor which enables such production systems is the consumption, and with the population growth over the decades, there has been a substantial increase in the consumption. This indeed has resulted in a high standard of living amongst the various segments and cultures of the population as this high standard of living and the rise of the middle class is characterized by the high annual resource consumption. In the same time frame, such a high standard of life does not come without a high cost and these costs are very clearly visible in our natural environment today, and they could be present in the form of shortage of clean water, ozone layer depletion, pollution, climate change, destroyed landscapes, biodiversity loses etc. such instances are not only the adverse effects but also endangers the future of human civilization and biodiversity.

A linear model of resource consumption typically follows a pattern of 'take-make-use-dispose' model where companies and corporations harvest and extract materials, use them to manufacture a product, sell it to a consumer who then uses the product and discards the product after its use or discards it halfway and this is apparently visible in the current economic scenario as the data suggests that around 65 billion tons of raw materials was introduced in the economic system in the year 2010 and this is expected to grow to 82 billion tons by the year 2020. (MacArthur, 2013)

In the meantime, value instability levels for metals, food and non-food agricultural farming yield in the initial decade of the 21st century were higher compared to any single decade in the previous century. (MacArthur, 2013) Without significant measures, high costs and unpredictability will probably set down deep roots if development is vigorous, populaces develop and urbanize, and asset extraction costs keep on rising. With three billion new white-collar class customers anticipated that would enter the market by 2030, value signs may not be stable or sufficiently broad to turn the circumstance around sufficiently quick enough to meet this development prerequisite.

1.2 Objectives and research question:

A report by World Economic Forum on the limits of linear consumption has demonstrated some trends which clearly show that the linearity is reaching its limits:

- With modern processes for manufacturing and production, there are opportunities to increase efficiency, but the gains from such capabilities are insufficient and are incremental to generate real competitive advantage or to create a differentiation factor.
- Agricultural productivity is developing more gradually than any other time in recent memory, and soil ripeness and even the nourishing estimation of sustenance are declining.
- The risk to supply security and safety associated with long, elaborately optimized global supply chains appear to be increasing.
- Production sites with an excessive need for virgin resources like water, atmosphere, etc. are facing challenges to renew their licenses to operate while they compete in susceptible and local resource markets. (Towards the circular economy, 2018)

With linearity reaching its limits, it is unclear if the corporations understand the role and importance of circularity and if they understand its importance, there is an apparent gap in its implementation. Circularity requires a system level change from the way we look at waste, to the way we operate the supply chains and it indeed involves new design techniques for efficiency and retracing a product back into the ecosystem.

To date, there is a clear knowledge gap towards its implementation and the understanding of differentiation of how circularity is differentiated from linearity (regarding strategy, barriers, and benefits).

The objective of this thesis is to evaluate the current state of transition from Linearity to Circularity, and this is accomplished by studying multiple cases of companies across various industrial sectors across varied geographies which have transitioned or planning to implement circular principles (or) circular business models. Such a multiple case study design approach will assist in the evaluation and find common patterns to understand the current circular strategy of implementation, key enablers, and barriers and the role of the critical stakeholders (communities, governments, corporations, SME's). Following the outlined purpose, this thesis is based on the subsequent research questions:

i. In an economy, where the resources are limited, why are the companies not aware of CE and if they are aware, what stops them from implementing the process

a. Current Understanding and awareness?

b. What are the current strategies or strategic initiatives?

ii. What are the Key barriers in the implementation of C.E?

a. In terms of corporations

b. Government's role

c. Consumer behavior

iii. What are the key enablers in the implementation of C.E?

a. New business models?

b. Role of Leadership?

1.3 Methodology:

1.3.1 Research Context:

The aim and focus are to obtain real-world experience/knowledge/perspectives from the business leaders and from the people who are in their initial stage in the area of implementing circularity in their business practices. Their knowledge/experience will either show some relevance to the theory, or it will negate it. In either scenario, the information gathered will lead a specific direction concerning understanding the key barriers, enablers, the current mind-set of people and corporations while implementing Circular Economy.

1.3.2 Research Approach:

Qualitative research methodology has been implemented in the collection of data. This is essential as the research is directed towards gathering the real-world perspectives and experience of the participants and hence. In-depth interviews were conducted with an unstructured interview structure to get the participant's perspectives and experiences in a natural environment (Creswell, 2013).

A qualitative research project is mainly based on narrative inquiry and exploratory research nature. The strength of qualitative research is its ability to provide elaborate textual descriptions of how people experience a given research issue. It includes information about the "human" side of an issue – that is, the often-contradictory behaviors, beliefs, opinions, emotions, and relationships of individuals. Qualitative methods are also useful in identifying intangible factors, such as social norms, socioeconomic status, gender roles, ethnicity, and religion, whose purpose in the research issue may not be readily apparent. (Anderson, Leahy, Delvalle, Sherman, & Tansey, 2014)

A key research method approach will be intensive desk-based research to summarize the literature review to get a clear understanding of the concept of Circular Economy. And multiple case studies and interviews will be conducted with participants from various industrial verticals to get an understanding of the present understanding, applications, enablers and barriers and the current perception of C.E in the ecosystem.

The primary and secondary data constitutes data from academic journals, reports and articles addressing Circular Economy and linearity to understand the current development path and approaches amongst individuals and companies and SMEs and to formulate and comprehend the role of circularity. Moreover, the researcher also participated in the Circular Economy forum at the Web Summit in 2017 to understand the transition towards circularity. Multiple case studies which involved in depth semi-structured interviews to understand the key aspects of circularity with respect to the literature are a part of the research.

The primary sources in this research rely on the interviews conducted with the professionals within the sustainability industry. Four semi-structured interviews have been conducted and the interviewees represent their organization and express their views/experience(s) about the influence/importance of circular economy. A non-probability sampling was deployed as the interviewees were not statistically representative (Creswell, 2013). Two types of sampling have been used,

- *Judgement sampling:* the gives the freedom to the researcher to conduct the research and choose the respondents with respect to an individual, organization, events, etc. as per the need of the research (Sharma, 2017). In this case, the respondents have been identified by their expertise and experience and role in the circular economy and sustainability. Also, respondent recommendation was made by the supervisor to further enhance the study.
- *Referral Sampling:* initial interviewees/respondents refer/recommends and help identify new possible respondents (Sharma, 2017).

For a one-time occasion, semi-structured interviews suit the need and requirement of the research. Also, it works well when dealing with members of the elite community and bureaucrats ("Bernard, H. R. (2011).

The details of the interviewees/cases are mentioned below,

Interview Code	Name of the Company	Industry/Sector	Country	Academic Background of the interviewee
PL1	Treeni Sustainability Solutions	Sustainability Consuting	India	PhD in Environmental Science and Engineering
PL2	Cirucular Economy Portugal	Waste management	Portugal	MSc in Environmental Policy and Management
PL3	NaturaMaterials.pl	Hemp consulting	Poland	MSc in International Strategic Management
PL4	Encore Modular Furniture Pvt Ltd	Furniture manufacturing	India	MSc in Energy and Sustainable Building Design

Table 1: Interviewees details, 2018.

The communication of the discussions was in English and in one interview some dialect of the Hindi language is used.

All the interviews were conducted via a skype- the time, time zone, Skype details, duration were shared before the interview call, and each interview lasted for an approximate time of 45 minutes. All

of the calls were recorded with the permission from them, and all the audio notes are transcribed, all the recordings will be stored in the digital cloud along with the transcript(s).

One of the challenges was gaining access to the people who are willing to share their perspectives as a majority of the participants might not want to share and be quoted on the possible lobbying across the industries and hence the limited number of interviews.

1.3.3 Multiple Case study:

According to Yin (2006), the case study approach is a phenomenon which occurs in a bounded and specified context and this later becomes the unit of analysis. Case studies are conducted to gather the descriptive, exploratory or explanatory analyses of group, individuals, policy, event etc. Multiple sources of information are used to describe a theme. A case study is conducted when,

- the focus is to gather the "how" and "why"

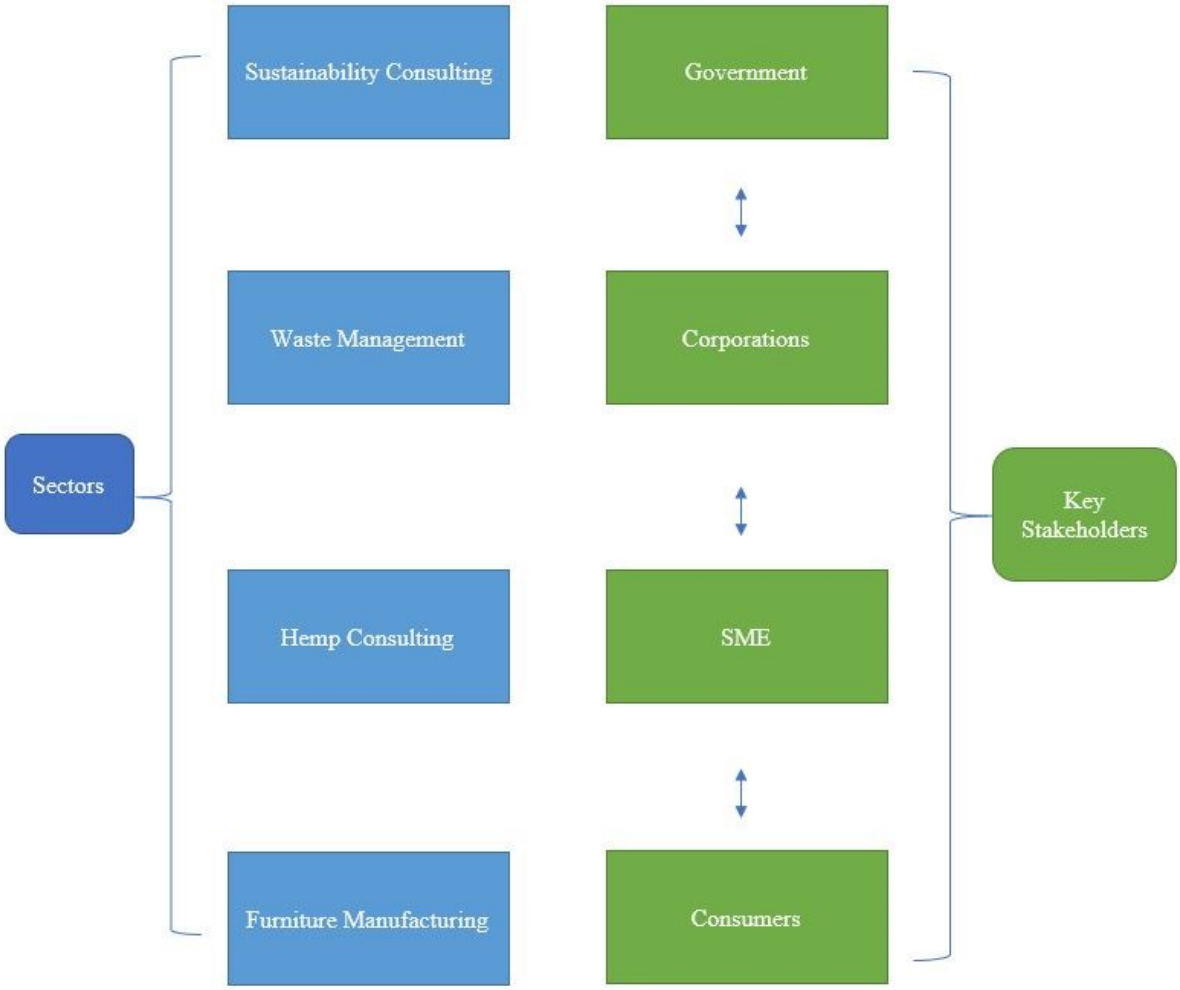
- the participants' behavior cannot be manipulated

Identification of complementary aspects of the context under analysis is done using multiple case studies, such a research methodology is used to confirm individual findings and to find common patterns across the phenomenon (Anderson et al., 2014).

It is evident from the literature that Circular Economy is considerably a nascent phenomenon which is currently applied on an experimental basis, there are firm theoretical conclusions concerning the positive impact circularity can create, whereas, there is a significant gap in its applications, i.e., theory to practice. However, there are some emerging institutions and organizations and SMEs who have already ventured into circularity, and due to the low current diffusion of the concept, no relevant conclusions can be drawn based on quantitative data. Also, since the nature of the research is more exploratory and narrative. However, it is essential to obtain the real-world perspectives and examples and experiences from the players in the industry, and this is achieved by conducting in-depth semi-structured interviews with the key stakeholders in a qualitative context (Yin, 2006).

An exploratory method is deployed during the research since it is essential to understand the "what" and "who" of the circularity and it is also essential to address the research hypothesis: "what are the barriers/enablers," etc. The cases will then be analyzed to determine the answers to the hypothesis as a starting point and possibly lead the opportunity for advancement of the current research.

To enhance the value of the study conducted, a comparative case study approach will be applied. Therefore, several manifestations of circularity will be observed across multiple industry verticals which involves the key stakeholders such as the government's, local communities, large corporations and SMEs. The analysis of various segments will be used to compile the similarities and differences in the approach towards the understanding, enablers, and barriers to circularity. The motive is to understand the common patterns and differentiating motivations. A matrix outlining the industries studied and the relation with the stakeholders is charted below,



1.1 Sectors studied and the influence of stakeholders amongst the sectors.

1.3.4 Relevance of the research:

By defining the concept gaps this research will contribute to a better understanding of the role that Circular Economy could play in addressing society's need for a more sustainable industrial model which invariably add to the growth of the economy. Furthermore, the exploration of key barriers and enablers will show which factors can negatively or positively influence the implementation of CE and shed light on the currently low diffusion of the concept. Both, defined gaps as well as key barriers and enablers, could be utilized for the establishment of a refined approach, enabling a more strategic implementation process and offering more guidance.

2.Circular Economy: Definition, Importance and implications:

The concept of Circular economy was initially introduced by Pearce and Turner (1990) and the concept relied on the principle that 'everything is an input to everything else'. The source of motivation to derive such a concept arises from the observation and understanding the relation between the first and second laws of thermodynamics and the traditional linear model of economy and hence a new concept was derived and was named as 'Circular economy' (Andersen, 2007).

The construction of the circular economy concept was inspired by the work of Kenneth Boulding and others which was already done a few decades earlier and they focused on discussing the importance of understanding the effect of overconsumption and its biosphere effects and increasing ecological deficit. Hence, the concept of 'closed system' was introduced by Boulding (1966) and the idea of such a concept was to enable the recycling of waste materials and reproduce the limited stock of inputs (Boulding, 2013). Circular economy today has been built on various schools of thoughts previously which have continually redefined, discovered the gaps and have tried to cover the gaps in the economic ecosystem. One such school of thought is Industrial Ecology and according to Garner and Keolein (1995), Industrial ecology encapsulates an holistic perspective to understand the relation between the economic activity and sustainability (Hond, 2000). Such a notion identifies the similarity between the natural ecosystem and man made industrial system both of which are identified by the flow of materials, information and energy (Korhonen, 2005).

Considering the present manmade industrial ecosystem, a transition towards sustainable industry ecosystem is crucial and it will require a shift in various factors which govern and function the ecosystem. Such factors include the change or transition in the structural and technological factors/agents with a combination of cultural and economic evolution so as to achieve optimization in the energy and materials (O'Rourke, Connelly, & Koshland, 1996). Several other researchers also mentioned the need and importance of the innovation factor as a key element in the process of manufacturing and in the process of product design and the key emphasis is on the effective redirection of the materials back into the production process which were previously considered as waste (Frosch & Gallopoulos, 1989). Enabling such processes and changes is possible with the synergistic collaboration between the key players, companies in the industry thereby involving exchange of resources (Stahel, 2016).

Over decades, there have been various terminologies and definitions which relate to circular economy but one of the most cited definitions which incorporate the definitions from various sources is the definition by Ellen MacArthur Foundation which describes C.E as "an industrial system that is

restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models'' (Ellen MacArthur Foundation, 2015). Drawing on the principles of industrial ecology, cradle to cradle principle, this interpretation distinguishes the materials into two types: biological material and technical material (Bakker, Wever, Teoh, & de Clercq, 2010). Materials of biological origin which has the potential to enter the biosphere again (biological materials) and materials which cannot biodegrade (technical materials). The objective of Circular Economy is to ensure the highest utility of both of these materials and this is attained with effective and careful product design and technological innovation (Ellen MacArthur Foundation, 2015).

2.1 Principles that govern Circular Economy:

Principle 1: Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows.

This principle enforces the dematerializing of the utility and that is achieved by delivering the utility virtually with the facilitation of technology. A circular system encourages the flow of nutrients by enhancing the natural capital and thereby creating a system of regeneration (Ellen MacArthur Foundation, 2015)

Principle 2: Optimize resource yields by circulating products, components, and materials at the highest utility at all times in both technical and biological cycles.

This principle enforces the circulation of the technical components and materials in the economy by the means of remanufacturing, refurbishing and recycling. And in such a system, the focus is more concentrated towards maintenance, rather than recycling and hence resulting in the preservation of a product's embedded energy and value. With extended product life cycle, the number of consecutive cycles are also maximized in the system and there by the product utilization is maximized by its sharing pattern (The Ellen MacArthur Foundation, 2012)

Principle 3: Foster system effectiveness by revealing and designing out negative externalities.

This principle focuses on the importance of "systems thinking" and redesigning the flow of the resources back into the system so that a product is either reutilized and the energy from a particular product is used to its optimum and it doesn't end up in a landfill.

2.2The current linear economic system and integration of Circular Business models:

2.2.1 Inefficient Supply chains and the integration of Circular Supply Chains:

"If the global population reaches 9.6 billion by 2050, the equivalent of almost three planets will be required to sustain current lifestyles" (UN, 2015). Over the next two decades, more people are expected to join the middle class and while it is good for consumption as more people who join the rising middle class, the more the consumption will be and hence this leads to increased production. But the primary issue is the way we currently extract, produce, use and dispose the products. And this can be evaluated by the 'material footprint' of an economy which refers to the amount of materials extracted to satisfy the consumption and these consumption can be in the form of basic needs such as food, shelter, clothing and various other basic necessities of human life.(United Nations, 2018)With respect to consumers, 29 percent of the global energy is consumed by households which invariably adds to 21 percent of the CO2 emissions (UN, 2015).

Since Industrial revolution, corporations and businesses have relied on the linear economic model which relies on extracting and getting cheap resources from the nature or from the ground. The challenge of this model is that the resources are finite. With the rising consumption pattern among people/population in various economies and with the decline in such resources which power the engine of production, numerous obstacles are being posed with every passing day and these challenges are primarily in the form of price risks and volatility among commodities which impact the entire production and the supply chain invariably impacting the consumption (Bouton et al., 2016).

It is estimated by Sustainable Europe Research Institute (SERI) that every year the production and manufacturing of products consumes materials which is estimated to be over 21 billion tons and these are the materials which unfortunately do not even enter the economic system i.e., these products are not physically incorporated into the production system of the products and these are in the form of

parting materials by-catch done via fishing or wood or harvesting losses from agriculture or unused/discarded materials from construction ("Data Visualisations – materialflows.net", 2018).

Moreover, the food industry gives a very specific overview about the losses along the entire supply chain where the loss of food is apparent along the entire process from food production to loss of food in the field due to pests and pathogens, due to spillage during transportation, losses during storage or due to the unavailability of required storage facilities like cold storage (specifically in the developing nations) and due to the product surpassing the expiry date and hence these food products simply go unused and these waste/spillage across the entire value chain constitutes to one-third of the food produced for consumption every year (FAO, 2011).

With such a scenario, it is essential to understand that circular economy or circularity does not only emphasize on "recycling". With the principles and the application of circular business models, the overall new material consumption can be reduced by 32% in about 15 years and 53% by 2050 (Esposito, Tse, & Soufani, 2018). The possibility that the primary or new materials can be replaced by recovered and repurposed materials is the kind of flexibility which is possible via enabling circularity across the entire value chain. And this is justified due to the nature of circular economy which encapsulates a disruptive and innovative model that coincides with disruption along the key stakeholders in the economy which includes the government, businesses and consumers and this is possible due to its regenerative prospect in the structure, design and objective. (Esposito et al., 2018).

One of the business model of circular economy is the "Circular Supply Chain" which works on the principle of supplying complete renewable, biodegradable, recyclable inputs for resource utilization for production and manufacturing of products. Such a system enables corporations to eliminate waste or utilize waste in an efficient way thereby reducing the negative externalities which is basically the waste generated across the supply chain or eliminates the usage of virgin materials at the primary stage of manufacturing and production and such a system is very crucial for businesses relying on scarce commodities or the ones which constitute to major environmental footprint (Lacy et al., 2014). The key aspect of such a model is collaboration across industries and providing the production services across the entire industrial network rather than functioning independently and thereby diversifying the processes in the industry across various key industrial leaders and SMEs to create a collaborative pool and aiming towards a win-win scenario. This is done via enabling an entire reverse logistics process so as to grow substantially in the industry without the need of unlimited resources. In circular supply chains, all the stakeholders play a crucial role i.e., from government to corporations

to consumers. To begin with, it is essential that the government lays out key policies which enables the retrace of materials within products in its entire lifecycle i.e., from production to consumption as this would enable businesses to utilize the materials responsibly and would also enforce the consumers to discard the products after their use appropriately. For example, CRAiLAR technologies eliminates the associated environmental risks by cultivating/producing renewable biomass resource and uses fibers like hemp, flax etc., and these fabrics are utilized in the apparel industry for the production of garments which are as durable as cotton (Ronchi, 2015). Generally, it takes about 2000 to 29000 liters of water for the production of a kilogram of cotton while CRAiLAR uses only 17 liters of water thereby saving as much as 99% of water consumption (Esposito et al., 2018).

2.2.2 End of Life waste and importance of Resource Recovery:

At the expense of environmental damage where the waste is discarded to landfill sites, the linear model hugely progressed and profited several industries like the manufacturing and creative industries, and raw materials suppliers (mining and oil industries) and these industries have somehow directly and indirectly influenced not just the supply chain but also the consumer behavior. It is nearly impossible to estimate the amount of commercial and municipality waste generated in the linear economy but it is certain that the quantity is bound to rise with the rise in the growth in the number of people around the world and factors like rising income along with migration to urban areas only add to additional consumption, thereby leading manufacturers to produce more which eventually ends up with consumers discarding the products – a typical linear behavior (Andrews, 2015)

By 2050, 70% of the global population will be urbanized and the fact is that residents in the urban area usually generate twice the waste in comparison to their rural counterparts. Presently, 1.3 billion tons of municipal solid waste is generated per year and by 2025, it is projected to increase to 2.2 billion tons per year (Hoornweg & Bhada, 2012). It is clear the end of life disposal has never been a sustainable practice, and this is evident with the increase in the concentration of CO2 in the atmosphere by 32% over the previous 250 years and the factors which contribute to such an increase are the usage of fossil fuels and land use changes. It is estimated that more than half of industrial CO2 emissions are linked with the primary materials processing which includes steel, timber, aluminum, glass, paper, concrete, etc. (Allwood, Kong, & Pole, 2012). It is essential to avoid the dissipation of technical materials and a clear differentiation between the biological and technical waste has to be established so that the technical materials do not end up as waste but instead are recovered, reused and recycled thereby significantly reducing the carbon emissions (Velenturf & Purnell, 2017).

The necessary developments are already taking place with the integration of technology such as 3D printing and IoT (Internet of Things) which is enabling corporations around the economy to responsibly produce products keeping in mind their design aspect thereby, resulting is efficient and smart product design and with the integration of sensors and via IoT, it is becoming possible to trace the product or more specifically trace the technical part of the product so that they can be recovered and reused or recycled appropriately (Esposito et al., 2018). Such a business model has the ability to leverage the strengths of new technologies and capabilities in order to recover the resource output which constitutes to the level of the initial investment. Such solutions range from integration of technologies via Cradle to Cradle process, where the product design is the primary focus and enables corporations to eliminate the material leakage and maximize the value of the product economically during and after its production. Such a process is valuable for corporations who mass produce and whose waste recovery can act as a key resource (Lacy et al., 2014).

2.2.3 Mounting pressure on resources and Product Life extension:

For businesses which are capital intensive, and which typically function in the business to business segment (industrial equipment manufacturers) for business to consumers platforms which primarily work on adding updates to their previous products, Product Life Extension is very crucial as it has the ability to capitalize on the economic value thereby negating the need of additional external resources and materials. Hence, with this model, resource efficiency can be attained much more faster and effectively (Guldmann, 2016). Value creation in Product Life Extension is created via 'power of the inner circle', which basically emphasizes on keeping the product alive in the economic system for as long as possible. This is also referred to the loop of maintenance and relies on convenient periodic updates on products thereby negating the need for continuous repair. In this process, the products are also refurbished where the product(s) are given a makeover in terms of its functional aspects to prolong its longevity (Lacy et al., 2014). This is presently applied in corporations which function in the recommerce area - for example, instead of just discarding a personal computer, it can be refurbished with refurbished components so as to keep it functioning and can be resold at a lesser price in comparison to a new personal computer and this ensures the longevity of the product instead of being a part of the pile on the landfill. Such a process also substantially reduces the utilization of virgin materials during the production process. The barrier lies with the mass adoption among consumers as typically consumers are more aligned towards procuring or purchasing brand new products and this stagnates and shrinks the recommerce area and this has an indirect effect on the manufacturers as they follow the demand from the market and while the trend of 'new products' in

the market is high, the producers opt for producing new products currently following a linear system of production. A possible transformation could be possible when the manufacturers and producers begin utilizing refurbished materials or reuse the components from previous products in creating a new product. The issue lies with the limited network of suppliers who supply refurbished materials and the ones who do currently most possibly have a price range which is in comparison to procuring the virgin material thereby enabling a manufacturer to produce a product with a virgin material source. And hence, mass adoption is one of the possibilities which has the potential to bring about disruption in the entire value chain.

Sharing Platform: One of the key issue faced by the manufacturers was their affinity against using refurbished products/materials in creation of new products as the price of procuring the refurbished source/material is almost like the virgin material. And the other challenge was in the mass adoption amongst the consumers. But this is not true across all the sectors in the economy. With the integration of technology on the sharing platform, industries like real estate, hospitality, transport are already being disrupted. Such platforms enable the collaboration between individuals and product users to share and utilize common resources and thereby extend the longevity and usability of the product via services. Such platform bridges the gap between underutilization and overcapacity and the result of which is reflected in increased productivity (Guldmann, 2016).

2.2.4 Product as a Service (PaaS):

An alternative approach to traditional business models is the PaaS model where the consumer is the prime focus of attention as this model offers immense customizability from a consumer perspective and it provides various options to a consumer as per the need to utilize a certain product. This model strongly challenges and almost eliminates the traditional 'buy and own' model as the PaaS model follows the approach of sharing and increasing the productivity and usability. In such a system, various formats are available for a consumer as per the need and requirement,

- Pay for use: customers/consumers pay only for the usage and the key criteria here is the time and such a model are obvious in car rental services where a consumer pays for the time or the number of kms driven.
- Leasing: this system enables a consumer to lease a certain product over a prolonged period and thereby eliminating the associated service and maintenance costs with the product.

- Performance agreement: corporations guarantee a certain standard of performance efficiency and the consumer pays for the quality of efficiency. And in case of wear and tear of the product, it's the corporation who is liable for the associated costs of repair/maintenance, etc. (Esposito et al., 2018).

2.3 Impact of Circular Economy:

2.3.1 Economic Opportunity:

A productive and complete utilization of inputs will lower the overall production cost and substantially result in the increase of the revenues from the circular activities. Such changes in the input and output production systems will be reflected in the wide supply/demand, prices and their volatility and these changes will emerge through various sectors of the economy which will result in indirect effects which eventually lead to an overall economic growth. Such changes will also be reflected in the consumer spending and household income which inversely result towards a better remuneration to labor. Such effects will only add a positive change to the GDP. "On a circular economy development path, European GDP could increase as much as 11% by 2030 and 27% by 2050, compared with 4% and 15% in the current development scenario."(The Ellen MacArthur Foundation, 2012).Similar result is possible in the emerging economies like India and can expect a similar "impact from the reduced annual cash-out costs of US$ 218 billion, 11% of India's GDP."(Ellen MacArthur Foundation, 2016)

2.3.2 Environmental and system wide Opportunities:

Emissions: A circular approach would substantially reduce the GHG emissions compared to the current linear approach. Such an approach will eventually lead to the reduction of usage of virgin materials, application of efficient construction mechanisms etc. For Europe, a 48% reduction of carbon dioxide emissions by 2030 or 83% by 2050 can be attained across construction environment, mobility and food systems. (The Ellen MacArthur Foundation, 2012). For emerging economies such an India, reduction of 23% by 2030 and 40% by 2050 is possible which would create a substantial impact considering its population size. (Ellen MacArthur Foundation, 2016).

Primary Material Consumption: A reduction of 32% by 2030 and 53% by 2050 in Europe and 25% by 2030 and 38% in 2050 in emerging economies like India is possible with Circularity. The negative environmental externalities are due to the heavy production using non-renewable materials primarily

coal and oil. These negative externalities are primarily observed in the mobility sector and the construction sector.

(The Ellen MacArthur Foundation, 2012) (Ellen MacArthur Foundation, 2016).

Increased land productivity and soil health: This would work on the principle of regeneration and has the potential to increase the productivity of the land. And such a productivity inversely implies that the waste in the food value chain is reduced. Overall, this would increase the regenerative potential of the land and the soil. Degradation of land approximately costs roughly USD 40 billion worldwide annually and this does not consider the utilization of fertilizers or the loss of biodiversity. With a circular approach, the usage of fertilizers may fall by 80% by 2050 in Europe and 49% by 2050 in emerging economies. (The Ellen MacArthur Foundation, 2012) (Ellen MacArthur Foundation, 2016).

Reduction in negative externalities: Reduction of water will be evident across various sectors specifically in the construction sector as that is one sector which utilizes enormous quantity of water to produce virgin materials. Circularity would reduce the water consumption significantly.

2.3.3 Benefits for Corporations:

Profit Opportunities: The common notion of Circularity is associated mainly with recycling according to the general population and it is crucial to identify its broad range of applications and its ability in creating new business models. The refurbishment and reselling of a mobile phone can possibly unveil 40% of its value compared to only reclaiming its raw materials which accounts to only 0.1%.

Various IT services companies around Europe are willing to heat corporate spaces and offices for free. And this is attained by installing their servers in the corporate office space and the cost of the electricity is taken care of by the IT service company so this enables a corporate space to receive heat for free and the IT services are able to reduce their cost of cooling the servers significantly as the corporate space has air conditioners which keep the servers at an optimal temperature.

These instances show how businesses are moving towards a service-based models and systems as such business models also foster a long-term relationship between the vendors/clients etc.

The process of reuse, remanufacturing and recycling becomes a critical part of the business process as the businesses maintain the ownership of their asset(s) and such ownership enables them to obtain

a commercial intensive which in turn maximizes the use of their asset(s). ("Businesses can turn a profit from the circular economy", 2018)

Reduced Volatility: A shift towards circularity clearly implies the reduction in the usage of virgin materials and would substantially enable more recycled inputs, such process(s) will eventually add a benefit to the company's cost optimization process and it will also reduce the risk of dependency on raw/virgin materials. Such a trend would eventually be reflected in various economic systems across the geography as the companies will not be affected by natural disasters or global/geopolitical imbalances.

Improved Customer Loyalty: The inclination towards service-based business models not only brings efficiency in the company's cost process(s) but also retains its customers for an extended period of time. For instance, Philips concept of 'lighting as a service' is a service where the company pays for the installation of its lightning systems and also provides the support cost of its lightning and the revenue is generated over the lifetime of the performance-based maintenance contract. ("Businesses can turn a profit from the circular economy", 2018)

2.3.4 Opportunity for Citizens/Consumers:

The possibility to meet the custom requirements becomes much more accessible for a consumer without the worry of paying an additional fee or paying more. Built-to-last products and reusable products will improve budgets and quality of life by bringing down the ownerships costs to the consumer and a significantly higher convenience can be attained as the hassles of repairs and returns will be avoided. The average disposable income for EU households would increase by €3,000, or 11% higher than the current development path by 2030. (The Ellen MacArthur Foundation, 2012)

3. Theoretical framework: Theory of Absorptive capacity in an Open Innovation Model:

The Open Innovation Model was initially proposed by Henry Chesbrough and in the past 10 years, this model of innovation has been able to emerge as alternative model. This model emphasizes on the assumption of integration of external ideas alongside internal ideas coinciding with external and internal market paths as firms and businesses aim for advancement and growth.

Such a model of open innovation typically challenges and opposes the vertically integrated and traditional model which relies on the fact that R&D, internal research efforts lead to development and commercialization of the products. The key assumptions of the firms operating in the open innovation system are in relation with the following factors,

a. Presence of smart and sharp people outside the firm and the need to exploit and utilize external knowledge sources.

b. Such external sources can add value to the firm

c. Research from the external source can be profitable for the firm even without it not originating internally.

d. Influence and focus towards a stronger business model rather than focusing on capturing the first mover advantage.

e. External and Internal ideas are essential to compete and win, and

f. A focus towards benefiting from the IP of other firms wherever and whenever necessary.

R&D in an open innovation system is considered as an "open system" where the ideas are facilitated and integrated from both inside and outside of the organization and such ideas can follow the market path in a similar fashion. Hence, the external paths and ideas are at an equal consideration compared to the internal ideas and paths. Such a process facilitates the interaction and engagement between various external firms which eventually results in greater idea/technology use and acquisition hence resulting in faster innovations. Compared to closed innovation systems (M & Sharan Kaur, 2015).

Such an innovation system is framed in three innovation dimensions: inbound, outbound and coupled outbound open innovation (Dabic, Dabic, Basic, & Vlajcic, 2017). Inbound innovation involves

crucial external factors like a) involvement of the customer, b) external networking and participation, c) outsourcing of R&D, d) crowdsourcing and open system intermediary (Dabic et al., 2017). Consequently, Outbound innovation system key sources which arises internally like, a) involvement of the employee, b) licensing of Intellectual property rights, c) Joint ventures, d) sales of market-ready products, e) spinoffs and donations to commons. (Dabic et al., 2017). Engagements which involve factors like agreements and contracts for co-developments, investor, designer contracts, licensing of patents, cross-licensing engagements and alliances of marketing constitute coupled innovation system (Dabic et al., 2017).

3.1 Influence of Absorptive capacity in open innovation systems:

According to Cohen and Levinthal, 1990 Absorptive capacity is defined as "a firm's ability to identify, assimilate, transform, and apply valuable external knowledge." (Nino, 2001)

In a globalized economy where the competition amongst firms and companies are intense, innovations play a crucial role to upgrade the firms' performance and maintain and strengthen their competitive position in the industry (Quinn, 2000). Various firms, organizations and companies invest their attention towards decision making capabilities, development of structures for the team, cross-functional interaction which acts an enabler element for efficient and productive innovations internally. But in the present globalized scenario only internal innovation capabilities are not sufficient to conquer and gain the competitive advantage. Hence, a trend which facilitates the partnerships, communication and collaboration between the organizations throughout the networks of the industry has emerged thereby opening up to the innovation processes externally. (Anatoliivna, 2013).

Such an absorptive capability not only enables the value and integration of the external knowledge but also facilitates the accuracy of the prediction of the future technological developments and hence guides the path to sustainability. A variation of the subset of absorptive capacity exists. Namely, potential and realized absorptive capacities. (Capacity, n.d.). Potential capacity does not ensure the commercialization of the product, but its primary objective is the assimilation and acquisition of external knowledge. It enhances the strategic flexibility and the freedom required to adapt to the changing market environment (Anatoliivna, 2013). Whereas, realized absorptive capacity objective is to exploit and imply the external knowledge.

4. Analysis of the Research:

The research questionnaire(s) were designed with the reference from the Literature Review, and the interviews were conducted in an unstructured/ semi-structured format, to enable the natural flow of the interviewee. A total of 5 interviews were conducted, and the participants ranged from their experience, industries yet they all function towards Circular Economy.

The aim of this research study was primarily to understand the current enablers and barriers to Circular Economy, and moreover, it was essential to understand the attitude of the critical stakeholders which includes mostly the large corporations, startups, SMEs and the general population. Along with which, it was also interesting to get an understanding of the awareness level within the society and corporations, people and the government. It is evident from the literature review that the key stakeholders are aware, although there hasn't been a rapid transformation yet and hence it is essential to understand the factors for the gap between theory and practice.

Cases: A total of 4 case studies were conducted from industries in multiple sectors and geographies.

Case 1: Treeni Sustainability Solutions which is a circular based consulting organization based in India and provides corporations (in the automotive sector) circular consulting services in terms of reverse supply chain, refurbishment and building sustainable value chains. This case gives the current gaps in the linear system and how covering those minor gaps could lead the direction to circularity.

Case 2: Circular Economy Portugal is a society focused organization and its primary goal is to involve communities via projects to educate them on the implementation of circularity so as to have a society without waste. This case is essential to understand how communities are creating an impact and how these impacts are affecting the mind-set of larger organizations.

Case 3: NaturalMaterials.pl is a polish start-up specializing in hemp products and follows the permaculture principle which is a subset of Circular Economy. And this case describes the importance of redesigning the products which are biodegradable.

Case 4: Encore Modular Furniture Pvt Ltd. is a modular furniture manufacturer based in India and has traditional practices of circularity in terms of recycling of waste. And this case describes how circularity can fit within the manufacturing ecosystem.

Each case follows a similar structure in terms of their current level of understanding of circularity, current strategy and future strategic initiatives towards circularity, barriers and enablers.

RQ1: In an economy, where the resources are limited, why are the companies not aware of CE and if they are aware, what stops them from implementing the process

- Current Understanding and awareness?
- What are the current strategies or strategic initiatives?

Current Understanding of Circular Economy:

Treeni sustainability Solutions has clearly distinguished between Strategy and Solutions and based on this framework they apply the circular strategies by measuring the resource and the resource utilization and the measurement is one of the key processes as most of the companies who function in the manufacturing sector in India (automotive primarily) do not necessarily use measurement as an essential tool for efficient resource utilization. Overall, for Treeni Sustainability Solutions, the primary goal is to minimize the externalities.

the principles of the circular economy, if they have to be applied within organizations, they have to embrace, minimizing their externalities. [Interview PL1]

And further about the understanding Circular Economy is in the aspect where, enterprises have to explore how they can modify and monetize their business models and thereby reducing the impact and the negative externalities and functioning more efficiently.

circular economy is a way or a means for enterprises to see how they can modify and monetize their business models and the uh, uh, thereby reducing the impact and the negative externalities. [Interview PL1]

Treeni sustainability solutions emphasize on the importance of open innovation model and primarily function on the principle of open innovation where they act as the external knowledge source and

consult large multinationals in order to help organizations minimize their externalities and strategize their business models.

While Treeni Sustainability solutions has oriented themselves towards a corporate identity, Circular Economy Portugal (CEP) has oriented themselves towards creating a circular community by raising awareness amongst citizens and communities and thereby collaborating with the governments for efficient waste management. The mission of CEP is to accelerate the transition towards circular economy and this is done by creating social impacts on a local level rather than targeting large corporations. The understanding is aligned towards moving beyond resource-efficiency and working towards enforcing policy framework, visionary entrepreneurship and social innovation.

The importance of virtuous cycle is emphasized where the energy and material resources are returned to the bio-socio-economic system. A potential absorptive capacity is observed here where the ideas and innovative approaches are exploited thereby setting examples for other communities to follow and in such a scenario, commercialization may or may not be possible until the practice reaches a certain mass of population and as the adoption of this mass of population will enable a faster transition towards circularity.

Naturalmaterials has transitioned itself into a product research entity and creates new products based out of hemp for other companies based on their need/requirement, and these other companies function in the manufacturing of guitar straps, hemp crate and everyday materials used to for construction and his products created out of hemp add as an external source in creating a modern yet sustainable product. The paradigm of 'open system' is applied here thereby creating synergies between internal and external stakeholders and hence facilitating the research and development. While other respondents spoke about their experiences in the area of circularity, Naturalmaterials seemed to be more aligned towards researching intensively on the products and the materials that have been sourced to build the product and thereby defining their inefficiency as per the environment and with this, they are creating plant based product only and creating a parallel product to everyday products and then collaborating with other organizations to commercialize. This shows a minimalistic usage of various open innovation system(s), from inbound to outbound to coupled innovation system and NaturalMaterials is using the concept of open innovation system as their framework and transitioning accordingly. Also, mentioned during the interview was the fact that, using such open innovation system has its pros and cons because as a small company they have the leverage to experiment and the stakes are low but the key issue arises due to the commercial aspect as the industry is not yet

completely ready to embrace hemp made products due to their pricing aspect and also due to the availability of low cost virgin resources.

“The goal of my company is to make sustainable products out of hemp, so to take everyday products and create a hemp or plant-based version” [Interview PL3]

With the goal, it is evident about the clarity of understanding and exploring ways to implement the methodology. Although, it was interesting to know that the founder was not much aware of the term ‘Circular Economy’ instead followed the principles of the Permaculture which is a subset of circularity. Permaculture is permanent agriculture and with the vertical of the industry that Naturalmaterials functions in, permaculture fits the scenario perfectly.

The design team lead of Encore Modular Furniture Pvt Ltd has an education in Energy and sustainability, the understanding of circular economy was very clear and believes that the entire process is crucial i.e., from the procurement of the raw materials until the product reaches its end life and at the end life, it is essential to give it new life by implementing circular techniques and principles.

In circularity, we make sure that at the end of that life we give it a new light to recycling, reuse or any other form so that the end product is reused, and the cycle goes on. [Interview PL4]

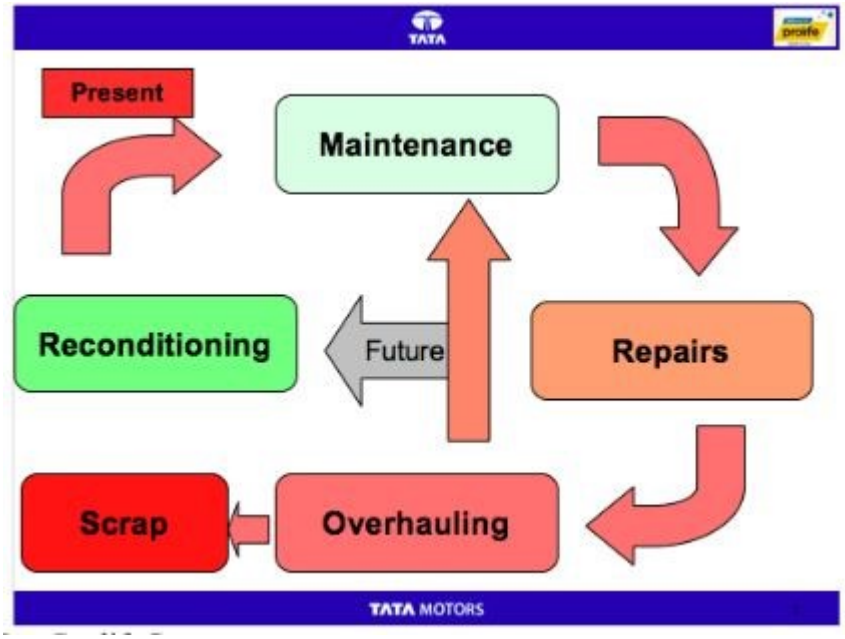
Strategic Initiatives:

As a consulting company focused towards sustainability and circularity, a key concern was raised by Treeni Sustainability Solutions towards the linear system of production and manufacturing, linear supply chain which is followed by large corporations and their non-alignment towards the transition to Circular Economy. And the key gaps mentioned were the ignorance towards achieving resource efficiency or achieving mass balance so as to reduce the negative externalities. As per the respondent, currently industries rely heavily on the cheap resource without realizing or without taking any necessary action step to safeguard the procurement of future resources.

On the contrary, there are some corporations and industrialist, particularly who are experimenting with the possible transition(s). one of the example mentioned was about an initiative by Tata Motors, a USD $42 billion organization ("Generate", 2018) , a leading automobile manufacturer began with

an initiative called “Tata Prolife” with an aim of developing after-market product support strategy, where a tata customer is provided with a refurbished aggregate of an engine part in exchange for an old aggregate. The current product portfolio of Tata Prolife consists of reconditioned engine long block, gearbox, power steering, turbo charger, air compressor. And the next strategy is to venture towards electrical components and starter motor to increase the product portfolio.

Tata Prolife Process

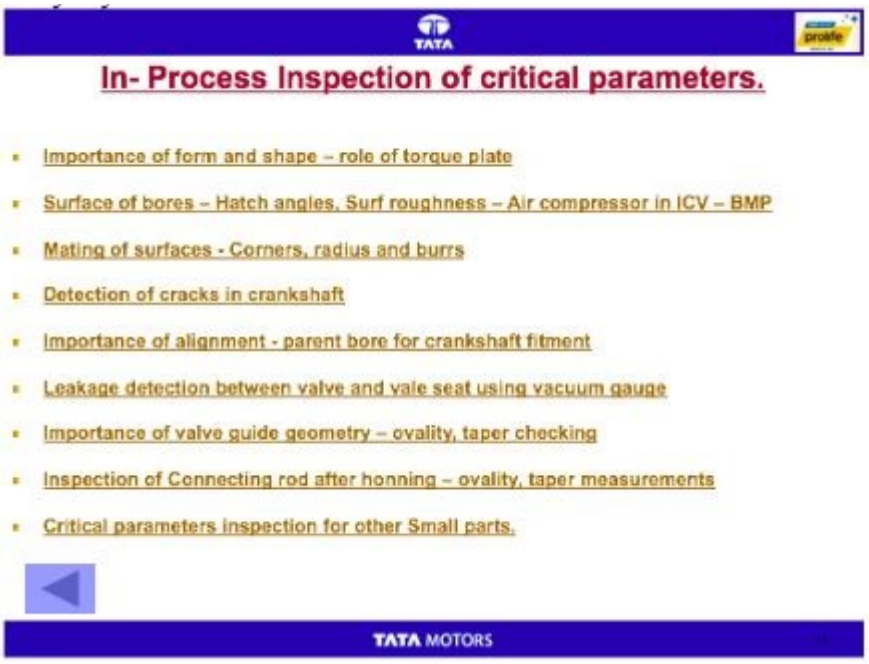


Source:http://www.customercare-cv.tatamotors.com/services/prolife-business.aspx

Such a refurbishment strategy is not only gaining traction across the industry but is also keeping its competitors at a close watch. One of the competitors being Mahindra & Mahindra, yet another automobile manufacturer is also exploring efficient methods to follow a similar process of refurbishment.

Customer acceptance could be a critical issue when the products and parts of engines are refurbished. And Tata Prolife tackles this by employing a “In-process Inspection of critical parameters and also offers an extended warranty to attract potential customers and the customer feedback helps them maintain the quality of their work which in turn results in customer loyalty.

Inspection Parameters



Source: http://www.customercare-cv.tatamotors.com/services/prolife-business.aspx

In the case of Tata Prolife, the gap between linearity and circularity is reduced by utilizing the waste and follow the take back system and such take back systems and reintroducing the product back into the ecosystem is reaping enormous benefits in terms of lower operational costs and customer loyalty.

Another example which was shared from their experience was about a multinational corporation specializing in floor and wall covering – Tarkett.

With an initiative called “Restart Tarkett” – the attitude shift is more focused towards, “not end of life of a product but end of use”. Through the Restart program, an entire reverse logistics system was implemented which gave its customers an option to return back the flooring and install a brand new eco designed flooring.

This process includes collection of the old flooring and installing the new ones. And the 2 key factors which boost such an initiative are:

- Cost effective local take back logistics
- Eco-design flooring systems for easy installation and removal.

Such an eco-design flooring system enables easy removal of the flooring and the used materials are easy to sort and recycle.

Source: https://www.tarkett.com/en/content/restart

With these, some of the key concerns were also raised regarding,

i. Quality issues.

ii. Quality standards.

And these two criteria are the key for both the consumer and the remanufacturer and the measures for the same is communicated by the manufacturer in this case (TARKETT).

Such a take-back system of reverse logistics has reaped tremendous benefits concerning financial gains, customer loyalty, etc.

It is about how you deliver your product and how you take it back. So how do you work with your partners and then what do the partners need to do. So, it's about defining the roles and responsibilities of each of these stakeholders [Interview PL1]

While Treeni Sustainability Solutions is focused towards corporations, CEP's approach is to educate the communities via practice of effective waste management. CEP believes in knowledge sharing, and they contribute to the society and educate the audience by giving presentations and talking about it in seminars and conference, but such workshops and conferences have a curated network of audience and to engage the local communities, CEP implements community projects which actively involves people from the local community and a pattern of practice and knowledge

sharing platform is established.

To reach the mainstream audience, to make the concept understandable and also that is relates to, let's say, ordinary consumers and citizens, we have a number of projects that are related to the concept. [Interview PL2]

Although Circular Economy being a broad concept and is very Industry specific, CEP does not align itself with only a particular service and associates itself with multiple sectors like food, construction, textile, etc.

We decided not to focus on a specific sector, but we have quite a broad scope, although some sectors particularly have interest. [Interview PL2]

Project Composting: This is one of the projects initiated by CEP in Lisbon, Portugal which involved societal stakeholders like the community itself and the local municipality. It not only educated the people about the importance of composting, but such a process also made the society and the municipality change their perspective towards composting. As traditionally, composting is not considered very much innovative and there is an unexpected behavior towards it. This aim of this project was to enable the collaboration, and that collaboration changed the perspectives of the stakeholders involved. Out of the entire waste generated by not just households but also companies, at least 41% is organic, which is most often not composed and ends up in the landfill. Also, what is missing is that most municipalities and most areas in Portugal do not have the right waste management

systems and several factors lead to this, some of them being, no appropriate infrastructure (collection bins, pickup trucks, etc.), discrepancies in legislation and inspection.

Hence, the aim of this composting project by CEP is to enable the grass root level, i.e., collaborating with communities and since composting is not a complicated process, t requires some basic knowledge, and some practical skills and its implementation is also quick.

One of the composting projects was initiated in a small scale to drive the change in the community garden(s) in the Almada district of Lisbon, Portugal and this project was a success due to the collaborative efforts of the communities and the local municipality. After this project, the similar project has been initiated on a larger scale in the Campolide area of Portugal.

Also, it is interesting to know that E.U has regulations in terms of recycling or composting the organic waste and hence the municipalities are obliged to at least compost 30% of the organic waste in order to comply with the regulations set by the E.U but the issue lies in the non-availability of the critical resources, and this can be in terms of the processing plants, since the value generated from the composting is low unless it is done at a large scale. And for this to happen, the end companies have to invest in the installation of anaerobic digestion plants to produce compost and hence, CEP is currently offering community composting as a complementary tool to industrial composting to enable the participation of all the stakeholders involved.

Because the problems with composting is also, that is a very low value product so it's hard to make a business out of it. So, what we do now is simply providing our service to municipality to implement community composting as a complement tool to Industrial composting. [Interview PL2]

While the first case focused on the importance of collaboration between the industry so as to refurbish the materials, the strategy of naturalmaterials follows a different dimension as they are not worried about resourcing the product back, and all that matters to them as mentioned by the founder of naturalmaterials was that their aim is to create products made out of hemp or plant based products which after their usage cycle even if not resourced back, they will have the ability to biodegrade and become a part of nature. And this strategy has transitioned from a previous strategy which was more aligned towards creating a brand and now it is more focused towards consulting other organizations and create a plant-based product for the other organizations.

By making something biodegradable, I am allowing the planet to take it back and so it can be reused on an atomic level somewhere, somehow, whether this becomes food for bacteria, which would become food for a new plant, food for animals, which could become food for me, the idea is to always return the surplus. [Interview PL3]

On the contrary, the design lead of Encore furniture mentioned about the difficulties in changing the strategies in a traditional family owned business but fortunately, Encore Furniture as an organization has been following some aspects of responsible and waste reduction. The design lead explained the process, Circularity as a practice has been implemented since the inception of the furniture's manufacturing unit. This is evident from the sourcing of raw materials. For example, particle board is one of the key material(s) in modular furniture and this particle board is the byproduct of saw dust and this process is currently being practiced at the manufacturing unit.

After the manufacturing, the leftovers or the waste which is typically wood based is all sold for recycling. Such application(s) indeed show the awareness about the concept. The current strategy is the strategy which has been in practice since a long time. And the present progress is directed towards enabling circular service systems. There is circular process internally in terms of manufacturing, but it is also essential to adapt with the changing times and embrace new service systems which are an essential part of circularity.

There are also instances where products have incorrect designs. In such cases, the product is dismantled according to the needs so as to fit with other products else it is sold at a lower price.

RQ2: WHAT ARE THE KEY BARRIERS?

Huge Disposal:

As per the representative from Encore Modular Furniture, with the current and constant change in the trend and since the business line is directed towards modular furniture, it is important to track the end of life of the product i.e., the supply chain, a product follows after its use by the consumer. Commonly, the product is discarded and lands up at the landfill and this needs a shift as the discarded produced can essentially be upcycled and recycled. Typically, in case of broken furniture, there is no appropriate awareness of possible disposal techniques, this broken furniture can be used to refurbish

into a new product and then be sold but the gap here is that the broken furniture doesn't reach the manufacturer and there is no other option apart from continuous manufacturing. Once the product life is over, it's very important for us to segregate the different parts of the product.

For example, what we do is, we segregate the organic and inorganic waste. Then what happens? It goes to the landfill. So, I think this kind of concept is very, very important. So, it's not just from the customer point of view. I think the companies that manufacture that product should also help the customers to figure out what to do. [Interview PL4]

On the contrary, the consulting agency stresses upon the outlook of waste and mentions that It is necessary that people, organizations and every stakeholder involved has to change the outlook towards waste. It is crucial to change the outlook towards waste, and this can be done when it is realized that there is value in the waste that is generated. It is also, essential to understand and realize the difference in the materials which is usually biological material and technical material, and once this differentiation is clear, the negative impacts will reduce substantially.

Another significant hurdle as per the founder of Naturalmaterials.pl is the absence of standardization of plastics as there are many products on any table for example which are comprised of plastic but none of them can be recycled, and along with this, large corporations in various verticals like FMCG, for example, do not analyses the materials effectively to create their products. And due to the current model of generating as much as possible and in a world where a significant portion of the products are made from plastic, one of the most significant costs that businesses face today is the cost of sorting.

<u>Monopoly and ignorance and resistance:</u>

As per the interviewees, regulations itself act as a barrier as there are currently no subsidies or any option to support the process of circularity and while some governments have become active in the

participation of circular economy, there are multiple companies whose names weren't mentioned to avoid controversy but they mainly function in the FMCG and retail industry and the organizations in these verticals opposed and lobbied against the new government policies concerning effective design and waste management and thereby the government had to postpone the implications of such policies and certainly bureaucracy also played a certain role in terms of influencing certain agents who represent the stakeholders like the organization itself or the government.

Moreover, as per the founder of CEP, funding is a huge issue and unlike the big corporations who can devote a part of their revenues into R&D, there are many SMEs who are still trying to survive to make enough money in the present day, and in Portugal, 90% of the companies are SMEs and there is unavailability of funding and other resources which can enable the transition. Some of the most significant sectors like the construction sector, for example, are seriously lagging concerning circularity as they don't even segregate their waste or recycle, let alone, implementing ways of constructing circularly.

While the initial cases mention about the possible monopoly in the industry, there is a different story with Encore Furniture Since it is a traditional family owned business, there is a huge possibility that the internal main management might be resistant to the business adoption. And this is the challenge currently being faced by the design lead of Encore Furniture as there is an opportunity to implement and enable the reverse supply chain or by implementing circular business models such as 'sharing platform' or a 'service-based model' but there is a resistance against experimenting. Also, there is a traditional approach towards the business and hence the resistance to adapt and most of the senior management is concerned with the risks associated with the transition and these risks are blindsiding the opportunities. Moreover, the senior management was concerned to be considered as a first mover and were more aligned towards companies and production units who have already implied techniques of circularity.

Unawareness:

The founder of Naturalmaterials.pl emphasizes the unawareness of the importance of sub segments within the industry and this is not concerned about the penetration of circular economy, it is more concerned towards unawareness of effective utilization, the waste product of hemp is a lignin heavy, woody interior waste which can be further used to create various hemp products like hempcrete. In parts of India and Ukraine for example, where hemp is grown, farmers are unaware of what to do with it and are entirely unaware of the additional properties of hemp and the farmers usually burn this waste, although burning the field has its benefits, but it is necessary not to burn the entire waste and utilize it for commercial purposes.

I believe that hemp is so important that all its byproducts should be used in a sensible, scientific way. Not just set on fire. [Interview PL4]

Alongside, the representative from CEP also mentions her frustration about the huge gap of communication between all the stakeholders and refers them as a multitude of corporations and consumers and the legislation. There is a lack of communication between these stakeholders and the delay of communication on the state of the problems with the regulatory framework and this is reflected in the consumer behavior.

And as a manufacturer, the manufacturer feels it is important not just to sell the product but also to communicate to the end consumer about the possible supply chain to either upcycle or recycle the product instead of dumping it in the landfill. Currently, there is no system of communication to the customer educating them about the various ways to dispose the product responsibly. Although, this can be enabled with EPR (Extended Producer Responsibility) which is the next strategy that the manufacturer is planning to apply.

According to Treeni Sustainability Solutions, there is a 'blame game' across all the stakeholders and such blame game leads to resistance to change and transition.

Business will always put it on the community, and the community will always put it on the business, and therefore the adoption of both these models will not happen. [Interview PL1]

Regulations:

According to CEP, the essential industrial sectors like construction are not even recycling their waste, it is important to notice and observe the underlying attitude towards such behavior. And one of the key reason is the ineffectiveness of the legislative system and the regulation. In spite of regulations being present, the gap lies in the fact that there are almost no inspection and monitoring sites and thus, in the end, the industry has adopted an attitude of generating as much as possible, and all these factors have been prevalent over the past decades, and hence these factors also influence the consumer behavior and thus the current consumer is conservative.

There's not enough inspection and monitoring sites, sort of, in the end, the market, thus what it wants simply is to generate as much as possible. This is also an immense mentality, yet the social sector is very conservative. [Interview PL 2]

Specifically, in the manufacturing sector, there are various regulations to maintain the standard. There are associations like BIFMA (Business and Institutional Furniture Manufacturers Association) which ensure a clean and green production of furniture and there are also FSC (Forest Stewardship Council) products to comply with the green standards.

The gap here is a multifaceted gap from the manufacturers and the government. Manufacturers do not really comfy with the standards and are following the traditional approach towards manufacturing and are resistant to changing trends and this is also since government has done a partial job by implementing the regulations and standards in place but there are no regular and routine monitoring of the compliance of these regulations and standards.

RQ3: WHAT ARE THE ENABLERS?

Leadership:

According to Treeni Sustainability Solutions, the awareness is already available amongst the various verticals in the industry, the interviewee believes that now it is essential to elevate the process of transition and business leaders have to drive this transition and lot leave it to a particular department, typically sustainability managers. It is believed that such a vast development needs a long-term vision which is usually pioneered by the business leaders and since they have the authority of implementation, the enablement can be faster. Currently, many production facilities have an EHS (Environmental Health and Safety) manager, but yet the issue arises with the production facilities who don't even have the management of EHS as they don't also have a waste inventory and hence end up losing material which is usually valuable. But with initiatives like ReStart by Tarkett and Prolife by Tata Motors, these initiatives justify the possibilities of implementation of circular business processes and attain resource efficiency thereby showcasing a minimalistic application of absorptive capacity and its ability to identify the issues or glitches with their current process and exercise their leadership potential as being part of the elite corporation so as to set an example for other corporations in the industry.

CEP mentions that some of the large corporations are already preparing for the future considering the mounting pressure on the resources. One of the examples mentioned was about Amorim which is the largest cork manufacturer in Portugal and are currently concerned about the securing supply of revenue in the future and hence are investing actively in R&D to make sure that they are not surprised by future disturbances in the supply chain. And are exploring methods of improved production and looking for alternatives, etc.

A strong vision and leadership is the need of the hour, the large corporations currently possess the power and the resources to lead the way and specifically in an industry like hemp, strong leadership has to potential to revolutionize the way businesses work today.

Legislation & Standardization:

For manufacturers the need of the hour is responsible manufacturing and according to the manufacturer this can be possible by understanding and evaluating the need for better management of the resources and to enable the activation of all the stakeholders which is possible with post

occupancy evaluation of the product as this will help a manufacturer to design better product(s), get constant feedback from the consumer which will also make the consumer aware as the manufacturer leads the path to establish a better, long lasting and a loyal relationship with the consumer. And such a technique also facilitates a better communication channel among the stakeholders and this communication can then be used to educate the consumer of how to dispose the product or how to reintroduce the product back into the supply chain.

The current system works in a way where there is no subsidies and tax relief for implementing circularity or enabling reverse logistics but with changing times, the government is realizing the need for sustainability and is certainly offering subsidies if a manufacturing process uses sustainable methods of production. With that, in India, the government has made the installation of solar panels mandatory and in many parts of India, the regulations have enabled individual households to move towards rain water harvesting, so these small initiatives are already creating a certain impact, the need of the hour is the implementation of these legislation on a broader scale.

The exciting property of hemp is that it follows a path of upcycle naturally. Many businesses are exploring ways to implement how to source back and reutilize the end of life product. With hemp, even if the sourcing again is not enforced and if a hemp product is discarded, it can biodegrade unlike plastic, and this possibility will unlock tremendous opportunities. One of the key enablers would be standardization of materials specifically plastics, and such uniformity will enforce the corporations to design better products which comply with the standardization.

As per Treeni Sustainability Solutions, another important and a key stakeholder is the government as the policies and regulations which are directed towards the enablement will foster the transition. There are already regulations in place particularly for the manufacturing and production sector, but they are limited to only specific materials, and the issue arises not in the regulation but the inspection of the processes. Because manufacturers have to comply with the said regulations directed by the government, but since there are no inspections, manufacturers take the policies for granted and usually do not comply with the standards for manufacturing. These standards reflect the standards in measurement of the input versus the output, waste collection, segregation, recycling, upcycling, etc.

Also, there are EPR (Extended Producer Responsibility) legislations for plastic and not for plastic waste and plastic packaging and many large FMCG, manufacturing, consumer goods electronics companies lobbied against it, and while government is enabling a faster transition, there are corporations who are not ready to embrace the change as it will affect their supply chain. Enabling EPR for plastic waste and packaging will reduce the use of plastic itself substantially.

Although there are areas, where the value of the waste generated, is high, and these policies have fostered developments and have made the environment better. For example, the regulations for recycling used batteries and due to which it's an uncommon sight to find lead batteries as waste. And similar is the case of other resources like copper, steel, iron, etc. but these are recycled on a regular basis since they fetch more monetary value.

Re-evaluating Business Models:

Sharing Model: With the enablement of sharing models across mobility and urban living, there is a tremendous opportunity for the furniture sector to reap the benefits by adapting to circular business models such as the sharing model or product as a service model which again, is a subset of the sharing model. The next strategic agenda for the furniture manufacturer would be to collaborate with e-commerce giants particularly in India who work on a sharing model and this will also enable a larger outreach as the trend of the furniture changes constantly.

The manufacturer is currently exploring the value they could generate when they associate themselves with e-commerce not just in terms of selling their product but to use the online platform to provide their products on a rental basis (product as a service).

The first target would be to develop a partnership with furlenco which is a furniture e-commerce start-up in India who have a networks of furniture manufacturers and suppliers and through this platform, an end customer can rent a furniture for a particular number of days or based on their requirement. Such a collaboration would automatically enforce the sharing model and has the potential to reap tremendous benefits.

The exciting property of hemp is that it is naturally up cyclable. Many businesses are exploring ways to implement how to source back and reutilize the end of life product. With hemp, even if the sourcing

again is not enforced and if a hemp product is discarded, it can biodegrade unlike plastic, and this possibility will unlock tremendous opportunities.

It is essential to understand the investments in handling waste, disposal, treatment charges, collection cost, primary collections, etc. to work out the waste economics. And the income is generated from the scrap, recyclables, plastics, etc. it is essential to focus on the mass balance of the materials, i.e., measuring how much of the input is getting converted into the output and then accordingly enhance the process efficiency so as to reduce the waste like packaging waste, process waste, etc.

Instead of looking at the waste economics, what you should be looking at is your production efficiency and the mass balance of materials. [Interview PL1]

"the current system, and basically what you've done, you have distributed materials and dissipated the energy and then you say, I am going to collect it back. So, Circular Economy in this concept, will never work. So, if you are not looking at completely revamping your business model, no matter what you to do the end products, you will never be able to harness the energy back from the products that you have distributed and it's in the end state. end state is use phase." [Interview PL1]

Education and technology:

Despite the rising awareness of circularity, there is still a gap amongst the general population regarding its understanding and measures to fill CEP is taking on this gap by providing practices of circularity amongst communities via projects and not just talks. And this is due to the clarity of approach of CEP which is more aligned towards coming close to consumers and citizens and leaving the other aspects like technology etc. on big companies as they have the resources) to do so.

Rather than addressing big industries and technological innovation because there are other organizations that are better equipped for that, with me, what I like to do is really bring circular economy close to consumers and citizens and to initiate the project [Interview PL 2]

It's a multitude of various factors that influence the transition to circular business model. What is needed is the facilitation of the loop with technological enablers like blockchain, innovative recycling techniques, etc. Technological innovation is not always the only solution. It must be a combination of different innovations both technological but also social and economic.

5. Discussion:

Awareness and Implementation:

The awareness about the concept revolved around minimizing externalities, resource efficiency and creating biodegradable products. Although 3 out of 4 participants were very much aware of the idea of circularity and are already exploring methods and exploring new ways to experiment with the application. There was a different insight to understand that the founder of naturamaterials. Pl wasn't sure about the terminology and yet was implementing the concept, his principles of implementation come from permaculture which is permanent agriculture which is a subset of the circular economy. Other perspectives focused on giving life to end of life products and to enable recycling and upcycling.

While most of the participants focused towards a business to consumer model by creating and producing efficient products, the founder of CEP believes in a different approach and instead follows a consumer to business model and this is being done via community projects like the composting project in multiple localities of Lisbon, with the collaboration of local municipalities and offering community composting as a complementary tool to industrial composting.

The current strategy with the furniture manufacturing vertical is enabling the recycling of leftovers and the waste generated. Also, the implementation of recycling is a lot more feasible because the type of waste produced is usually wood or by-products of wood and hence one of their key stakeholders is a recycling facility.

Amongst the cases studied there is a clear application of open innovation model in their own ways and techniques. To begin with, Treeni Sustainability Solutions primarily relies on inbound open innovation system where the primary criteria is to assimilate new strategic initiatives and since it works as a consulting firm, it is key for them to have multiple approaches and then work towards outbound innovation system where the strategies can be commercialized. Such is a case observed

with tata motors which is one of among the very few corporation(s) in India who is open to assimilate external knowledge and combine it with their internal capabilities to maintain strategic and competitive advantage. Although many corporations and companies typically in the FMCG and retail sector are still accosted to the NIH (Not Invented Here) syndrome and are risking their own future sustenance by assuming that they can have a hold over the monopoly and thereby restricting and influencing the policies in their favour which is harmful for the procurement of the resources thereby harming the environment. But initiatives like Tata Pro-life and the Restart initiative by Tarkett shows a strong example of embracing the assimilation of new knowledge source incorporated by other stakeholders which are typically external knowledge source and these initiatives are catching the attention in the industry and thereby forcing their own competition to begin collaborative efforts in order to strategize their market strategy and incorporate resource efficiency methods and attain mass balance.

Interorganizational learning is more apparent with the furniture manufacturer and currently there is a resistance towards acquiring new external knowledge, yet the key focus is to rely on internal knowledge sources and attain mass balance in the entire production supply chain.

With the compost project, the direction of the enterprise is more aligned towards consumer to business (C2B) and thereby providing municipalities and corporations services which involves the consumers and hence this creates a large pool of various stakeholders like the consultant, consumer, municipality and the organization to work together and attaining efficiency and enabling best practices and thereby setting an example for a whole new innovation model which is possible in the open innovation system. Currently the challenge is that such a C2B model is in its nascent stage and follows an approach of potential absorptive capacity where the commercialization is not the priority and commercialization is the key for survival for initiatives like the composting project or for SMEs' like naturalmaterials.pl . Hence, the participants enforce on the need for realized absorptive capacity as this will enable the adoption across all the stakeholders and across multiple industrial verticals and there by assimilating the knowledge from internal and external sources can be rapid thereby influencing its commercial aspect.

Barriers:

Resistance:

One of the important barrier common across the verticals was the resistance from the top management. Although there are industries with big corporations,

who are investing in R&D to explore the application and implementation of circularity yet a majority of the participants voiced out their opinion about the resistance from the top management regarding going circular. There were several reasons for the opposition, the major one being the cost of transition and the fear of experimentation since not a lot of industries are active in circularity currently. Moreover, one of the participants also mentioned how large corporations and electronic goods company lobby against the government while they want to implement systems such as EPR (Extended Producer Responsibility) and also emphasizes on the way such corporations have a monopoly over the industries and these industries typically impact everyday people the most.

Currently, large FMCG companies manufacture low-value products, and this production is on a large scale, and another participant argues about the low evaluation of materials used for the creation of the products. Such factors clearly show a massive gap in the current working of sectors in the economy and they clearly show the presence of NIH syndrome where the industry leaders typically run the monopoly and remain restricted. Although such organizations do have gatekeepers but the respondents mention the need of having a gatekeeper in the upper most management to effectively drives the changes and transformation thereby setting an example.

Unavailability of Resources: almost all the participants agreed on the low diffusion of resources in the current economy. While large corporations can invest in R&D, SMEs are still struggling to make enough money and with the current legislation limits the growth and implementation of circularity as it needs a 360 turn of the supply chains and the business models which indeed requires a lot of resources like technology, infrastructure, legislation, etc. and unfortunately, things are not in place yet. Although there is development, the participants believe that the growth can be enhanced.

The legislation is a crucial barrier currently as there are no incentives for enabling circular supply systems or enabling product life extension. There are

only benefits of using renewable sources of energy. The governments across the economies are starting to embrace absorptive capacity and hence there is assimilation of new external sources and knowledge but currently it is mostly available as a potential capacity and hence this explains the limited availability of resources.

Education and Communication:

The awareness of C.E is mostly around people who work with the sustainability vertical, and there is a low diffusion of the concept amongst the general population. The need of the hour is a well-defined awareness model to educate the people about the importance and impact of circularity.

The designer from Encore Modular Furniture believes that there is a lack of overall communication from the producer to the consumer. What is missing are the information about the disposal or about upcycling when the product reaches the consumer, and the consumer is ready to dispose of the product after its use. The consumer is unaware of the possibly recycle, upcycle, reverse logistics, and it is necessary that the producers establish a communication channel to communicate the ways of disposal to their consumers.

From an agricultural standpoint and particularly in the case of hemp, hemp farmers are unaware of the hemp waste, the same hemp waste can be used to produce various by-products, products like hempcrete which can be used in the construction of small-scale buildings and this hemp crate can be an alternative for bricks and one of the exciting property of hempcrete is that it is fireproof, but the farmers are entirely unaware of the possibilities with hemp.

It is clear that the current industry across the verticals interviewed and studied follow a close innovation system where the stakeholders are relying upon traditional knowledge source which are currently restricting farmers, consumers, producers to achieve resource efficiency. Although there are many active change makers who are enabling the transition to an open innovation system, but the key challenge is mass adoption amongst the stakeholders.

Measurement and Metrics: there is an apparent imbalance between the production and the waste generated in the process of production. The respondent explains from experience in previous projects that, two of the major components are missing in the life cycle of production, i.e., measurement and metrics. Producers today focus on producing an abundance of products, and they do not measure the ratio of input to the generated output. And the interviewee believes that, if this process of measurement and input/ output ratio is considered, there can be tremendous improvements in the process, to begin with, and such measurements enable feedback-rich systems thereby minimizing the waste.

Once the metrics are considered, and with the feedback systems, it will be evident that the primary issue arises with the choice of the type of material and that will reflect a flaw in the design of the product, and hence a direction of change can begin from a reverse approach.

Inefficient design of products: The principal focus of today's production is mass production, while most of the waste ends up in the landfill, there is a shallow awareness level about the inconsistency in the design of the products. Large retailers are producing low-value products which have very low durability due to the material used for its production, and this is due to the way the product is designed. Such inefficient process yet again show the monopoly in the industry and there is a need for an entire system revival and this could be possible with gatekeepers being present as decision makers and thereby drive the transition via inter organizational learning and then assimilating external knowledge for a faster transition.

Enablers:

Leadership:

Every participant emphasized the need for a strong vision and leadership. One of the interviewee was very specific in this scenario and believes that it is not

efficient to appoint an EHS (Environmental Health and Safety) personnel. The need of the hour is strong leadership to drive the transition. Similar views were also expressed by other participants, and it is believed that large corporations have the opportunity to lead the change as they have the influence, network and the resources. All that is needed now is the assimilation of internal and external knowledge sources thereby following an open innovation model and a coupled absorptive capacity.

Mass Balance:

the current focus across many manufacturing facilities is the focus on waste economics. One of the interviewees emphasizes on the irrelevance of waste economics and instead focuses on mass balance on the production system, i.e., what percentage of input is getting converted into the output and attain a balance in this ratio. As the roadmap to achieve the mass balance will end up rectifying various underlying issues in the processing system. Such assimilation of knowledge resource is very crucial for large corporations and hence joint efforts between the corporations and consortium will enable rapid developments.

Innovative Package:

All the participants stress the importance of technological development and infrastructure. While the founder of CEP believes that technologies like the Internet of Things, the blockchain, etc. will lead the path, but what is needed is a comprehensive understanding of all the enabling factors which is not just technology but a combination of technology with social and economic factors.

Legislation:

there are multiple aspects while addressing legislation, to begin with, there must be serious enforcement of standardization across plastics, plastic waste, and plastic packaging. Enabling of EPR (Extended Producer Responsibility) will ensure producers are responsible for the extension of the life of the product. Post-occupancy

evaluation is another important aspect and can be implemented across various sectors, and this will not just enable the assessment but also continuous feedback from the consumers which may lead to additional possibilities. Also, with that, the government must start aligning towards providing support to circular business systems regarding subsidies and tax relief.

Circular Business Models:

the implementation of circular business models is already reaping enormous benefits in large sectors such an automotive. Automotive manufacturers in India like Tata Motors, Mahindra, and Mahindra, are already exploring and experimenting with the refurbishment of engine parts from old engines, and this is currently a commercial option.

Sharing business model is also reaping the potential benefits concerning efficient usage and enabling better support, communications between the stakeholders in the mobility and the furniture industry. Such a model also allows customer loyalty which leads to repeat business.

6. Conclusion:

The research aimed to facilitate the understanding of the concept of circular economy. The theoretical part of the study clarifies how the production systems have been functioning. Starting from mass production to lean production and how these processes must lead to several harmful socio-economic imbalances. The theory also clarifies the need for circularity and the way circularity justifies this can reap enormous benefits and not just in monetary value. The principles along with potential benefits to the entire economy are outlined. Possible implementation techniques with the integration of circular business models have also been discussed giving an overall approach from the understanding to its implementation.

Through the interviews with the participants from multiple industrial backgrounds, the thesis extends knowledge on the understanding and implementation of circularity among corporations and SMEs. The fieldwork also highlights the potential threats posed by the large corporations as they lobby against the government while the government wants to enforce some strict policies like EPR,

post-occupancy evaluation, etc. the gaps are tremendous in terms of consumer behavior, in terms of technological developments, etc. but with this the major shortcoming is the traditional practice of mass production and the resistance towards transition.

Practical Implications:

The results of this research may be useful for the practitioners and researchers to help understand the current gaps involving the key stakeholders (government, corporations, SMEs and communities) and with the interviews conducted, it serves an example to understand how individuals are leading the change towards circularity with various approaches.

Limitations:

A large sample of companies and interviews would provide a more in-depth perspective and can be used to validate more specifically, but one of the critical challenges is the access to such organizations as there are very few organizations active around circularity and many of whom do not feel prepared to share the insights.

Also, the qualitative approach is limited in its way and cannot be expanded to a broader population the way quantitative research can.

7.Recommendations:

the interview process with 4 active change makers with varied background and experience provided a broad perspective centered around circularity. It was very evident from the kind of view a beginner (up to 5 years) in the industry had, compared to a person with 20 years of experience. The speed up process of transition and innovation around circularity can be fastened if there is a collaborative ecosystem among the change makers hence enabling not just knowledge sharing but also experience sharing (mentoring).

Along with this, the concept of circularity must be taught not just with institutions but has to be enforced on a much more massive scale and with

appropriate audience in mind. It is clear that there is still time forth transition and hence it is essential to include circularity as a part of school syllabus to prepare the future generation(s).

After the Paris agreement in 2016, the overall population has become much more aware of sustainability, and this was due to the involvement of economies and politics enhanced by the outreach of the media. Such a replica of outreach might be essential to enable the awareness amongst the familiar stakeholders and to influence action.

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