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Sustaining Circular Business Models: An Analysis of Successful Cases in Manufacturing Industries

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I. Introduction

Recognizing the significance of sustainability, businesses are striving to address the emerging sustainable challenges. Circularity, particularly through Circular Business Models (CBMs), plays a crucial role in tackling these sustainability issues by transforming traditional linear business practices into more circular and sustainable ones. However, the adoption of CBMs has been sluggish, with a noticeable decline in their practical implementation over the past few years [1], suggesting that an effective business model to support them is still absent. Therefore, focusing on successful CBM practices is needed [2]. According to existing research, most challenges related to CBMs are encountered within their circular supply chain due to complexities in reverse logistics, sourcing, and collaboration. Thus, we stress the urgent need to analyze successful operational practices related to resilience in supply chains of CBMs. Through this research, we aim to identify the patterns and specifics of cases that have succeeded in sustaining CBMs, as well as to pinpoint effective resilience-related practices (RRPs) for CBMs' supply chains through addressing the following research questions:

RQ1- Which industries are demonstrating consistent operational success as CBMs?

RQ2- What sort of practices have these successful CBMs adopted to build up resilience?

II. Literature Review

Studies have identified that CBMs achieve sustainability when their supply chains are integrated with resource loops [3]. A framework was identified introducing CBM's resource loop types- closing, slowing, narrowing, intensifying and dematerialising [3]. These loops explain recycling, extending product use phases, resource efficiency, service-based solutions and replacing products with software solutions or technology, respectively. Scholars argue that assessing static operations for CBMs is insufficient due to inherent uncertainties and risks [4], necessitating a focus on resilience [1]. Based on the sustainable supply chain resilience practices as mentioned by Negri [5] and three planning horizons identified by Lambiase [6], resilience practices are categorized into strategic (supply chain redesign, information sharing and effective design of reverse logistics), tactical (supply chain integration, demand management, supply management), and operational (lean operations, product characteristic management, top management commitment) dimensions. This framework serves to evaluate successful RRPs of CBMs for selected case studies.

III. Materials and Methods

This study employs content analysis as the methodology. The cases are drawn from previously conducted research identified based on a search string applied to the SCOPUS database. An inclusion criterion was set up to focus only on studies that were on case studies which explore CBM resource loop types. Out of 54 relevant studies, a total of 19 studies conducted with case studies were selected. Through an in-depth study of these papers, we identified 42 related cases across eleven industries. The data analysis related to these 42 cases was conducted using MAXQDA software and Microsoft Excel.

IV. Results and Discussion

A. *Successful Cases of CBMs across Industries*

The analyzed 42 successful cases on CBMs span over 11 industries as per Fig.1. Most of the successful cases represent electronic industry followed by construction sector. Among all identified cases, the ***closing loop*** emerges as the most prevalent CBM, as out of the 19 studies reviewed, 13 refer to this model and its practices, accounting for 68% of total cases. Closing loops were utilized in all cases of automotive, furniture and paper industries and six cases in electronic items manufacturing industry. The main reason for this dominance is that recycling is prioritized over the other resource loop types in the aforementioned industries [7]. ***Dematerialising loop*** is highlighted in 13 over 19 studies reviewed emphasizing 63% of total cases with prominence from automobile and ceramic sectors [9]. Those industries have utilized advanced industry 4.0 technologies such as AI, blockchain and IoT to implement dematerialising loops [8].

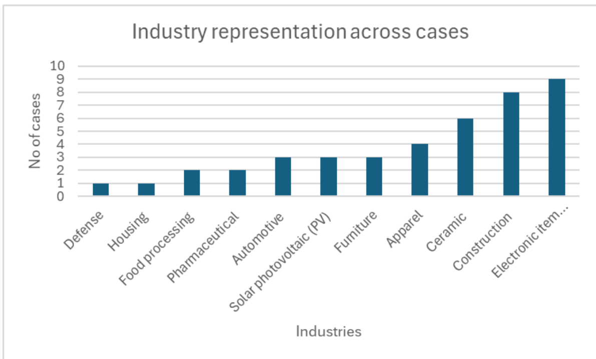

Fig. 1. Industry representation across cases

B. *Successful Cases of CBMs across Countries*

As shown in Fig.2, upon analyzing successful cases predominantly from Europe, it is clear that the adoption of advanced technologies such as IoT and blockchain is key to their success. Successful cases in CBMs are also reported in developing countries like India, Pakistan, and Bangladesh particularly in apparel industry mainly driven by global sustainability demands in manufacturing [9].

C. *Successful RRP for CBM Loop Types*

Fig. 3 represents the developed conceptualization on RRPs for each CBM resource loop. According to Fig. 3, the most mentioned loop types—closing, intensifying and dematerialising—are primarily linked to RRPs at the strategic level. In order to reduce their operational errors, both closing loops and intensifying loops require an efficient reverse logistics operation that is in line with the company's supply chain redesign [8]. Dematerialising loops entirely contingent upon information sharing and thus they need to think strategically in this practice. Additionally, they must strategically restructure their supply chain in light of the product replacement [7,8]. In businesses, dematerializing loops operate in tandem with closing loops, primarily to streamline reverse logistics operations [11]. Cases indicate that closing loops are more advanced and often evolve with disruptions, emphasizing them to adapt more on suitable RRPs [11]. They engage with all RRP levels—strategic, tactical, and operational, demonstrating rapid success in implanting RRPs while other CBM loop types have only focused on one decision level of RRPs. Slowing loops currently lack effective RRPs and are advised to leverage parleying in conjunction with intensifying loops supported by strategic level RRPs.

V. CONCLUSION

This research investigates the successful cases of CBM that are performing effectively. Manufacturing industries like electronics, construction and ceramics have effectively adopted RRPs to sustain in the industry mainly because they are facing continuous disruptions. Among that, firms in Europe are performing well with RRPs and cases identify the reason as the attitude and affordability towards technology utilization. The developed framework represents which planning horizons have the firms focused when implementing RRPs successfully and which RRPs should be addressed accordingly. This study expands upon the work presented by Geissdoerfer [5] through adding CBM loop types and planning horizon levels. It assists practitioners in pinpointing the appropriate resilient practices. Future research should explore, industry-specific RRPs utilizing primary data for a concise understanding.

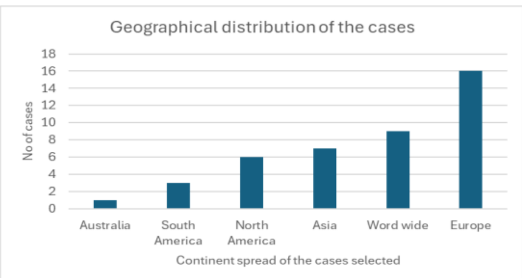

Fig. 2. Geographical distributions of the cases

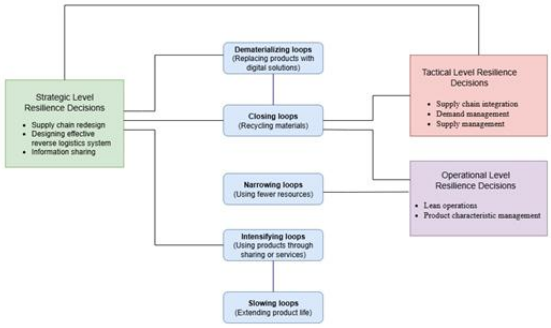

Fig. 3. Final conceptualization

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