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Antecedents of Frugal Innovation and its Relationship with Sustainability in Manufacturing Smes of Emerging Economies

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Abstract: - The rising disaster, climate issue and poverty across the world have become the reason of introduction of UN based Sustainable Development Goals (SDGs) and compelled companies to use less detrimental business practices. The situation is particularly precarious in the domain of SMEs because even multinational organizations were unable to adopt sustainable practices on a big scale. Therefore, the purpose of this study is to examine how design leadership and the sustainability of SMEs are related, with a focus on the mediating function of frugal innovation. Additionally, this study looked at how the link between frugal innovation and design leadership is moderated by dysfunctional competition. Convenient sampling was used to collect the quantitative survey from 340 employees of SMEs in Lahore and Faisalabad. SmartPLS 4 was used for the data analysis. According to the study's findings, sustainability and design leadership have a substantial beneficial link. Furthermore, the link between sustainability and design leadership is heavily mediated by frugal innovation. However, the link between frugal innovation and design leadership is not moderated by dysfunctional competition. Besides this, implications of this study are also given in a later section.

Keywords: *Design Leadership, Frugal Innovation, Sustainability, Dysfunctional competition*

I. INTRODUCTION

SMEs are backbone of several economies worldwide as they contribute majorly in their economy. It can be understood through various numbers e.g., 99.3% of the private SME businesses in UK provide 47.8% of total jobs (1), 99.8% of all the enterprises in Europe are SMEs which provide two third of all jobs and put 57% value addition in the EU organizations (2). Likewise, SMEs in China contribute 60% in the industrial growth (3). In the same manner, SMEs contributes significantly in the economy of the developing countries as contribute 33% in total income and 45% of total employment (4). Specifically, SMEs contribute 60% in the job market of the Asian countries (5). However, Small and medium enterprises are more prone to the uncertain and rapidly changing business markets due to lower resources and skills in comparison to the MNCs (6). This can be understood through the global financial crisis of 2008 that SMEs have experienced great loss in their business demand which caused financial distress (7). Furthers, sustainability has gained the significant attention across the world and further SDGs presented by UN have forced especially the manufacturing enterprises to adopt business practices which helps in meeting the economic goals along with the social and environmental goals. Hence, sustainability confirms the availability of the strategic resources to the organizations and helps to attain the competitive advantage (8). Further, sustainability determines the efficient resource utilization, encourage ecological betterment, financial wellbeing and reduces carbon footprints (9). Notably, organizations strive to attain the competitive advantage through sustainability, however, integration of sustainability in the organization is a complex process and difficult for the SMEs due to resource shortage (8).

On the contrary, emerging market customers require the cost effective and cheap products and services which can be attained through frugal innovation (10). Additionally, lower end customers of the emerging markets need the products and services which are less innovative but valuable and compatible. Here, frugal innovation is a useful strategy to the SMEs in order to meet the customer demand of valuable and cheap products in the emerging markets (11). Further, unique and innovative processes requires the leadership which entails the consideration of future and invests in innovative design environment that nurture innovation (12). Thus, design leadership can be an appropriate strategy to adopt frugal innovation (12, 13).

More specifically, SMEs play crucial role in the economic growth of these developing economies (13). These SMEs lack the resource which necessitate the novel innovative approaches to maintain their competitiveness and achieve their sustainability (14, 15). Frugal innovation is an appropriate method towards sustainability which

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exhibits the cost-effectiveness, resource optimization and production efficiency (16). In this way, advanced technologies i.e., IOT, automation, renewable energy systems supports in the adoption of frugal innovation (17). Precisely, cost effectiveness, energy efficiency, resource optimization are crucial for the manufacturing firms. Hence, technological advancements play key role to foster frugal innovation and ultimately achieve sustainability. Technology enables the organizations to overcome their resources shortage through managing the affordable and accessible innovation (18). For instance, SMEs may employ digital technologies such as cloud computing and other AI-based technologies that supports in producing goods at a reasonable price without sacrificing quality (19). In a similar vein, IOT and other digital technologies can reduce energy use and save cost (20). It is also mentioned that installing solar panels can both fulfill energy demands and remain economical (21). Additionally, enterprise resource planning, or ERP, helps businesses save money and solve operational process inefficiencies (22). Therefore, these technologies aid in the effective adoption of the thrifty invention.

Furthermore, dynamic markets of this modern era introduces more uncertainty and challenges which can undermine the organizational innovation process (23). Besides this, emerging markets upholds the political influence and power to penetrate in the business markets which raises the dysfunctional competition and may affect the innovation process (24). Previous literature have considered the influence of technology turbulence on the frugal innovation process of SSME in the emerging markets (13, 25), however, the dysfunctional competition affect in this relationship is in its infancy.

Precisely, SMEs in the developing countries experience less structured mechanisms to exploit the market opportunities (26) which can potentially influence the SMEs' resource utilization strategies and innovation business process. Legal functioning and structured rules and regulations has key importance in the smooth functioning of SMEs. As the political influence in the government departments is higher causes the dysfunctional competition (27). It is also noted that intense dysfunctional competition negatively influence the innovation process and enables the competitors to exploit the weak legal rules and regulation (23). Conclusively, literature has established the role of different leadership perspective on the organizational innovation process and sustainability. However, how the design leadership can be more productive to achieve the frugal innovation process in order to yield the sustainability in the context of SMEs is rarely considered. In addition, the findings have also overlooked how the dysfunctional competition in the business markets of the developing economies influence their innovation process and ultimately sustainability. Thus, current study investigates the relationship between design leadership and SMEs' sustainability through the mediation of frugal innovation. Further, this study analyzes the moderation of dysfunctional competition between the association of design leadership and frugal innovation. This study findings provide the empirical evidence on how the design leadership can be useful strategy to meet the sustainability goals in the context of SMEs from the emerging markets. Further, this study will highlight how the dysfunctional competition in these emerging markets undermine their frugal innovation process.

II. Literature Review

2.1. Underpinning theories

Resource based view theory is used as the underpinning theory along with the support of the institutional theory in current study. . RBV theory enlighten us that how SME's can utilize their scarce resources in order to adopt the innovation process to sustain in the market (28). These resources comprises of tangible and intangible resources (29). The design leadership act as the key resource that supports in the frugal innovation adoption and leads sustainability. Further, design leadership enables the SMEs in order to deal with uncertainties exist in external environment. Besides this, institutional theory provide the support to the organizations to link it with the external macro environment (30). Institutional theory provides the deep insight regarding the resource selection in the complex environment (31). Despite a significant awareness of the literature on the twofold issues of resource scarcity and institutional void, little is known about how frugal innovation occurs within these two simultaneous difficulties.

Furthermore, there are several external factors which can create hindrance in the success of SMEs. These hindrances include the state policy, political issues, customer choices (32). Therefore, institutional theory facilitate in providing the insights and overcoming these external hindrances.

2.2. Design Leadership, Frugal Innovation and SMEs' Sustainability

Leadership is crucial to achieve the desired design functioning of the firms (33). Design leadership invests in designing by creating strategies and a design environment in order to predict the future (33). Design leadership is known to foster an innovative atmosphere and maintain staff alignment with the organization's strategic design objective (33). Additionally, because they lack organizational capacities, businesses attempt to minimize the risks when confronted with disruptive innovation. It emphasizes the necessity of design leadership as a means of overcoming the problem of disruptive innovation and calls for creative solutions (34).

Design leadership is concerned with the adoption of emerging technology and the inventive requirements of the future (12, 35). For example, AI cuts down on resource waste and helps create sustainable solutions by effectively identifying the regions that require resources. Additionally, using institutional design leadership is beneficial for addressing the innovation problem (34). Frugal innovation encompasses product design, which makes low-income consumers able to purchase reasonably priced goods (36). In addition, the UN's sustainable development objectives have placed a strong emphasis on taking comprehensive steps to build social trust, reduce poverty, preserve the environment, and promote economic well-being (37). Further, leadership fosters the planning and innovation that assist sustainability (38). Thus, design leadership can be useful approach to adopt frugal innovation and ultimately meet the needs of low-income clients.

H1: Design leadership positively influence the SMEs' Sustainability.

H2: Frugal Innovation mediates the relationship between design leadership and SMEs' sustainability.

2.3. Frugal Innovation and Sustainability

Frugal innovation has emerged as a crucial technique in the quickly evolving business marketplaces that promote sustainability with limited resources, particularly for SMEs in developing nations (39). Frugal innovation is highlighted as a more practical approach to accomplishing sustainable goals as the economic, social, and environmental challenges that rising economies face become more obvious (40). Frugal innovations is helpful under the resource shortage and significantly reduces the socio-economic inequalities (41). Frugal innovation is the source of a company's prosperity by utilizing the fewest resources possible (Khan, 2016). Affordable and value-added products may be developed through frugal innovation to give lower-income consumers a high-quality living (42).

In a similar vein, frugal innovation has been seen to boost the profit ratio for businesses by producing cost-effective goods and services. Waste management, recycling, and resource conservation are examples of frugal innovations that improve ecological performance (16). Due to its low energy consumption and promotion of resource conservation, frugal innovation therefore improves economic performance (43). Further, frugal innovation encourages doing more with less which reduces the environmental impact (44). Thus, frugal innovation positively create the impact on the society through creating their wellbeing and overall health (41). Besides this, frugal innovation exhibits cost innovation and affordable value innovation which enables the SMEs to serve both requirements of the customers i.e., minimal cost and reasonable featured products in reasonable price (42, 45). Thus, frugal innovation successfully leads the sustainable outcomes (46). Thus, it is hypothesized that:

H3: Frugal Innovation positively influence the SMEs' sustainability.

2.4. Moderation of Dysfunctional Competition

The opportunist, unlawful and unjust behavior of the organizations in the market is described as dysfunctional competition (47, 48). Similarly, another study explains that dysfunctional competition determines the perceived legal support and protection regarding illegal activities (49). Dysfunctional competition creates hurdle in the way of innovation processes and ultimately influence the performance (48, 50). Innovation process involves the new methods to increase the efficiency and effectiveness of products while remaining cost-effective (51). Further, it is already established that innovation process in any organization leads the sustainable competitive advantage (52).

Besides, dysfunctional competition negatively influence the new venture's performance (49, 53) and discourages the speed of developing the new products (49). To elaborate more, China is one the countries where legal rules are inadequate (53) and organizations face challenges of patents and copyright violations in the market (54). Similarly, judiciary in India has flaws as it is expensive, vulnerable, and politicized(55). SMEs in India face the unlawful and unethical practices in markets (56). Under such unprotected environment, organizations face the challenge of dysfunctional competition and results in negative consequences. Previous study has also noted that dysfunctional competition has negative influence on the organization's profit (53). Further, India is growing rapidly and technological advancements are also prompt which increases the uncertain environment (23). Indian bureaucracy adopts the corrupt practices and damages the legal functioning (57) of business environment (56).

Thus, it is difficult for the SMEs to protect their business interests under such situation of injustice and illegal practices (23). Similarly, unlawful practices are part of the Pakistan's business environment in the system and authorities in the government are politicized which do not promote the sound competition and ultimately becomes the reason of dysfunctional competition. Thus, SMEs are not able to break these barriers as comparison to the firms with higher capabilities and resources. Therefore,

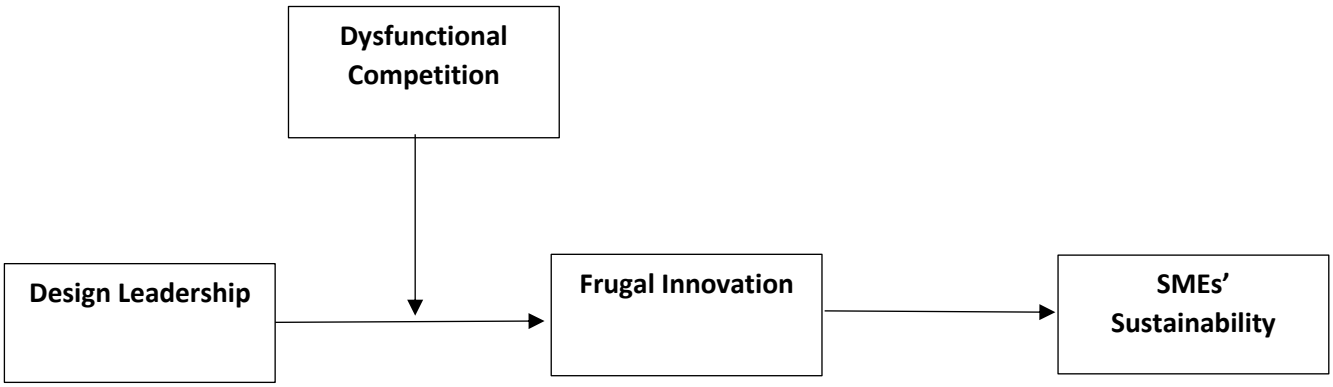
dysfunctional competition can cause failure of the new ventures (49). Previously, the study found the significant moderation of dysfunctional competition between the leader's intellectual capital and innovation (23). However, this study analyzed how the dysfunctional competition moderates the between design leadership and frugal innovation.

H4: Dysfunctional competition positively moderates the relationship between design leadership and frugal innovation

2.5. Theoretical Framework

Methodology

Figure1: Theoretical Framework



2.6. Data collection and sampling

In this study, manufacturing SMEs functioning in two big cities of Punjab province of Pakistan were targeted. The selected of Punjab province is based on the existence of 60% in this province which substantially contribute to the national economy (58). The convenient sampling techniques was used to gather the data from owners and managers of the SMEs in these cities. Further, the recommended sample size was 96 based on the G*Power calculator (59). However, this study collected 340 responses which was beyond the suggested sample size of 96.

2.7. Instruments and Tools

In this study, constructs were analyzed through the instruments adopted from the previously established studies. All of this study questionnaires were based on the 5-point Likert scale ranging from strongly disagree 5 to strongly agree=1. Precisely, this study adopted the 18-items design leadership instrument from Muenjohn, Chhetri (60). Likewise, frugal innovation was measured through suggested 5-items comprising cost innovation and affordable value innovation Zeschky, Winterhalter (61). Similarly, SMEs' sustainability was measured through 15 items emphasizing environmental, economic, and social performance (62). However, SPSS23 and SmartPLS 4 was used to analyze the descriptive, measurement model and structural analysis under this study.

III. FINDINGS

3.1. Data Analysis and Results

In the current study, SmartPLS 4 was used to perform the estimation analysis (63, 64). The recent studies have also validate SmartPLS 4 as the useful tool to predict the relationships among the constructs (65, 66). Besides this, measurement model and structural model was analyzed to validate and measure the path coefficient.

3.2. Data normality

Although data normality is not necessary for PLE-SEM, inferential statistics emphasize how crucial it is to confirm data normality prior to conducting additional analysis. Although it is crucial to verify data normality before to inferential statistics, PLS-SEM does not require it (67). However, in order to confirm the data normality and provide more compelling findings, we used SPSS 21 to examine the data normality. This study data was normally skewed and kurtosis between the suggested range of -2 and +2.

3.3. Common method bias

In this study, single time data was gathered from the participants which may raise the common method bias. Accordingly, the issue of common technique bias may be examined using a multi-collinearity test (68). Consequently, VIF, which evaluates the common method bias, was used to study collinearity and this study's all of the constructs scored lower than 3.3 which confirms that this study is free from common method bias (68).

3.4. Demographics

In the following Table 1 show the demographic details of this study's participants. Out of the 340 participants in the research, 290 (85.3%) were men and 50 (14.7%) were women, according to table 1. Additionally, out of 340 individuals, 163 (47.9%) were married and 177 (52.1%) were single. In terms of age, 181 participants (53.2%) were between the ages of 25 and 35, while 100 participants (29.4%) were between the ages of 18 and 25. Two participants (0.6%) were older than 50, while 57 individuals (16.8%) were between the ages of 35 and 50. Additionally, 52 individuals (15.6%) have additional credentials, 199 people (58.5%) have a master's degree, and 88 participants (24.9%) have a bachelor's degree. Finally, table 1's results reveal that 78 (22.9%) of the participants had less than a year's experience, 201 (59.1%) had one to five years' experience, 22 (9.7%) had six to ten years' experience, and only 28 (8.1%) had more than ten years' experience.

Demographics	Category	Frequency	Percentage
Gender	Male	290	85.3%
	Female	50	14.7%
Marital Status	Single	177	52.1%
	Married	163	47.9%
Age	18-25	100	29.4%
	25-35	181	53.2%
	35-50	57	16.8%
	Above 50	2	0.6%
Education	Bachelors	88	25.9%
	Master	199	58.5%
	Others	52	15.6%
Experience	Less than 1 year	78	22.9%
	1-5 year	201	59.1%
	6-10 year	33	9.7%
	Above 10 years	28	8.2%

Table 1: Demographics

3.5. Measurement model assessment

Table 2 reveals outcome of convergent validity, which was evaluated using AVE (Average Variance Extract), composite reliability, and item loadings. The majority of the items' factor loading was over 0.60, and those that had loadings below the standard number were disqualified. Additionally, every build has demonstrated composite dependability above 0.70, meeting the required standards (69). Furthermore, every construct in this investigation has an AVE that is higher than the recommended value of 0.50 (70).

Table 2: Measurement model assessment

Constructs	Items	Loadings	Alpha	CR	(AVE)
Frugal Innovation	FI1	0.744	0.818	0.873	0.579
	FI2	0.76			
	FI3	0.808			
	FI4	0.798			
	FI5	0.689			
Design Leadership	DL1	0.61	0.93	0.939	0.525
	DL2	0.653			
	DL3	0.791			
	DL4	0.804			
	DL5	0.784			
	DL 5	0.652			
	DL6	0.719			
	DL7	0.649			
	DL8	0.637			
	DL9	0.833			
	DL10	0.696			
	DL11	0.765			
	DL12	0.73			
	DL13	0.775			
Dysfunctional Competition	DC1	0.79	0.853	0.865	0.615
	DC2	0.751			
	DC3	0.789			
	DC4	0.806			
Sustainability	SUS1	0.777	0.941	0.948	0.566
	SUS10	0.658			
	SUS11	0.761			
	SUS12	0.757			
	SUS13	0.741			
	SUS14	0.659			

SUS15	0.745
SUS2	0.768
SUS3	0.782
SUS5	0.801
SUS6	0.702
SUS7	0.814
SUS8	0.745
SUS9	0.801

3.6. Discriminant validity

The discriminant validity of constructs may be evaluated using both HTMT and Fornell-Larcker criteria; however, Fornell-Larcker is unable to detect the discriminant validity in certain conditions (71). Thus, discriminant validity was analyzed and the HTMT value of this study's constructs was lower than the threshold value of 0.90 (72).

Table 3: HTMT

	Dys C	FI	KM	SUS
Dys C				
FI	0.469			
KM	0.398	0.78		
SUS	0.356	0.756	0.674	

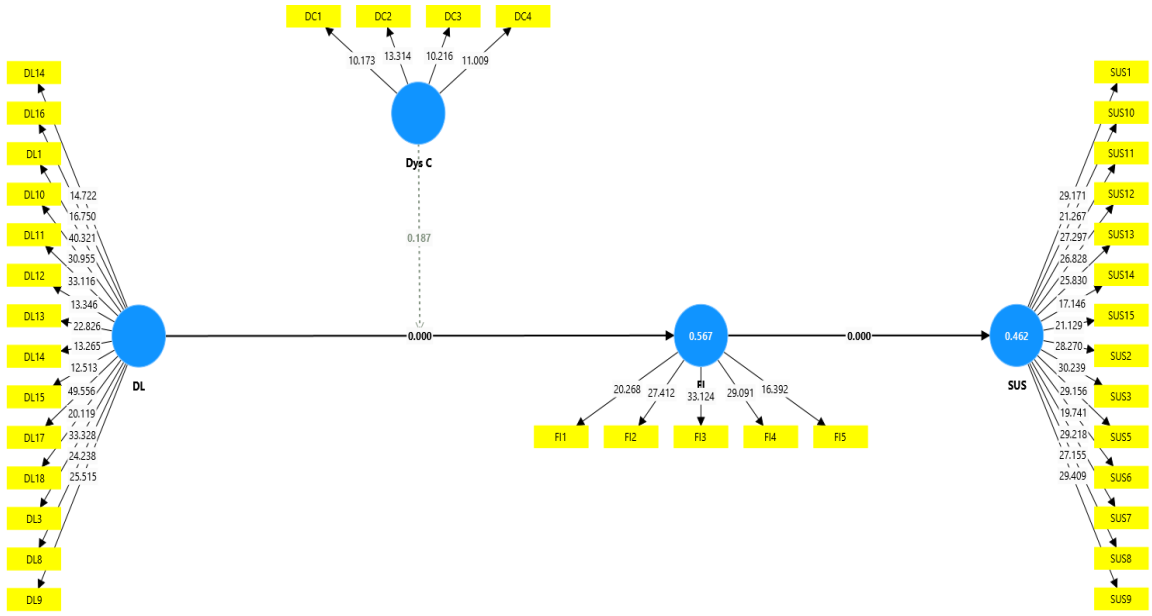
3.7. Structural model assessment

At SMART PLS, bootstrapping was also used to examine the structural model (73). Therefore, using path coefficients, standard errors, and t-values, the association between the variables in this study was examined. Additionally, the empirical hypotheses that were used to investigate the correlations between the research components are shown in table 4. All of the hypotheses in this investigation were approved based on the criteria of $t>1.645$ (95% CI) and $P<0.05$.

Table 4: Structural model assessment

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Direct Effect					
Dys C -> FI	0.234	0.238	0.04	5.878	0
FI -> SUS	0.679	0.684	0.029	23.798	0
DL> FI	0.611	0.613	0.035	17.436	0
Dys C x DL -> FI	-0.047	-0.046	0.036	1.319	0.187
Indirect Effect					

DL -> FI -> SUS	0.415	0.419	0.028	15.026	0



Structural Model Assessment (Fig. 2)

IV. Discussion

Global climate change has forced the organizations to achieve sustainability with one exception to the SMEs. As they are also striving hard to meet the requirements of people and reducing negative footprint on society and environment as well. Resultantly, innovative processes are need for creation of cost-effective solutions (26). Thus, this study examines the relationship between design leadership and SMEs' sustainability through the mediation of frugal innovation. Further, this study investigates the moderating role of dysfunctional competition between the association of design leadership and SMEs' sustainability. The data were collected from owners and managers working in the manufacturing SMEs.

This study results revealed that design leadership positively influence SMEs' sustainability. To best of author knowledge previous no study has tested design leadership and sustainability especially, in Pakistan SMEs context. This finding is in line with the recent study which have found the positive and significant relationship association between design leadership and innovation (12). Similarly, positive association has been reported regarding sustainable leadership (44),, self-leadership (Marvel & Patel, 2017). Further, this study results also highlight a positive association between frugal innovation and sustainability that is also in parallel to the recent literature (13, 74, 75). Moderating role of dysfunctional competition is also tested in this study. The results reveals the insignificant moderation of dysfunctional competition in context of SMEs. The reason for such results may be attributed to the limited resources availability, lack of awareness, and cultural aspects associated with the Pakistan based SMEs.

4.1. Practical implications

This study has also highlighted few implications for managers, administration and policymakers in context of SMEs. The study under lens of RBV highlights that management of SMEs can effectively use design leadership for radical transformation of their innovation processes to have desired outcomes. Specifically, manufacturers can reduce their resource consumption to avoid the negative impact on environment due to their operations. This study findings will help such organizations to understand how design leadership can foster sustainability. Similarly, study will also facilitate SMEs to comprehend how dysfunctional competition can affect them regarding their innovation processes such as frugal innovation and their preparation for sustainability. Accordingly, SMEs' managers need to emphasize on design leadership for cost-effective and innovative products to address the needs of low-end customers. This will not only facilitate business retention but also help them to be sustainable enterprise.

4.2. Limitations and Future Directions

There are also few limitation in the current study. First, this study has gathered the cross sectional data which can raise the issue of common method bias. Future studies can collect the time lagged data for to avoid this issue. Second, this study has gathered data from owners and managers, however, opinion of the employees should also considered for the holistic insights. Third, this study has collected data from only one province which can compromise the generalizability of the findings. Future researchers should focus on the participants from others provinces and emerging economies to achieve the generalizability of the findings. Fourth, current study has focused on the dysfunctional competition, however, future researchers should investigate how the design leadership and frugal innovation can be strengthen in the presence of AI and other digital technologies.

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