

**DRIVERS AND BARRIERS TO CIRCULAR ECONOMY IMPLEMENTATION: AN
EXPLORATIVE STUDY IN PAKISTAN'S AUTOMOBILE INDUSTRY**

Martin Agyemang

Faculty of Management and Economics,
Dalian University of Technology,
Dalian, Liaoning Province 116024, PR China

Email: martinon463@yahoo.com

Simonov Kusi-Sarpong (Corresponding author)

Portsmouth Business School
University of Portsmouth
Portland Building, Portland Street, United Kingdom

Eco-Engineering and Management Consult Limited

409 Abafum Avenue

Ti's - Adentan, Accra-Ghana

Email: simonov2002@yahoo.com

Sharfuddin Ahmed Khan

Industrial Engineering and Engineering Management Department
University of Sharjah
Sharjah-UAE

Email: skhan@sharjah.ac.ae

Venkatesh Mani

Montpellier Business School,
2300, Avenue des Moulins,
34185 Montpellier Cedex 4, France

Email: m.venkatesh@montpellier-bs.com

Syed Tahaur Rehman

NED University of Engineering and Technology
Karachi, Pakistan

Email: s.taharehman@gmail.com

Horsten Kusi-Sarpong

Eco-Engineering and Management Consult Limited

409 Abafum Avenue

Ti's - Adentan, Accra-Ghana

Email: horstenk@yahoo.com

DRIVERS AND BARRIERS TO CIRCULAR ECONOMY IMPLEMENTATION: AN EXPLORATIVE STUDY IN PAKISTAN'S AUTOMOBILE INDUSTRY

Purpose: Circular economy has gained considerable attention from researchers and practitioners over the past few years because of its potential social and environmental benefits. However, a very little attention has been given in literature to explore the drivers and barriers in circular economy implementation in Pakistan. Therefore, the purpose of this paper is to identify the drivers and barriers to implementing circular economy in Pakistan automobile manufacturing industry.

Design/methodology/approach: This study adopts an explorative approach to understand the drivers and barriers at the micro level circular economy implementation in Pakistan automobile industry. The research design includes both qualitative and quantitative methods using survey instrument and interviews to gather data. The use of the two main sources of data provided the opportunity for triangulation of the data to improve the validity of the findings, and enables greater inferences from the results.

Findings: This study shows that “Profitability/ Market share/Benefit” (30%), “cost reduction” (22%), and “Business principle/Concern for environment/Appreciation” (19%) are the top three drivers. Similarly, “unawareness” (22%), “cost and financial constraint” (20%), and “lack of expertise” (17%) are the top three barriers in implementing CE principles in Pakistan automobiles industry.

Research limitations/implications: This study considers only Pakistan automobiles industry, and the practical implications potentially limits to emerging Asian economies.

Originality/value: This study is the first of its kind that has investigated the drivers and barriers of circular economy at the organizational level in the automobile industry

of Pakistan. Thus, helps to advance the understanding of the subject matter and enables the formulation of effective policies and business strategies by practitioners for upscaling circular economy and sustainability.

Keywords: Circular economy; barriers; drivers; emerging economy; automobile; manufacturing.

1. Introduction

Over the last few years, CE has gained considerable attention from researchers and practitioners because it considers both social benefits and improves environmental protection (Jawahir and Bradley, 2016; Govindan and Hasanagic, 2018). Also, it provides an opportunity to optimize manufacturing process by producing sustainable products and maintains the value of products as much as possible (European Commission, 2015; Govindan and Hasanagic, 2018). CE always keep resources in the close-loop supply chains even if it reaches its end- of- life and are re-used again (Smol *et al.*, 2015). Circular economy (CE) refers to the transitioning of business operations from the traditional linear economic system where natural resources (inputs such as raw materials) are converted into products via production creating waste leading to the deterioration of the environment, to a circular system where damage done in resources acquisition is restored. This ensures little waste is generated throughout the production process and product life-cycle for the advancement of sustainable resource use, sustainable recycling and closed-loop supply chains (Bernon, Tjahjono and Ripanti, 2018; Schroeder *et al.*, 2018; M. Yang *et al.*, 2018).

CE concept and its implementation are becoming essential for enterprises and countries to minimize and manage waste effectively and efficiently. Emerging economies

can potentially gain many benefits from CE through proper policymaking and its implementation as it provides several opportunities in different sectors such as in smart phone, plastic, food supply chain, and steel. For instance, as many as end-of-life products such as electronics and clothes from developed countries end up in these economies for refurbishment and consumption (Amoyaw-Osei and Agyekum, 2011). Hence, it is imperative for emerging economies to develop strong mechanisms for refurbished and recycled imported items. This can reduce cost of import (economic), minimize pollution (environmental) due to product recycling and protect environment through “non-discard” behavior as well provide low cost recycled products to locals (Social).

CE is a structured approach and requires efficient implementation. More recently, many researchers and practitioners have identified several barriers (see e.g. (Vanner *et al.*, 2014; Van Eijk, 2015; Shahbazi *et al.*, 2016; Mont *et al.*, 2017; Pheifer, 2017; de Jesus and Mendonça, 2018; Kirchherr *et al.*, 2018; Ranta *et al.*, 2018) (de Jesus and Mendonça, 2018) to CE implementation. On the other hand, to overcome these barriers and implement CE successfully, many identify and highlight several drivers (Park, Sarkis and Wu, 2010; Zhu, Geng and Lai, 2010; Smol *et al.*, 2015; Lieder and Rashid, 2016; Hazen, Mollenkopf and Wang, 2017; Mont *et al.*, 2017; Quina, Soares and Quinta-Ferreira, 2017; Govindan and Hasanagic, 2018)

As aforementioned, it is evident in recent CE literature that numerous efforts have been made towards identification of barriers, drivers and developing CE framework. Nonetheless, in many emerging economies including Pakistan, CE concept and its potential benefits were explored little or scant. In addition, limited attention was paid in identifying the barriers and drivers in implementing CE in emerging economies

beside China. Thus, there is a need for more research that can focus on developing and emerging economies.

In order to contribute to the CE literature, the objective of this study is to identify the drivers and barriers of CE with a focus on Pakistani automobile manufacturing sector. This research is motivated by the fact that Pakistan is an emerging economy and many sectors are contributing to the overall country's GDP. The automotive manufacturing sector that mainly consists of automobile assemblers (Toyota, Honda, Suzuki, Hino) and automotive parts manufacturers is one of the key contributors to the Pakistan's economy. In 2017 alone, the sector contributed 12 billion rupees, in addition to the taxes paid by the customers and distributor such as car showrooms and outlets, which amounted to about 32% to 35% (FBR Report, 2017)^[1]. This indicates the positive growth in automobile industries, yet there is a mismatch of this growth to operational excellence, specifically in terms of technological advancement, organizational practices, and innovation in sustainability (Khan *et al.*, 2018). One way to address this operational deficiency is through CE implementation. However, these firms have limited knowledge on CE, and struggling to cope up with their implementation. Additionally, the existing literature provide limited knowledge on CE principles especially in emerging economies. In order to address this void in the theory and contribute to practice, this research aims to answer the following research questions.

- *What are the drivers that enables the implementation of CE in Pakistan automobile industry?*
- *What are the barriers that hinders the implementation of CE in Pakistan automobile industry?*

¹ <https://www.fbr.gov.pk/docs/Return-Forms-for-Tax-Year-2017/832> (Assessed: 30 September 2018)

The study makes the following contributions. The paper identifies the most relevant and pressing barriers and drivers for CE implementation in Pakistani automobile industry. These drivers and barriers provide a base for automobile enterprise managers and stakeholders in Pakistan to formulate policies and strategies in dealing with the challenges that hinders CE implementation and to promote and enable successful implementation and transitioning of enterprises to CE systems. This multifaceted framework can serve as a theoretical framework for future research, especially studies from emerging economy perspective. Overall, this paper provides a unique research space to shed insights on CE from an underrepresented emerging economy (Pakistan).

The remainder of the paper is organized as follows. Section 2 discusses the relevant literature pertaining to CE, and the methodology, which comprises of the research design, sampling techniques, and methods used in conducting the survey. The data analysis is presented in section 3. Section 4 presents discussions followed by conclusion and further research direction in section 5.

2. Relevant Literature

This section provides discussion on brief overview of CE in the context of emerging economies, then move on to the discussion of different drivers and barriers identified in literature. Finally, discussion of research gaps and highlights in the literature is presented.

2.1 *CE in emerging economies*

CE can be defined as an industrial economic system with the focus on restoring and regenerating resources, aiming at keeping and making the maximum use of and

drawing as much as possible value at all times (Bernon, Tjahjono and Ripanti, 2018; M. Yang *et al.*, 2018). Although, the evolution of CE scientific knowledge were predominately based in the political geographies of China and developed countries/regions especially the European Union, it is suggested that CE provides opportunity to emerging economies to improve their waste management and makes substantial efforts into their supply chains for effective resource use (IC, 2015). Over the years, the concept of CE has been emerging in new political and economic geographies. It is evident from Rwanda, Nigeria, and South Africa, who's governments are closely working with European Union's World Economic Forum through establishment of African Alliance on CE (Kilian, 2017; Circular Economy Club, 2017; Department of Environmental Affairs Republic of South Africa, 2017). Moreover, multilateral development banks (MDBs) are analyzing the potential of CE in Columbia and Turkey (Rosca, 2015). Similarly, Indian Resource Panel (InRP) which is responsible for the examination of the resource-related issues faced by India and advice the government on a comprehensive strategy for resource efficiency, proposed an action plan for resource management considering CE^[2]. CE and proper waste management is essential for emerging economies to minimize growing waste crisis for better health and environmental outcomes. The estimate indicates that about 8-10% of global greenhouse gas emissions are attributed to waste dumps by 2025 (Mavropoulos, 2015). It is essential in global supply chains to maintain a circular and continuous flow of material to reduce pollution by recovering material, energy, and water as much as possible through extension of product life. If the manufacturer does not recover a product, it

² <https://www.gktoday.in/gk/indian-resource-panel-inrp/> (Assessed: 19 September 2018)

means that energy, material, and water used in manufacturing is thrown away ^[3]. Unfortunately, not much attention was given by emerging economies towards CE implementation and potential benefits of circularity. Nevertheless, emerging economies such as India, Pakistan, and Ghana have started to gain benefits of CE by importing discarded electronic waste from developed countries for recycling (Amoyaw-Osei and Agyekum, 2011). This shows the importance of CE in terms of economic, environmental, and social perspective. In terms of cost, if emerging economies considers CE concept as an opportunity, it may result in reduction of cost of imports and minimize wastes. In order to do that, they need systematic strategies and regulatory mechanisms enforced by governments, and the organizations must follow (Gurtoo and Antony, 2007). The government and regulatory authorities can incentivize in terms of tax rebate to those organizations that have implemented CE economy successfully (Jakhar et al, 2018). Others assert that government and regulatory bodies should develop infrastructure and create awareness among customers, and highlight the CE's importance. Organizations in emerging economies can be encouraged this way to adopt CE principles and gain associated social, economic, and environmental benefits (Winans, Kendall and Deng, 2017).

2.1.1 Drivers for CE in the context of emerging economies

CE plays an essential role in emerging economy growth and is essential to identify and understand the drivers of CE in supply chains (Govindan and Hasanagic, 2018). There are several reasons that stakeholders engage in CE such as “resource scarcity”, “environmental degradation”; “good business opportunities”, “compliance with regulation”, “consumer pressure”, “collaboration with customers” and “improved firm

³ https://learn.tearfund.org/~/_media/files/tilz/circular_economy/2016-tearfund-closing-the-loop-en.pdf?la=en (Assessed: 19 September 2018)

performance” (Geng and Doberstein, 2008; Geng *et al.*, 2013; Zhu and Geng, 2013; Govindan, Diabat and Shankar, 2015; Abubakar, 2018; Gaur and Mani, 2018). Drivers that encourage the adoption of CE initiatives can be broadly divided into two categories which are internal environment and external environment (Govindan and Hasanagic, 2018). There are many studies that identified drivers in different sectors such as manufacturing (Lieder and Rashid, 2016), construction (Smol *et al.*, 2015), and service (Tukker, 2015). Ilić and Nikolić (2016) categorized CE drivers into four major categories which are “basic drivers”, “public health”, “resource management” and “economic-financial capacity” and used these drivers as a tool to compare different municipalities’ goals achievement in Serbia. Similarly, Wilson (2007) proposed six broad groups of drivers for the development of waste management, including “public health”, “environmental protection”, “climate change”, “the resource value of waste”, “institutional and responsibility issues”, and “public awareness”.

Mont *et al.* (2017) categorized five major internal drivers as “economic” “environmental benefits”, “greater security of supply and resilience”, “new and enhanced customer relationships” and “company values, strategies and aspirations” and state that internal drivers are driven by new profit opportunities. In addition, Mont *et al.* (2017) points out that “coercive pressure” and “market pressure” are the two major external drivers that are essential for achieving the benefits of CE. Many researchers identified several drivers of CE such as “cost savings in manufacturing” (Stahel, 2010; Walsh, 2010) “diversified and customized offering” and “Increased brand protection and loyalty” (Ellen MacArthur Foundation, 2015) “revenue growth from recovering waste” and “increasing competition from low-cost countries” (Mont *et al.*, 2017).

Govindan and Hasanagic (2018) categorize CE drivers into five different clusters which include “policy and economy” (Park, Sarkis and Wu, 2010; Li and Li, 2011; Ilić

and Nikolić, 2016; Hazen, Mollenkopf and Wang, 2017; Quina, Soares and Quinta-Ferreira, 2017) which cover drivers such as laws concerning product take back and economy growth, “health” (Ilić and Nikolić, 2016; Pringle, Barwood and Rahimifard, 2016) that includes increasing animal and public health, “environmental protection” (Ilić and Nikolić, 2016; Pringle, Barwood and Rahimifard, 2016; Hazen, Mollenkopf and Wang, 2017; Quina, Soares and Quinta-Ferreira, 2017; Clark et al. 2016) that includes climate change, quality of agriculture and the protection of renewable resources (Yuan, Bi and Moriguichi, 2006; Ilić and Nikolić, 2016; Pringle, Barwood and Rahimifard, 2016) “society” which combines population growth, urbanization, job creation potential, consumer awareness and “product development” (Su et al. 2013) that is essential in improving the efficiency of materials, energy use and increase the value of products.

2.1.2 Barriers for CE in the context of emerging economies

Over the last few years, the research pertaining to the identification of CE has been gaining importance among the practitioners, industry, and academia (Lieder and Rashid, 2016). There were notable literature that have identified and discussed barriers to CE (see e.g. Vanner *et al.*, 2014; Van Eijk, 2015; Shahbazi *et al.*, 2016; Mont *et al.*, 2017; Pheifer, 2017; de Jesus and Mendonça, 2018; Kirchherr *et al.*, 2018; Ranta *et al.*, 2018). de Jesus and Mendonça (2018) combined previous literature and its findings related to CE barriers and developed a CE barriers framework. They differentiated between “soft” and “hard” barriers that hinders the implementation of CE (Kirchherr *et al.*, 2018). Similarly, Zhu and Geng, (2013) have identified barriers of extended supply chain practices among Chinese manufacturers. Others discussed the challenges and opportunities of CE in Spanish SME (Ormazabal *et al.*, 2018). In addition, Prieto-Sandoval, Jaca and Ormazabal (2018) highlights the relationship with eco-innovation

on the consensus view of the CE framework. Araujo Galvão *et al.* (2018) combined bibliometric network and content analysis to identify the main barriers to CE which include technological, policy and regulatory, financial and economics, managerial, performance indicators, customers, and social. Govindan and Hasanagic (2018) classified CE barriers into eight different categories which are “governmental issue”, economic issue”, “technology issue”, knowledge issue”, management issues”, CE framework issue” cultural and social issue” and “market issue”.

Pheifer (2017) identified barriers to CE including “no sense of urgency and company culture”, “lack of data”, “financing of circular business propositions”, “current governmental legislations and ruling”, and “current linear system in place”. Similarly, Mont *et al.* (2017) identified “difficult to collaborate with other companies”; “lack of consumer awareness”; “low prices of many virgin materials”, “high upfront investment costs” and “products are not designed for circular business models” as some of the major barriers to CE. Kirchherr *et al.* (2018) categorized barriers into four categories related to culture, regulatory, market and technology. Van Eijk (2015) identified “circularity is not effectively integrated in innovation policies” and “governmental incentives support the linear economy” as some of the major barriers in CE India. Other CE barriers are related to business models including “difficulty to internalize legal risks”(Prendeville and Bocken, 2016) “decreased sales of new products due to increased sales of repaired, reconditioned and remanufactured products” (Ellen MacArthur Foundation, 2013), “lack of supply (or quality) of returned products or resources and difficult to organize takeback logistics” (Kissling *et al.*, 2013) “uncertainties about the residual value of the new products” (Mont, Dalhammar and Jacobsson, 2006) “unpredictability of volume of returned products can make it difficult for companies to plan and financially forecast”

(Linder and Williander, 2017) and “risks with product performance, and increased liabilities for reconditioned products or materials” (Mont *et al.*, 2017)

In the literature, many other barriers were discussed and categorized including barriers related market covering: “lack of design tools for circular business models and for circular products” (Bakker, Hollander, Ed van Hinte, 2014) and “current infrastructure does not support circular offerings, i.e. locked-in infrastructure” (Mont *et al.*, 2017), barriers related to value chain covering: “existing supply chain dependencies and relationships prevent circularity” (Boons and Lüdeke-Freund, 2013), “OEMs may risk damaging relationships with their retailers and dealers by offering repair or refurbishment” (Prendeville and Bocken, 2016), and “component producers and other non-OEMs may have limited or unclear opportunities to adopt circular business models because of their position in the value chain” (Mont, Dalhammar and Jacobsson, 2006), barriers related to finance, coercive, customer related, organizational strategies and capabilities, and technical issues are listed (Mont *et al.*, 2017). In addition to that Van Eijk (2015) categorized barriers in term of lever which are “general framework”, “design and production”, “consumption”, “recycling and recovery”, and “logistics”.

2.2 Research highlights and gaps

There are several studies that have identified CE drivers and barriers in the context of emerging economies that includes China (Geng *et al.*, 2013); Bangladesh (Moktadir *et al.*, 2018); and India (Ellen MacArthur Foundation, 2015), but studies specific to Pakistan is scant. Additionally, greater number of studies have acknowledged for future investigations at the micro level CE implementation to provide managers with some insights for addressing the barriers that challenge implementation and drivers for the transition of enterprises to CE (Govindan and Hasanagic, 2018; Luthra and Mangla,

2018; Mangla *et al.*, 2018). In addition to these literature gaps, majority of these studies are centered on the general manufacturing sector with none specifically focusing on the automobile industrial sector. Therefore, there is limited studies that have investigated the drivers and barriers of CE at the micro level in the automobile industry of Pakistan. Hence, this study makes incremental contribution to fill the literature void. The study help advance understanding of CE and enable the formulation of effective policies and business strategies by managers and policy makers for up scaling CE and sustainability.

3. Methodology

This section presents the research design, sampling techniques and sample applied to the study. The section also provides the method used to support the analysis of the survey data for further discussion and interpretation.

3.1 Research design and sampling

In order to understand the drivers and barriers at the micro level CE implementation in Pakistan automobile manufacturing sector, an explorative study approach was adopted. An explorative study has the potential to provide first insights into a research phenomenon under investigation (Forza, 2002; Lee and Kim, 2009). The study utilized both qualitative and quantitative methods including, designed questionnaire survey and interview to gather data. The use of the two main sources of data provide the opportunity for triangulation of the data to improve the validity of the findings, and enables greater inferences from the results (Yin, 2003). Respondents were selected to fill the survey questionnaires based on three sampling techniques which focused on homogeneity, purposiveness and self-selection (Miles, and Huberman, 1994; Kusi-Sarpong, Sarkis and Wang, 2016). With regards to homogeneity, we focused on firms that were really interested in improving their sustainability through circularity

(CE). In terms of purposive, we selected managers (representative of each surveyed company) who were directly dealing with issues related to CE and were particularly considered informative and knowledgeable on the subject matter.

We used self-selection to provide some flexibility in our selection to enable managers to decide either to partake or otherwise in the study, reaffirming their willingness and commitments to the study. The survey questionnaire was standardized and consisted of two parts: 1 drivers for adopting of micro level CE in the enterprise; 2 barriers that hinders the implementation of micro level CE in the enterprise. The sampling process resulted in 112 dataset received from Pakistan automobile enterprises who were interested in improving their overall sustainability through CE. Fig. 3 shows the final list of companies (represented by representative managers) involved in the study. The 112 Pakistan companies indicate sufficient variation for a representative study of CE-based sustainability initiatives. The sample (companies) vary in terms of business type as well as their respondent managers' homogeneity (e.g. head of production, duty manager logistics, business growth manager, etc.).

Furthermore, the survey respondents were requested for interviews, and a total of 28 among 112 accepted to participate further. Each interview lasted for about 25 minutes. Based on the reviewed literature, the interviews guide was developed and entailed questions about the perceived motivations and hindrances regarding CE implementation. Relevant secondary documents such as annual reports, environmental policies, and industrial magazines from the interviewees were collected. All interviews were recorded and transcribed. One of the authors visited in person and interviewed the respondents between March 2018 and October, 2018. We utilized Excel to analyze the survey data. In order to ensure similar themes emerge from the transcript data, two authors independently coded and compared their coding structures based on themes

identified in the literature and terms used by the respondents. Feedback was sought from the interviewees as well. When there was disagreement, again themes were revised, and the process has been repeated until final agreement is reached between two independent coders.

4. Survey Results, Findings and Analysis

In this section, the survey data and subsequent analysis are discussed in perspective of the literature and research objectives. First, some basic demographics are explored; then, data relating to the research question are examined.

The characteristics of sample suggest that the respondents were generally experienced management professionals: 60% of the respondents had 1-5 years of work experience, 28% had 5.5–10 years of work experience, 12% had 10.5-15years of work experience, 3% had 15.5–20 years of work experience, and 1% had 20.5-25 years of work experience. Also, the greater portion of the respondents who had 1-5 years' experience suggest a young generation of management professional with relatively high level of curiosity to engage in new ideas such as CE. Fig. 1 shows this information.

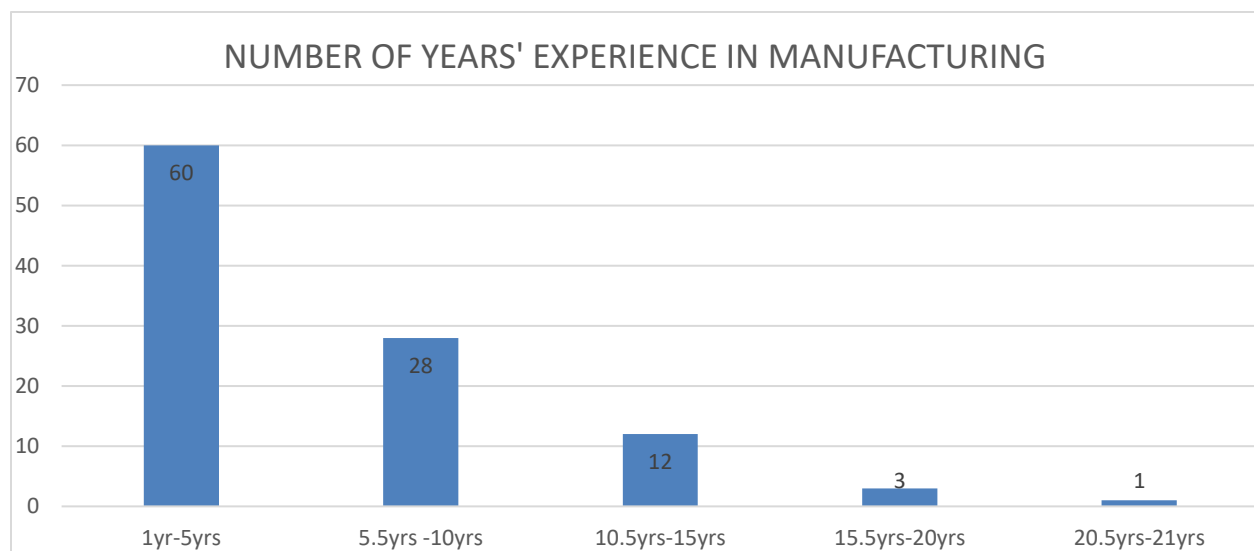


Fig. 1. Years of working experience in automobile manufacturing

Fig.2 shows that the employees' headcount stands at over 500 in majority of the enterprises. Others, i.e., 8 enterprises shows the employee headcount of less than 499. Thus, most of the respondents (enterprises) are large scale industries. In addition, most of the enterprises had both local operations in their state as well as, the nation-wide operations. A handful of the enterprises had international operations.

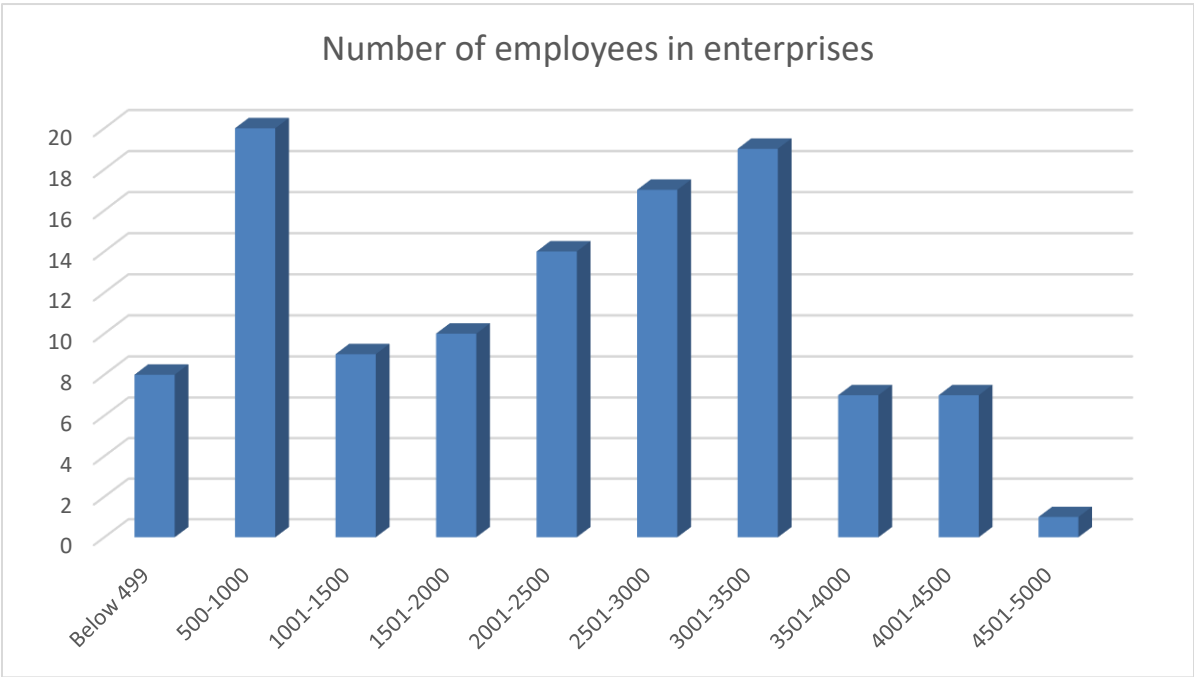


Fig. 2: Number of employees in enterprises

Fig.3 below describes the sample in terms of the kind of enterprises respondents were involved. It highlights the diversity of the respondents. Majority of the enterprise were suppliers of parts to automotive assemblers.

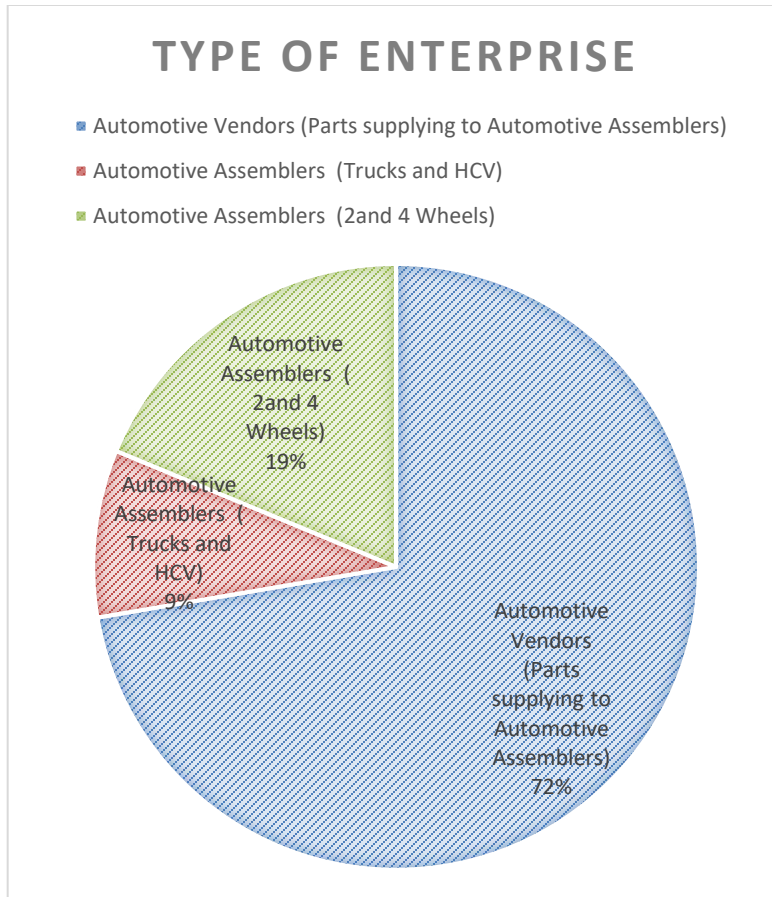


Fig. 3 Type of respondent enterprises

4.1 Drivers that enable the implementation of micro level CE

The main drivers identified in the exploration of micro level CE implementation are shown in Fig. 4. The findings are categorized into internal and external drivers. The findings presented are discussed below. They are compared with the extant literature, to see how our empirical investigation converges with existing literature.

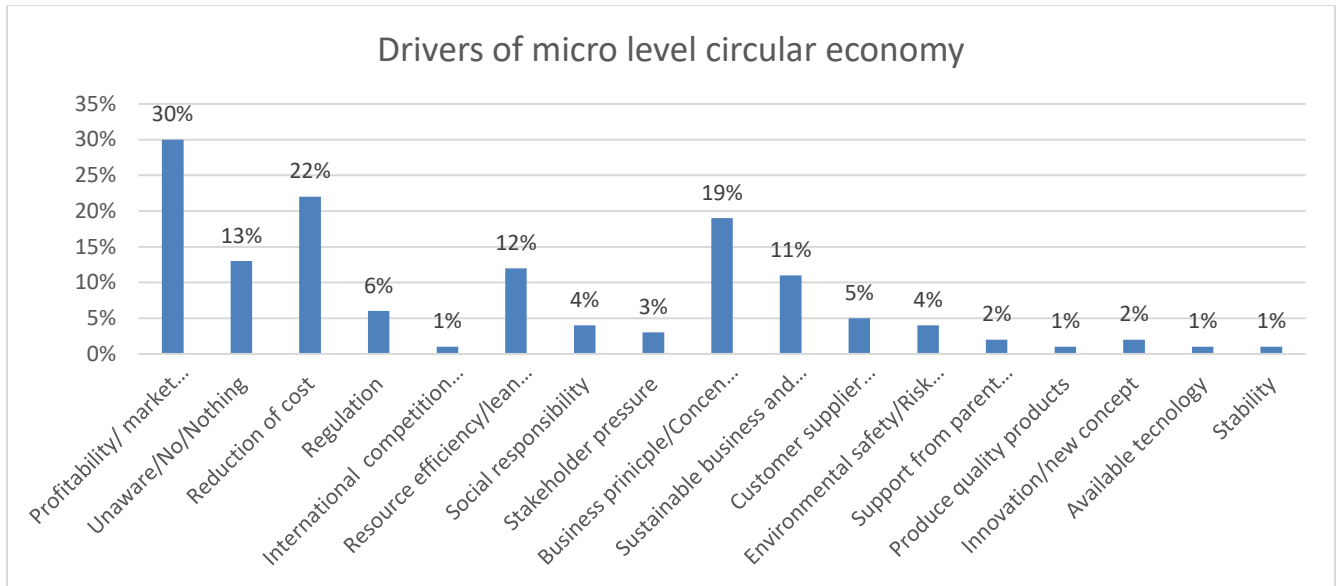


Fig. 4 Drivers of micro level CE

4.1.1 Internal drivers

4.1.1.1 Profitability/Market share/Benefit

Fig 4 suggest that, many enterprises would like to embrace and adopt CE initiatives in pursuit of the shareholders benefit, increase market share and the pursuit of higher or new profits through increased competitiveness and overall sales . This perception is very much in tune with the literature as the main idea of CE is to drive economic performance by addressing the challenges of environmental management. Interviewed respondents gave the impression that they are more profit-driven to implement CE initiative than to enhance their environmental performance in itself. The respondents see CE initiatives as opportunity to identify new sources to increase quality market share and subsequently higher profit. These sources include the reduction in the production of waste that can potentially lead to increase in profit margin, increase in the return on investment and opportunity to maintain and attract new customers. Thus,

there is a strong emphasis by enterprises to sustain and increase profitability through CE initiatives.

4.1.1.2 Unaware and interest to gain insight

All respondents had a fair idea on sustainability practices and had expressed some knowledge on the need to ensure sustainability in their enterprise and the industry. However, many respondents (13%) seem not aware of CE and couldn't provide a clear understanding of the motivating drivers of the idea in their operations. Nonetheless, they expressed interest to gain more insight on how such an idea can advance the interest of their enterprise.

4.1.1.3 Reduction of cost

The results indicate that 22% of respondents perceive cost reduction as a driver of CE. This is informed by the understanding that a linear model of operating their business which involves throwing away material at the end of life is expensive and difficult to sustain in the face of increasing raw material prices in an increasingly international marketplace where resources and energy costs represent important competitiveness factors. Ellen MacArthur Foundation (2012) study suggest that cost saving potential of the automotive sector is one of the most prominent in CE among many others. Thus the potential to reduce material cost of product and avoid the related risks to supply constraints and price volatility motivate many enterprises to consider CE (Behrens *et al.*, 2016; CEPS, 2018).

4.1.1.4 Resource efficiency

The automotive industry is a large consumer of resources and the industry is much concerned about resource efficiency, and lean manufacturing and design for material consumption (Rothenberg, Pil and Maxwell, 2001; Ingarao, Di Lorenzo and Micari, 2011). Sustainable and efficient production systems are fundamental for enterprises to decrease the use of natural resources, and reduce the environmental burdens created by production systems. Over 12% of respondents perceive the implementation of CE practice as a potent means to transform or shift their business model in the current linear system into a resource-efficient, low-carbon, and sustainable circular economy.

4.1.1.5 Business principle concern for environment

The global call to sustainable development has been imbued by many enterprise as a core principle of their business operations especially in regards to decoupling of economic growth from environmental degradation and the need for sustainable consumption and production patterns. Thus, as a principle and appreciation for these values, 19% of respondents expressed that their transitions to CE is a strategic means to ensure the core business principle, concern for environment and appreciation of the shared concerns of sustainable development enshrined in many national and international documents is adhered.

4.1.1.6 Sustainable business and growth

Sustainable business and growth is perceived as a driver of CE by 11% of respondents. Many of the respondents raised issues regarding the growing potential market of CE models. Again, many of them were convinced that adopting circular business practices is a means to position their businesses to respond to the emerging market in the

automobile industry which demands the consumption of less resources and create opportunity such as new jobs in generation of energy and recycling from waste material (CEPS, 2018).

4.1.1.7 Customer supplier relationship (CSR)

A significant number of respondents (5%) perceive CE as an opportunity to enhance the customer supplier relationship and to build loyalty with their customers. They perceived CE initiative to have the potential to attract new customers and strengthen or improve their relationship with existing customers as well as enhance their loyalty to meet their requirements.

4.1.1.8 Environmental safety and risk management of health and safety issues

In order to ensure environmental safety and reduce the risk of business operation, CE practices presents the opportunity to manage this critical concern to many enterprises in the automobile industry. As Pakistan has become an important player in the global automobile manufacturing industry, it is important for many large and leading enterprises to safeguard themselves in terms of enhanced safety and health practices. 4% of respondents perceived environmental safety and risk management as an important drive of CE initiatives in the automobile industry.

4.1.1.9 Quality products

The literature makes emphasis on quality of circular products, which motivates customers and consumers to demand such products (Cui, Wu and Tseng, 2017). Good and higher quality circular products ensure that the consumer enjoys the same or even higher satisfaction than the traditional linear product. As such, 1% of respondents

perceive the ability of enterprises to produce quality circular product can drive and sustain the implementation of CE.

4.1.1.10 Innovation/new concept

The literature suggest that CE as an emergent concept which frames waste and resource management with the aim to offer an alternative to prevalent linear take-make-dispose practices in enterprises is appealing to enterprise managers who would like to consider new ideas in sustainability due to its potential to address their concerns (Blomsma and Brennan, 2017). The finding shows that 2% respondents perceives of such an opportunity as an important driver in the automobile industry. Automobile enterprises are interested in considering alternative production systems that can deliver on optimum production, optimized consumption and minimum waste to enhance their economic and environmental performance. A respondent pointed out “this new concept helps us to think strategically on how to recycle old rejected and used parts of our enterprise”.

4.1.1.11 Technology availability

To help companies obtain a competitive advantage in a changing market resulting from digital revolution, the rapid proliferation of new technologies has enabled many enterprises to recognize the present and future opportunities in CE initiatives (CEPS, 2018). These technologies such as mobile technology, the internet of things (IoT) and data analytics create the conditions under which CE innovations such as the creation of efficient waste collection systems, new markets for remanufactured good or transformation of existing ones can be advanced in creating the conditions for the CE to be rolled out in large scale operations. 1% survey respondents perceive the potential

of available advanced information technology and physical technology to drive CE and revolutionize the way the industry currently operates.

4.1.1.12 Stability

Another interesting observation is the potential of the implementation of CE practices to enhance the stability in the midst of uncertainty in business operations. Managers and organizations must have a consistent approach towards CE implementation to yield the full benefits. In addition, governmental agencies must be consistent in incentivizing those organizations that have implemented CE initiatives. Change of government and other factors must not affect the business and their mindset towards CE. This is essential for emerging countries such as Pakistan to achieve long term goals.

4.1.2 External drivers

4.1.2.1 Regulations

The literature shows that national and international regulations can provide the framework, channels, and means for enterprises to transit from a linear to circular model systems (Govindan and Hasanagic, 2018). Government and authorities in attempt to promote policies and enforce laws that can promote cleaner production and end of life management, creates a mandatory driver for many enterprises to implement CE practices. Furthermore, government can enable enterprises to access credits and loans as well as diversified investment mechanisms in CE implementations. Also, authorities can institute effective legislations to stipulate associated rewards and accountability of CE initiatives. 6% of respondents perceives national and international regulation as an important drive to the implementation of CE initiatives in the automobile industry. The interview respondents gave the impression that since

enterprises are very much profit driven, without the establishment of regulations towards CE in the industry, most enterprises wouldn't be motivated to implement any advanced or effective CE initiatives. One interviewee said the potential to enjoy tax benefits for implementing CE initiative could be the most effective means to significantly implement CE practices in the automobile industry.

4.1.2.2 International competition and push

In the face of fierce and intensive competition in today's automobile business environment, the enterprises are motivated to implement CE practices that can enhance their potential to gain substantial competitive advantages that can enhance their economic and environmental performance. Most stakeholders of the automobile industry are aware of the global ecological impact of their activities and as such are interested in how enterprises stand out in their contribution to addressing the problem. 1 % of the survey respondents, mainly involved in international operation consider that for their business to thrive at the international level, they need to be keen on how they can implement CE.

4.1.2.3 Social responsibility

The social responsibility of enterprises and CE are ideas grounded in "sustainability". As such, 4% of respondents perceive CE as a means to fulfill their social responsibility towards society. According to Esken, Franco-García and Fisscher, (2018), both social responsibility and CE are united in their expressed long-term perspective, however, strategic CSR aims at guaranteeing an enterprise's ability to be productive and competitive in the long-term and CE has the same goal at heart. Thus, if enterprises are

able to effectively implement CE principles, they can potentially gain a short –term cost benefits as well as generate long-term strategic opportunities.

4.1.2.4 Stakeholder pressure

A continued pressure from stakeholders can drive enterprises to implement CE initiatives. The literature shows that throughout the last decade, increased public opinion continue to demand that enterprises adopt more responsible ways of production and consumption (Fonseca and Domingues, 2018). The shared opinion of 3% survey respondents stressed on the changing attitude of automobile customers and consumers as well as society in general, increasing interest in circular initiatives. According to one interviewee; “government everywhere support and promote circular activities. They are beginning to initiate policies and regulations, and we need to respond to that to stay in business.” They perceive, stakeholders pressures among the most significant drivers of CE implementation.

4.1.2.5 Support from parent company

Multinational enterprises seeking to be global leaders in their industry support it suppliers towards CE implementation (McIntyre and Ortiz, 2015). 2% survey respondents perceive the support of parent companies as key drivers in the automobile industry for CE implementations.

4.2 Barriers that hinders the implementation of micro level circular economy

The identified perceived barriers of micro level CE implementation by the respondents are presented in Fig. 5.

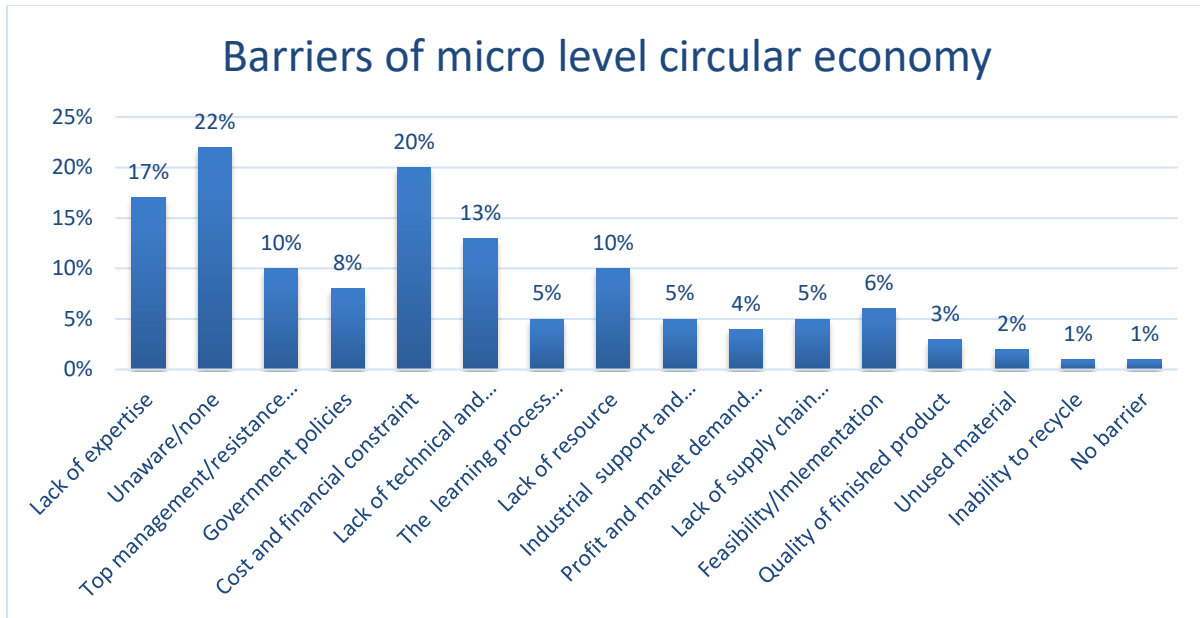


Fig. 5 Barriers of micro level CE

4.2.1 Internal barriers

4.2.1.1 Lack of expertise

A major perceived bottleneck of CE is the lack of relevant expertise or detail technical knowledge in place for the transition from linear to CE (Shahbazi *et al.*, 2016). Yet this prerequisite is not fulfilled by many enterprises in the automobile industry in Pakistan. 17% of the respondents raised this concern and lack of expertise came up as the third highest barrier. One interviewee noted: “We have no advance expertise available to help us turn all these waste material into something useful again and those that we are able to salvage are not of high quality remanufactured products”. Remanufacturing in the automobile industry is more labor intensive than the traditional manufacturing and requires technically skilled engineers or technicians (Yang *et al.*, 2018), as such many enterprises that are not able to afford the cost of such expertise are limited to implement CE.

4.2.1.2 Unaware/none

Although CE practices seem to dominate contemporary discussions on sustainability, a staggering number of 22% survey respondents had none to limited knowledge on the concept and how important it is in terms of its benefits and risk for their enterprise and the automobile industry. The existing literature points out lack of awareness as a barrier to CE, however, it is often not at a very significant level as our survey results indicate.

4.2.1.3 Top management/Resistance to change

Many researchers emphasize the role and vision of top managers' appreciation of new ideas and changes that can transform the way enterprises operate or design their supply chains (Agyemang *et al.*, 2018). If there is any resistance from managers to change their corporate strategy, successful implementation of CE initiative cannot be realized. To overcome this barrier, top managers can conduct workshops and training of their workers and suppliers to promote CE practices in their enterprise and supply chain. 10% of survey respondents indicate that they perceive barriers to CE practices due to the less motivation of top managers. Thus, employees and suppliers are not very much incentivized to embrace CE practices. One interviewee shared that: "our leaders do not understand the benefits and risks of their new strategic direction. Therefore, we are not able to push such ideas".

4.2.1.4 Cost and financial constraint

Previous literature emphasizes on the significant role of cost and financial constraint that hinders the implementation of CE initiatives (Kirchherr *et al.*, 2018). Respondents provide the impression that at the initial stage of CE implementation, they expect their

cost to be high due to the investments they make. One interview pointed out: “the initiative involves cost due to restructuring of a decade old plant that was built a decade ago when there was no knowledge on CE Again, other interviewees emphasized on increase in operation cost. For instance, one state that “collecting used tyres from market adds extra cost to our operations. Also hiring skilled expertise to support us make circular products really expensive for us.”

4.2.1.5 Lack of technical and technological capacity

The lack of technical and technological capacity of enterprises as well as their in ability to have a possible means to embrace CE practices rank 5th among barriers. Technology is a requisite in CE implementation (Vanner *et al.*, 2014; Pheifer, 2017). Interviewed respondents suggest that non-availability or low grade technologies in automobile industry hinders the implementations of CE. Currently, despite the health hazards as well as environmental risks, many enterprises use low grade technologies and unskilled workers to manage collections of returned parts in the industry.

4.2.1.6 The learning process and associated risk

Previous literature suggest that the evolution of CE implementation maybe associated with risk (Linder and Williander, 2017) 5% of survey respondents were of the view that CE is a learning process and it will take time for enterprises in the automobile industries to embrace the transition from linear to CE. Discussions with respondents suggest that automobile enterprises are at the initial stages of CE as compared to those in the developed regions as they still use age old methods to manage their end of life processes; this involves inherent risks associate with the learning process. One

interviewee articulates: “it will take time because it is not easy to change the set-up and all operations at one go”.

4.2.1.7 Lack of resource

Lack of various resource capabilities hinders automobile enterprises from recycling, reuse and recycling. Unlike the conventional linear material product flow, the initial stage of developing a close loop may require investment to be made by enterprises to achieve circular products (Ghisellini *et al.*, 2018). Such resources including organizational resource, financial resources, access to capital, and availability of public funds for CE implementation may be unavailable, scarce and inaccessible. 10% of the survey respondents perceive lack of various resources as the hindrance to the implementation of CE in the automobile industry. One interviewee pointed out that: “we do not have sufficient resources to collaborate with all our suppliers and customers and so, it extremely difficult to effectively implement CE”.

4.2.1.8 Profit and market demand level

The key business factors of profit and market demand level plays a significant role in CE implementation (Ghisellini *et al.*, 2018). Increasing circular product demand on the market, make profit-driven enterprises interested to deliver these products. According to interviewees, the Pakistani local market for remanufactured or recycled products is increasing but limited. There is potential increase in demand if more customers have a better appreciation and confidence in circular products. Thus, 4% survey respondents perceive low levels of profit and market demand to be an important barrier to CE implementation.

4.2.1.9 Feasibility of CE Implementation

The feasibility acts as a hurdle to CE implementation. The limited research in the automobile industry, specifically in developing and emerging economies on CE has limited the confidence of enterprises to consider the transition to CE systems. 6% of survey respondent perceive that feasibility of CE implementation as an important barrier. One interviewee stated that: “there is no space for CE in our enterprise because of strong actions we are required for such an implementation.” The lack of extensive research required to develop facilities and operating systems in the automobile is by far limited, thus there is limited standard and monitoring to understand and convince most enterprises on the implementation of CE initiatives.

4.2.1.10 Quality of finished product

Although product quality is identified as a driver of CE implementation, it can also inhibit implementation (Yang *et al.*, 2018), 3% respondents perceive product quality as a significant barrier to CE implementation and consider the negative perception of circular products as poor quality to limit its market demand. Also, an interviewee pointed out: “sometimes circular products does not meet the standards of our customers and so they expect us to sell it at a lower prices. We can’t make enough profit margin from such a situation”

4.2.1.11 Unused material

A couple of survey respondents (2%) listed their inability to use all their end of life product for remanufacturing or production purposes. Therefore, a viable barrier to CE implementation is the lack of capacity of enterprises to turn back into the circulation material outputs as inputs for circular products.

4.2.1.12 No barrier

This study shows that 1% of survey respondents perceives no barrier(s) to hinder the implementation of CE practices in the automobile industry, although CE literature highlights several barriers to CE implementation

4.2.2 External barriers

4.2.2.1 Government policies

The survey result is in tune with the established literature that hold government policies as significant barriers to CE implementation (Mangla *et al.*, 2018). Among the government policies highlighted by survey respondents, the majority include policies with regard to taxation, and unstable political conditions that produce short term government policies to support the implementation of CE initiatives. Interviewees stressed on ineffective government policies and deficient regulations on collection and treatment of recyclable materials that limits the potential of enterprises to successfully transit from linear to a circular systems. Also, government agencies that support the industry to make transition are less resource with inadequate technical capacity to carry out their duties effectively as well as lack effective collaboration mechanism to adequately support enterprises.

4.2.2.2 Lack of industrial support

The lack of industrial support such as availability of shared technical support from professionals and other external stakeholders interested in environmental concerns for the industry, that can enable enterprises implement CE is significant to hinder the potential to achieve sustainable systems (Agyemang *et al.*, 2018). Survey responses

shows that 5% consider the limited industrial support for automobile enterprises as crucial barrier to CE implementation in the industry. Interviewed respondents perceive the lack of keen support from the various associations in the industry to support CE implementation as an important barrier.

4.2.2.3 Lack of supply chain integration and effects of supply chain complexity

Modern enterprises operate in the context of complex supply chains which involves the need to take decision on a range of factors (Coenen, van der Heijden and van Riel, 2018). Since, CE implementation may even require the need to close the loop of the traditional supply chains, dynamic complexity and deep uncertainty is even much more significant in such scenario. Thus, the literature highlights the lack of supply chain integration and effects of supply chain complexity as a significant barriers to CE(Linder and Williander, 2017). Likewise, 5% of survey respondents perceive the importance of supply chain integration and effects of supply chain complexity as an important barrier to CE implementation.

5. Discussions, managerial implications and conclusion

Due to the importance of CE, numerous government policies and enterprise commitments have been taken to advance the idea of CE especially in China, European Union region and many other developed regions and countries (Winans, Kendall and Deng, 2017). However, enterprises in emerging economies interested in implementing micro level CE practices such as cleaner production, eco-design, green purchasing, consumption and product recycling or reuse in their enterprises are at the elementary stages of the agenda for CE and require well-designed business strategies to foster successful transition to CE. These CE practices has the potential to advance the design

of reverse supply chains, recycling, reusing or remanufacturing end-of-life products (Nasir *et al.*, 2017).

This study explored the perceived drivers and barriers to CE implementation among large scale enterprises in the Pakistani automobile industry by means of an explorative approach with a survey questionnaire and interview guide. The study identifies and offer an understanding of the relevant drivers and barriers to CE implementation in the Pakistani automobile industry that can be a foundation to design effective management strategies and policies for the transition of linear models product flow to circular systems. Among the pressing drivers identified in the study, it shows that managers are strongly motivated by the potential of CE to increase profits, market share and benefits of shareholders as well as, the potential of the enterprise to reduce cost. This outcome is in agreement with some existing studies. For example, studies that have investigated barriers to CE in manufacturing industry also identified cost saving as the key driver to CE in manufacturing industry (Stahel, 2010; Walsh, 2010).

Also, enterprises concern for environment which is a part of their business principles, interest to design for environment, resource efficiency and lean manufacturing, as well as focus to deliver sustainable business and growth, encourages many managers of enterprises to consider the implementation of CE initiatives. On the other hand, due to the fact that many managers are not aware or well informed on the idea of CE and the financial cost of investment needed for implementation, many enterprise are hinder to implement CE initiatives. This is an interesting situation as Franklin-Johnson, Figge and Canning, (2016) argued that, though CE is attracting considerable governmental and institutional interest globally, it is the organizations and individual managers who are key to realizing this dream. This outcome clearly tells us that, CE is indeed in the infancy as people who are supposed to take the lead have little

to no knowledge about the concept. This explanation is in alignment with the outcome that, lack of expertise, lack of technical and technological capacity, top management influence and lack of resources are highly significant barriers that hinder the ability of enterprises to implement CE initiatives. This is not surprising as leadership is key to any organizational change and that unawareness on the part of these managers about CE could potentially lead to unwillingness to implement CE (Geng and Dobersteinm 2008).

Furthermore, the finding of the study suggests that many of the drivers and barriers of CE at the micro level are internal rather than external factors. In order for enterprises to overcome the hindrances to CE initiative, it is critical enterprises consider the many internal factors that limits their potential to transit to CE. One important vehicle for achieving this is to integrate CE initiatives into organization's strategy, mission, vision, goals and key performance indicators, which will call for employees training to inform etc (Kirchherr *et al.*, 2018).

Moreover, compared to previously identified barriers in other studies, it is interesting to show that unawareness is an extremely relevant barrier to CE implementation in the automobile industry (see for example Zhu and Geng, 2013; Mont *et al.*, 2017). The survey could further be explored to understand why awareness tend to be the most common barriers to CE in the automobile industry. Also, awareness campaign can also be used to ensure that enterprises get motivated to consider the implementation of CE initiative. Finally, further study can focus on barriers and drivers in SMEs in automobile industry.

References

Abubakar, F. (2018) *an Investigation Into the Drivers, Barriers and Policy Implications of*

- Circular Economy Using a Mixed-Mode Research Approach*. Available at: [http://etheses.whiterose.ac.uk/20947/1/FH Abubakar%282018%29 An Investigation Into The Drivers%2C Barriers And Policy Implications Of Circular Economy Using A Mixed-Mode Research Approach.pdf](http://etheses.whiterose.ac.uk/20947/1/FH%20Abubakar%282018%29%20An%20Investigation%20Into%20The%20Drivers%2C%20Barriers%20And%20Policy%20Implications%20Of%20Circular%20Economy%20Using%20A%20Mixed-Mode%20Research%20Approach.pdf).
- Agyemang, M., Zhu, Q., Adzanyo, M., Antarciuc, E. and Zhao, S. (2018) 'Evaluating barriers to green supply chain redesign and implementation of related practices in the West Africa cashew industry', *Resources, Conservation and Recycling*. doi: 10.1016/j.resconrec.2018.04.011.
- Amoyaw-Osei, Y. and Agyekum, O. O. (2011) 'Ghana e-waste country assessment', *SBC e-waste Africa Project*.
- Araujo Galvão, G. D., de Nadae, J., Clemente, D. H., Chinen, G. and de Carvalho, M. M. (2018) 'Circular Economy: Overview of Barriers', *Procedia CIRP*. doi: 10.1016/j.procir.2018.04.011.
- Behrens, A., Rinaldi, D., Drabik, E. and Rizos, V. (2016) *The Role of Business in the Circular Economy: Markets, Processes and Enabling*.
- Bernon, M., Tjahjono, B. and Ripanti, E. F. (2018) 'Aligning retail reverse logistics practice with circular economy values: an exploratory framework', *Production Planning and Control*. doi: 10.1080/09537287.2018.1449266.
- Blomsma, F. and Brennan, G. (2017) 'The Emergence of Circular Economy: A New Framing Around Prolonging Resource Productivity', *Journal of Industrial Ecology*. doi: 10.1111/jiec.12603.
- Boons, F. and Lüdeke-Freund, F. (2013) 'Business models for sustainable innovation: State-of-the-art and steps towards a research agenda', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2012.07.007.
- CEPS (2018) *The Role of Business in the Circular Economy*, Centre for European Policy Studies. Available at: <http://www.scopus.com/inward/record.url?eid=2-s2.0-84949807776&partnerID=40&md5=736fc93fe5bc8635ff79c068db9c0e1b%0Ahttps://www.ceps.eu/system/files/RoleBusinessCircularEconomyTFR.pdf>.
- Coenen, J., van der Heijden, R. E. C. M. and van Riel, A. C. R. (2018) 'Understanding approaches to complexity and uncertainty in closed-loop supply chain management: Past findings and future directions', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2018.07.216.
- Conny Bakker, M. C. Hollander, Ed van Hinte, Y. Z. (2014) *Products that last: Product*

- design for circular business models*. 2nd edn. TU Delft Library.
- Cui, L., Wu, K. J. and Tseng, M. L. (2017) 'Selecting a remanufacturing quality strategy based on consumer preferences', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2017.03.056.
- Van Eijk, F. (2015) 'Barriers & Drivers towards a Circular Economy - Literature Review', *Acceleratio*, (March), pp. 1–138. Available at: <http://www.circulairondernemen.nl/uploads/e00e8643951aef8adde612123e824493.pdf>.
- Ellen MacArthur Foundation (2013) *Towards the Circular Economy*, *Ellen MacArthur Foundation*. doi: 10.1162/108819806775545321.
- Ellen MacArthur Foundation (2015) 'Growth within: a circular economy vision for a competitive europe', *Ellen MacArthur Foundation*. doi: Article.
- Esken, B., Franco-García, M. L. and Fisscher, O. A. M. (2018) 'CSR perception as a signpost for circular economy', *Management Research Review*. doi: 10.1108/MRR-02-2018-0054.
- European Commission (2015) 'An EU action plan for the circular economy', *Com*. doi: 10.1017/CBO9781107415324.004.
- Fonseca, L. M. and Domingues, J. P. (2018) 'Adoption of Circular Economy concepts and practices by Portuguese Citizens and Companies', *Proceedings of the International Conference on Business Excellence*. doi: 10.2478/picbe-2018-0033.
- Forza, C. (2002) 'Survey research in operations management: a process-based perspective', *International Journal of Operations & Production Management*. doi: 10.1108/01443570210414310.
- Franklin-Johnson, E., Figge, F. and Canning, L. (2016) 'Resource duration as a managerial indicator for Circular Economy performance', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2016.05.023.
- Gaur, J. and Mani, V. (2018) 'Antecedents of closed-loop supply chain in emerging economies: A conceptual framework using stakeholder's perspective', *Resources, Conservation and Recycling*. doi: 10.1016/j.resconrec.2018.08.023.
- Geng, Y. and Doberstein, B. (2008) 'Developing the circular economy in China: Challenges and opportunities for achieving "leapfrog development"', *International Journal of Sustainable Development & World Ecology*. doi:

10.3843/SusDev.15.3:6.

- Geng, Y., Sarkis, J., Ulgiati, S. and Zhang, P. (2013) 'Measuring China's circular economy', *Science*. doi: 10.1126/science.1227059.
- Ghisellini, P., Ji, X., Liu, G. and Ulgiati, S. (2018) 'Evaluating the transition towards cleaner production in the construction and demolition sector of China: A review', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2018.05.084.
- Govindan, K., Diabat, A. and Shankar, K. (2015) 'Analyzing the drivers of green manufacturing with fuzzy approach', *Journal of Cleaner Production*, 96, pp. 182–193. doi: 10.1016/j.jclepro.2014.02.054.
- Govindan, K. and Hasanagic, M. (2018) 'A systematic review on drivers, barriers, and practices towards circular economy: a supply chain perspective', *International Journal of Production Research*. Taylor & Francis, 56(1–2), pp. 278–311. doi: 10.1080/00207543.2017.1402141.
- Gurtoo, A. and Antony, S. J. (2007) 'Environmental regulations: Indirect and unintended consequences on economy and business', *Management of Environmental Quality: An International Journal*. doi: 10.1108/14777830710826676.
- Hazen, B. T., Mollenkopf, D. A. and Wang, Y. (2017) 'Remanufacturing for the Circular Economy: An Examination of Consumer Switching Behavior', *Business Strategy and the Environment*. doi: 10.1002/bse.1929.
- Ilić, M. and Nikolić, M. (2016) 'Drivers for development of circular economy - A case study of Serbia', *Habitat International*. doi: 10.1016/j.habitatint.2016.06.003.
- Ingarao, G., Di Lorenzo, R. and Micari, F. (2011) 'Sustainability issues in sheet metal forming processes: An overview', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2010.10.005.
- Jawahir, I. S. and Bradley, R. (2016) 'Technological Elements of Circular Economy and the Principles of 6R-Based Closed-loop Material Flow in Sustainable Manufacturing', in *Procedia CIRP*. doi: 10.1016/j.procir.2016.01.067.
- de Jesus, A. and Mendonça, S. (2018) 'Lost in Transition? Drivers and Barriers in the Eco-innovation Road to the Circular Economy', *Ecological Economics*. Elsevier, 145(December 2016), pp. 75–89. doi: 10.1016/j.ecolecon.2017.08.001.
- Khan, S. A., Kusi-Sarpong, S., Kow Arhin, F. and Kusi-Sarpong, H. (2018) 'Supplier sustainability performance evaluation and selection: A framework and

- methodology', *Journal of Cleaner Production*. Elsevier Ltd, 205, pp. 964–979. doi: 10.1016/j.jclepro.2018.09.144.
- Kirchherr, J., Piscicelli, L., Bour, R., Kostense-Smit, E., Muller, J., Huibrechtse-Truijens, A. and Hekkert, M. (2018) 'Barriers to the Circular Economy: Evidence From the European Union (EU)', *Ecological Economics*. Elsevier, 150(December 2017), pp. 264–272. doi: 10.1016/j.ecolecon.2018.04.028.
- Kissling, R., Coughlan, D., Fitzpatrick, C., Boeni, H., Luepschen, C., Andrew, S. and Dickenson, J. (2013) 'Success factors and barriers in re-use of electrical and electronic equipment', *Resources, Conservation and Recycling*. doi: 10.1016/j.resconrec.2013.07.009.
- Kusi-Sarpong, S., Sarkis, J. and Wang, X. (2016) 'Assessing green supply chain practices in the Ghanaian mining industry: A framework and evaluation', *International Journal of Production Economics*. doi: 10.1016/j.ijpe.2016.04.002.
- Lee, K. H. and Kim, J. W. (2009) 'Current status of CSR in the realm of supply management: The case of the Korean electronics industry', *Supply Chain Management*. doi: 10.1108/13598540910942000.
- Li, X. and Li, Y. (2011) 'Driving forces on China's circular economy: From government's perspectives', in *Energy Procedia*. doi: 10.1016/j.egypro.2011.03.051.
- Lieder, M. and Rashid, A. (2016) 'Towards circular economy implementation: A comprehensive review in context of manufacturing industry', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2015.12.042.
- Linder, M. and Williander, M. (2017) 'Circular Business Model Innovation: Inherent Uncertainties', *Business Strategy and the Environment*. doi: 10.1002/bse.1906.
- Luthra, S. and Mangla, S. K. (2018) 'When strategies matter: Adoption of sustainable supply chain management practices in an emerging economy's context', *Resources, Conservation and Recycling*. Elsevier, 138(June), pp. 194–206. doi: 10.1016/j.resconrec.2018.07.005.
- Mangla, S. K., Luthra, S., Mishra, N., Singh, A., Rana, N. P., Dora, M. and Dwivedi, Y. (2018) 'Barriers to effective circular supply chain management in a developing country context', *Production Planning and Control*. doi: 10.1080/09537287.2018.1449265.
- McIntyre, K. and Ortiz, J. A. (2015) 'Multinational corporations and the circular

- economy: How Hewlett packard scales innovation and technology in its global supply chain', in *Taking Stock of Industrial Ecology*. doi: 10.1007/978-3-319-20571-7_17.
- Miles, M.B., Huberman, A. M. (1994) *Qualitative Data Analysis: An expanded sourcebook*. 2nd edn. California, USA: Sage:London & Thousand Oaks.
- Moktadir, M. A., Rahman, T., Rahman, M. H., Ali, S. M. and Paul, S. K. (2018) 'Drivers to sustainable manufacturing practices and circular economy: A perspective of leather industries in Bangladesh', *Journal of Cleaner Production*. Elsevier Ltd, 174(November 2017), pp. 1366–1380. doi: 10.1016/j.jclepro.2017.11.063.
- Mont, O., Dalhammar, C. and Jacobsson, N. (2006) 'A new business model for baby prams based on leasing and product remanufacturing', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2006.01.024.
- Mont, O., Plepys, A., Whalen, K. and Nußholz, J. L. K. (2017) 'Business model innovation for a Circular Economy: Drivers and barriers for the Swedish industry--the voice of REES companies'.
- Nasir, M. H. A., Genovese, A., Acquaye, A. A., Koh, S. C. L. and Yamoah, F. (2017) 'Comparing linear and circular supply chains: A case study from the construction industry', *International Journal of Production Economics*. doi: 10.1016/j.ijpe.2016.06.008.
- Ormazabal, M., Prieto-Sandoval, V., Puga-Leal, R. and Jaca, C. (2018) 'Circular Economy in Spanish SMEs: Challenges and opportunities', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2018.03.031.
- Park, J., Sarkis, J. and Wu, Z. (2010) 'Creating integrated business and environmental value within the context of China's circular economy and ecological modernization', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2010.06.001.
- Pheifer, A. G. (2017) 'Barriers & Enablers to Circular Business Models', (April), pp. 1–26. Available at:
<https://www.circulairondernemen.nl/uploads/4f4995c266e00bee8fdb8fb34fbc5c15.pdf>.
- Prendeville, S. and Bocken, N. (2016) 'Design for Remanufacturing and Circular Business Models', in *Sustainability Through Innovation in Product Life Cycle Design Part of the series EcoProduction*. doi: 10.1007/978-981-10-0471-1_18.

- Prieto-Sandoval, V., Jaca, C. and Ormazabal, M. (2018) 'Towards a consensus on the circular economy', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2017.12.224.
- Pringle, T., Barwood, M. and Rahimifard, S. (2016) 'The Challenges in Achieving a Circular Economy within Leather Recycling', in *Procedia CIRP*. doi: 10.1016/j.procir.2016.04.112.
- Quina, M. J., Soares, M. A. R. and Quinta-Ferreira, R. (2017) 'Applications of industrial eggshell as a valuable anthropogenic resource', *Resources, Conservation and Recycling*. doi: 10.1016/j.resconrec.2016.09.027.
- Ranta, V., Aarikka-Stenroos, L., Ritala, P. and Mäkinen, S. J. (2018) 'Exploring institutional drivers and barriers of the circular economy: A cross-regional comparison of China, the US, and Europe', *Resources, Conservation and Recycling*. Elsevier, 135(December 2016), pp. 70–82. doi: 10.1016/j.resconrec.2017.08.017.
- Rothenberg, S., Pil, F. K. and Maxwell, J. (2001) 'Lean, green, and the quest for superior environmental performance', *Production and Operations Management*. doi: 10.1111/j.1937-5956.2001.tb00372.x.
- Schroeder, P., Dewick, P., Kusi-Sarpong, S. and Hofstetter, J. S. (2018) 'Circular economy and power relations in global value chains: Tensions and trade-offs for lower income countries', *Resources, Conservation and Recycling*. doi: 10.1016/j.resconrec.2018.04.003.
- Shahbazi, S., Wiktorsson, M., Kurdve, M., Jönsson, C. and Bjelkemyr, M. (2016) 'Material efficiency in manufacturing: swedish evidence on potential, barriers and strategies', *Journal of Cleaner Production*, 127, pp. 438–450. doi: 10.1016/j.jclepro.2016.03.143.
- Smol, M., Kulczycka, J., Henclik, A., Gorazda, K. and Wzorek, Z. (2015) 'The possible use of sewage sludge ash (SSA) in the construction industry as a way towards a circular economy', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2015.02.051.
- Stahel, W. R. (2010) *The performance economy: 2nd edition, The Performance Economy: 2nd Edition*. doi: 10.1057/9780230274907.
- Tukker, A. (2015) 'Product services for a resource-efficient and circular economy - A review', *Journal of Cleaner Production*. doi: 10.1016/j.jclepro.2013.11.049.

- Vanner, R., Bicket, M., Withana, S., Brink, P. Ten, Razzini, P., Dijn, E. Van, Watkins, E., Hestin, M., Tan, A., Guilche, S. and Hudson, C. (2014) *Scoping study to identify potential circular economy actions , priority sectors, material flows and value chains, European Commission*. doi: 10.2779/29525.
- Walsh, B. (2010) 'PSS for Product Life Extension through Remanufacturing', in *Proceedings of the 2nd CIRP IPS² Conference, Linköping, Sweden,*.
- Wilson, D. C. (2007) 'Development drivers for waste management', *Waste Management and Research*. doi: 10.1177/0734242X07079149.
- Winans, K., Kendall, A. and Deng, H. (2017) 'The history and current applications of the circular economy concept', *Renewable and Sustainable Energy Reviews*. doi: 10.1016/j.rser.2016.09.123.
- Yang, M., Smart, P., Kumar, M., Jolly, M. and Evans, S. (2018) 'Product-service systems business models for circular supply chains', *Production Planning & Control*. Taylor & Francis, 29(6), pp. 498–508. doi: 10.1080/09537287.2018.1449247.
- Yang, S., M. R., A., Kaminski, J. and Pepin, H. (2018) 'Opportunities for Industry 4.0 to Support Remanufacturing', *Applied Sciences*. doi: 10.3390/app8071177.
- Yin, R. K. (2003) 'Case Study Research . Design and Methods', *SAGE Publications*. doi: 10.1097/FCH.0b013e31822dda9e.
- Yuan, Z., Bi, J. and Moriguchi, Y. (2006) 'The circular economy: A new development strategy in China', *Journal of Industrial Ecology*. doi: 10.1162/108819806775545321.
- Zhu, Q. and Geng, Y. (2013) 'Drivers and barriers of extended supply chain practices for energy saving and emission reduction among Chinese manufacturers', *Journal of Cleaner Production*. Elsevier Ltd, 40, pp. 6–12. doi: 10.1016/j.jclepro.2010.09.017.
- Zhu, Q., Geng, Y. and Lai, K. hung (2010) 'Circular economy practices among Chinese manufacturers varying in environmental-oriented supply chain cooperation and the performance implications', *Journal of Environmental Management*. doi: 10.1016/j.jenvman.2010.02.013.

APPENDICES

Appendix A : Main Survey Questions

1 Are you familiar with the idea of circular economy in sustainability?

Yes

No

2 What do you perceive as drivers for adopting of micro level CE in your enterprise?

.... Compliance with regulation

.... Increase profit

.... Lower cost

.....Available technology

....Awareness

....Stakeholders pressure

..... Others (mention): -----

3 What barriers do you perceive hinders the implementation of micro level CE in your enterprise?

.... Financial investment

.... Product quality

.... Government policies

.....Technical and technological capacity

..... Others (mention): -----

Appendix B: Interview guide main questions

1. What do you think drives CE in the automobile industry?
2. What has been your experience in your organization considering CE initiative implementation?
3. In what way do you think your organization is driven to implement CE?
4. Can you explain what practices you think you can do if you can implement CE initiatives and what could possibly motivate you to implement such practices?
5. What do you think are the barriers of CE in the automobile industry in Pakistan?
6. In what way do you think your organization is hindered to implement CE
7. Can you explain what practices you think your organization can implement in CE but it is been hindered