

Orchestrating frugal eco-innovation: the plethora of challenges and diagnostics in lean startups of emerging economies

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Abstract

Purpose – Sustainable development research assumes that startups, under extreme financial constraints, cannot sacrifice resources now for benefits later without risking their survival. Furthermore, their non-compliance with environmental regulations adds fuel to the fire. This paper aims to explore the challenges faced by startups in resource-scarce economies and the innovative ways of coping with these challenges.

Design/methodology/approach – The data for the study was collected through 17 semi-structured interviews taken from startup owners and industry experts based in Pakistan and Bangladesh. The transcribed data were coded through NVivo 12 and themes were generated by merging 47 open and 14 axial codes.

Findings – The findings show that a lack of government support and lack of organisational readiness and motivation significantly affect startups' frugal eco-innovation. Empirical evidence reveals problems related to the business ecosystem, and internal organisational issues also contribute to challenges faced by startups in attaining a competitive position in the industry.

Research limitations/implications – The study's findings suggested leveraging dynamic capabilities can help lean startups in frugal eco-innovation. Furthermore, organisational cohesion, business ecosystem, government regulations and assistantship, organisational mismanagement and market realisation are decisive in startups' competitive position in emerging economies.

Practical implications – The findings of the study will result in a higher adoption rate of more competitive business models, and hence, startups' sustainability. The results would be an effective and efficient deployment of sustainable technological solutions, creating more customer and shareholder value leading to economic growth.

Originality/value – This research offers a comprehensive analysis of frugal eco-innovative startups by exploring the interplay between different challenges and organisational capabilities. Furthermore, the study contributes to the existing body of knowledge by providing empirical evidence that eco-innovation can be conducted in a resource-constrained environment. This study challenged the scholarly and managerial assumption of the availability of finances as a significant player in

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eco-innovation. The study also links the Darwin theory of startups to a competitive edge over rivals for startups' survival.

Keywords Frugal innovation, Eco-innovation, Lean startups

Paper type Research paper

Introduction

The new startups' contribution to any country's economic development cannot be denied (Cantamessa, Gatteschi, Perboli, & Rosano, 2018), yet such ventures face many challenges (Hossain, 2018). Aiming to last long, very few sustain the initial business life, making durability a key and clear indicator of business success (Barnard, 1938). Earlier research found profitability, age and firm size significantly influence business durability. However, interest in innovation as a decisive factor has increased recently (Miranda & Borges, 2019; Ortiz-Villajos & Sotoca, 2018). Integrating innovation with sustainability (Forcadell, Aracil, & Úbeda, 2019) addressed the challenges faced by innovative startups due to the global environment's deterioration (Hepburn, Pless, & Popp, 2018). However, financial constraints play a significant role in the startups' decision to eco-innovate (Sica, 2018).

The integration of economic and environmental aspects with innovation (Ozaki, Shaw, & Dodgson, 2013; Stott & Tracey, 2018), on the one hand, created widespread human prosperity while on the other hand can address deteriorating global environmental system (Hepburn et al., 2018). Such integration can be beneficial for new startups in terms of increased sales, reduced risk, cost reduction (Forcadell et al., 2019) and becoming a more attractive employer by building up innovation capabilities (Schaltegger, 2011). Averting adverse environmental impacts and regulatory compliance are the primary drivers behind this emerging concept (de Jesus Pacheco, ten Caten, Jung, Navas, & Cruz-Machado, 2018). Notwithstanding these potential benefits, most of the organisations face severe challenges while dealing with sustainability-related issues. As human innovation is increasingly responsible for environmental deterioration (Hepburn et al., 2018), an eco-friendly approach is considered a viable solution. However, the lack of finances is the primary factor affecting lean startup's decision to eco-innovate (Sica, 2018). Although frugal innovation has gained significant attention in South Asian markets, there is a dearth of research in resource-constrained economies (Bhatti, Khilji, & Basu, 2013). The Global Innovation Efficiency Index ranked Pakistan and Bangladesh at 4 and 10, respectively, at the national level (Bhatti & Ventresca, 2013). However, weak economic institutional policies, resources and infrastructure discourage innovation (Mario Pansera & Owen, 2015). Furthermore, the developing an eco-innovative programme as an integral part of the company's strategy under enforced environmental regulations institutions is inevitable (Diaz-García, González-Moreno, & Sáez-Martínez, 2015).

The study of the above literature enriched our understanding of eco-frugal innovation concepts, yet the recent research studies identified many issues outstanding. As a measure of success (Barnard, 1938), the startups aspirant of durability considers innovation a significant source (Ortiz-Villajos & Sotoca, 2018). However, such innovations have been a source of a deteriorating global environmental system (Hepburn et al., 2018). Because of environmental impacts and legislation compliance, startups long for a more eco-friendly approach (de Jesus Pacheco et al., 2018). Yet, the lack of finances (Sica, 2018) has been considered a significant barrier to eco-innovation. Adding to the irony, the recent pandemic of COVID-19 has further increased the vulnerability of startups in emerging economies (Salamzadeh & Dana, 2020). This study, bridging the gap in the above literature,

investigates the challenges and diagnostics of resource-constrained eco-innovation through exploratory research (Ghisetti, Mancinelli, Mazzanti, & Zoli, 2017; Sica, 2018). Drawing on the Darwin theory of startups (Farbey, 2015), the study argues that four discrete sets of challenges will influence frugal eco-innovative startups' sustainability. Darwin's theory of "survival of the fittest" is the best-fit theory in such a competitive environment (Behl, 2020). Management scholars have recently laid the importance of strategic decisions for gaining a competitive edge over rivals (Raffoni, Visani, Bartolini, & Silvi, 2018). A large part of competitiveness is driven by the kind of resources that any firm possesses and how it builds upon it and uses it to expand its business (Anwar, Khan, & Shah, 2018). We explain the Darwinian model's application (Galvin, Rice, & Liao, 2014) to the dynamic capabilities of startups to leverage their efforts in addressing the challenges in the way of sustainability. So this research, taking a different approach, examines what challenges startups in the emerging economies face and how they are addressing such challenges in their quest for frugal eco-innovation?

This study has several significant contributions. Firstly, we provide a deeper understanding of the concept of frugal eco-innovation and explore how startups in Pakistan and Bangladesh are addressing frugal eco-innovation. Furthermore, the study also unveils the challenges faced by such startups in implementing such a model. Secondly, by providing empirical evidence that eco-innovation can be conducted in a resource-constrained environment, this study challenged the scholarly and managerial assumption of the availability of finances as a significant player in eco-innovation (Sica, 2018). Instead, this study finds innovation with non-deteriorating environmental impact is possible without high financing. Finally, the study provided a holistic model of the challenges and diagnostics of frugal eco-innovation better to understand the concept from a theoretical and practical perspective.

Literature review

Startups' role in economic development

Startups are considered the backbone of any economy. The growth of startups is significantly associated with economic development at the industrial, national and regional level through exploitation of new business and job opportunities (Tripathi, Seppänen, Boominathan, Oivo, & Liukkunen, 2019; Zaki & Rashid, 2016), yet some scholars such as Davis, Haltiwanger, and Schuh (1996) founded only larger companies contributing in the destruction and creation of jobs. Hence, in empirical studies, Fritsch and Noseleit (2010) proposed that both findings may be correct. The startups serve as a source of new job opportunities. Schindele and Weyh (2011) and induce employment growth in established firms, thus contributing to economic stability, social cohesion and new job creation (Forsman, 2008; Ratten, 2014). Furthermore, these companies can work as a spring for economic shocks. In the 2009 debt crisis and economic slump of Europe, for example, small and medium-sized enterprises (SMEs) accounted for more than 98% of all enterprises, thus serving as a backbone of the European economy, 58% of gross value added and 67% of total employment (Ecorys, 2012). Likewise, in the USA, SMEs contribute 99.7% of US employment, including 48.5% of private jobs, 63% of new job creation in the non-governmental sector and 33% of exporting value (SBA, 2014). Thus, the startup plays a significant role in economic development and stability, social uplift and employment, creating a national and regional level.

Pakistan and Bangladesh have been depicted as countries with a dysfunctional political environment (Mario Pansera & Owen, 2015). However, because of being densely populated countries, Pakistan and Bangladesh have a growing and dynamic SME sector

(Khandker, 2014). However, on the other hand, both countries are faced with environmental degradation issues (Sun, Mohsin, Alharthi, & Abbas, 2020). Some scholars (Bhatti et al, 2013) professed that emerging economies such as Pakistan and Bangladesh had shown the capability to outperform in resource-constrained environments. They further argued that such emerging markets had become the epicentre of frugal innovation because of plentiful sources of R&D, growing demands and large market size (Mario Pansera & Owen, 2015). Frugal products in emerging markets offer various low-tech entrepreneurial opportunities, meeting the local community's needs and improving millions of lives (Radjou, Prabhu, & Ahuja, 2012). Besides that, emerging markets are experiencing consumer demand for frugal products/services. This attraction is mainly associated with the characteristics and benefits of frugally developed products. For instance, frugal products are considerably cheaper, offer core functionalities, optimised performance (Weyrauch & Herstatt, 2017) and triple bottom line – social impact, environmental benefits and business opportunities (Mario Pansera, 2018). Although frugal products do not have sophisticated technological features, yet, meet customers' basic needs at a low cost by providing a comparably high value (Dost, Pahi, Magsi, & Umrani, 2019). Hence, a discussion focussing on emerging economies is reasonable. Despite the huge market for frugal products, the subject's theoretical investigation remains mostly unclear as of today (Weyrauch & Herstatt, 2017). Therefore, it is important to investigate the subject matter.

Frugal eco-innovation

Innovation has been historically associated with high financial requirement. In the current economic paradigm, competitiveness is based on the ability of countries and their respective companies to innovate (Barrichello, dos Santos, & Morano, 2020). The study of literature also shows that the theme of innovation, on the one hand, has been strictly connected with economic concerns; on the other hand, environmental areas integrating with the innovation process are gaining researcher's attention (Ozaki et al, 2013; Stott & Tracey, 2018). Thus, a new field of innovation management, simultaneously addressing economic and environmental efficiency, is getting researchers' attention. Cheng, Yang, and Sheu (2014) defined eco-innovation as "the invention, acclimation or manipulation of a production method, product, management or service or business model unique to the company resulting in reducing the ecological hazard, contamination and other adverse effects of resources used (including energy use) compared with relevant substitutes". Developing an eco-innovative programme as an integral part of its strategy under enforced environmental regulations and market pressure is inevitable (Cheng et al, 2014; Diaz-García et al, 2015).

Furthermore, sidestepping adverse environmental impacts and legislation compliance are also considered to be the primary drivers behind this emerging concept (de Jesus Pacheco et al, 2018), with the potential of changing the nature and intensity of competition amongst the firms (Doran & Ryan, 2012; Kammerer, 2009). Researchers have noted that eco-innovation is also directly associated not only with the business performance of any company (Cheng et al, 2014) but it also stimulates economic growth and development (Doran & Ryan, 2012). Hence, frugal eco-innovation is positively influencing the business performance at the company and regional level.

Financing eco-innovation, the policy agenda developed world, is essential for sustainable development and green growth. To contribute to sustainability and increase environmental efficiency, established corporations have a high probability of investing in green R&D. In contrast, SMEs in general and new startups specifically find difficulties to invest their limited resources in green innovation (Revell, Stokes, & Chen, 2010). Voluminous research can be found addressing drivers of eco-innovation (Horbach, 2008; Horbach, Rammer, & Rennings, 2012),

acknowledging the significance of demand-pull, supply push and regulatory factors for their development. Nevertheless, empirical studies are yet to investigate financial resources as a key constraint for carrying green research projects (Ghisetti et al, 2017; Sica, 2018). As the companies face resource scarcity problems, there is a need to explore the notion of eco-innovation that is less dependent on financial resources for its initiation in new startups.

As an alternative to costly innovation with skewed return (Kerr & Nanda, 2015), many individuals and companies from the developing world are opting for frugal innovation (Rosca, Arnold, & Bendul, 2017), the provision of “good enough” products and services sufficing the needs of resource-constrained consumers (Agarwal, Grottke, Mishra, & Brem, 2017). Hossain, Simula, and Halme (2016) defined “frugal innovation as a resource-limited work out (i.e. business model, service, product or process) implemented and designed notwithstanding technological, monetary, material or other resource limitations, resulting in significantly economical compared to the competitor and is well enough meeting the expectation of customers who otherwise may remain unserved”. Conceptually, frugal innovation is associated with the reduced cost of high-efficiency products or services (M. Pansera & Sarkar, 2016). Although predicting the success of frugal innovation can be challenging, developing countries with limited resources can serve as a breeding ground for such ventures.

Role of dynamic capabilities in startups

Although the dynamic capabilities perspective has become one of the most frequently used theoretical lense in management research, critics have repeatedly voiced their concerns with this literature, particularly bemoaning the lack of empirical research (Schilke, Hu, & Helfat, 2018). Dynamic capabilities are considered to be a useful tool for startups to sustain competitive advantage. As innovation is viewed as a change process, dynamic capabilities are associated explicitly with changes during innovation (Yunfei, Dongming, & Peter, 2014). The term dynamic capabilities refer to organisational capabilities that enable organisations to respond quickly to continuously changing scenarios (Oliva & Kotabe, 2019). In the hypercompetitive startup ecosystem, flexibility-based capabilities are highly significant. More robust dynamic capabilities mean that the startup has higher flexibility to adapt to the volatile environment (Yunfei et al, 2014). Thus, strong dynamic capabilities are necessary for fostering startups agility essential to address deep uncertainty, such as that generated by innovation and associated dynamic competition.

Research method

This study adopted an exploratory research approach (Yin, 2017) takes the liberty to explore insights concerning challenges faced by frugal eco-innovative startups. The study considers phenomenology an appropriate approach for the researcher to study the startup owners' experiences (Groenewald, 2004). These challenges loomed during our empirical data gathering, which was not expected during the research design and also not identified in the literature review (Bryman, 2016). This multi-method approach was based on the following four stages, namely, literature review, interviews with the practitioners, category building and thematic analysis (Akter et al, 2019).

Research context

This research is grounded in the startups of Pakistan and Bangladesh, emerging economies of Asia. Pakistan and Bangladesh have been depicted as countries with a dysfunctional political environment (Mario Pansera & Owen, 2015). However, because of being densely populated countries of the world, both Pakistan and Bangladesh have a growing and

dynamic SME sector (Khandker, 2014). However, on the other hand, both countries are faced with environmental degradation issues (Sun et al, 2020). Some scholars (Bhatti et al, 2013) professed that emerging economies such as Pakistan and Bangladesh had shown the capability to outperform in resource-constrained environments. The contribution of startups to economic development has been well-recognised (Mario Pansera & Owen, 2015; Shabib-ul-Hasan, Izhar, & Raza, 2012) and around the world (Forsman, 2008). After exploring the common issues concerning the general impact of startups, this research further identified 17 firms representing the startup sector. As unemployment is the most blazing problem and poverty and unbalanced development in these countries (Aslam & Hasnu, 2016), entrepreneurial culture development can be the best solution (Haque, 1961). In emerging economies such as Bangladesh and Pakistan, entrepreneurial culture development helps uplift the local economy and contribute to society through innovative startups (Aslam & Hasnu, 2016).

Research design and data collection

The study adopted a systematic literature review (SLR) (Hossain & Anees-ur-Rehman, 2016) for several advantages over the conventional narrative literature review approach (Hossain, 2018). It is a transparent, replicable and rigorous technique in the following sequence:

- Defining research questions.
- Designing the strategy.
- Study of relevant articles.
- Application of omission and addition standards.
- Assessing the quality.
- Synthesising literature (Charlton, 2012).

Following the procedure mentioned above, as described in the introduction part, the research questions were defined. In the next step, the research protocol was adequately planned. In total, 11 major databases and publishers were searched for related articles (Table 1). As a search term in the title, abstract and keywords, innovation, frugal innovation and eco-innovation were used. The peer-reviewed, full-text and scholarly journal properties were selected, for the ABI/INFORM complete database, to search academic nature articles. On the EBSCO database, peer-reviewed and full-text were applied as search limitations.

Table 1.
Articles reviewed
from each database
under systematic
literature review
(SLR)

Database	No. of articles retrieved
ABI/INFORM complete	63
Science direct	99
EBSCO	28
Taylor and Francis	63
Emeralds	41
IEEE Xplore	8
InderSciences	2
Web of Science	63
Sage premier	24
Scopus	44
Wiley	44
Total	497

For IEEE Xplore databases and Emeralds, no limitations were imposed. In the case of other databases such as ScienceDirect, Sage Premier, Scopus, Web of Science and Taylor and Francis the same technique was applied.

In the second stage, 17 semi-interviews were conducted from the founders of lean startups and researchers from different research institutions. The interview questions were formulated based on a literature review and group meeting, including startup owners and academia members. Furthermore, for validity, the interview questions were finalised with two experts from qualitative research who suggested several recommendations in the light of the study by McNamara (2009). The aim of including researchers in our sample was to get on first-hand data from academicians' perspectives. The sample size was determined using the thematic saturation technique, deciding the stage where little new information is obtained (Weller et al, 2018). The research participants' demographic analysis (Appendix 1) shows an average duration of each interview to be 35–58 min. As the interviews were a part of a more extensive data collection series on our research topic, we also used focus group interviews and non-participant observations (Appendix 2). Given the nature of the data involving the concept of frugal and eco-innovation, the purposive sampling technique (Creswell & Poth, 2016) was adopted to reach our data source with experience in field innovation management. Thirdly, based on transcribed data collected from interviews, coding was done using NVivo 12, a widely used software to analyse heterogenous qualitative data sets (Miles & Huberman, 1994), to explore the major themes. Qualitative data were analysed through a process of iteration, contextualised within an emerging structure of theoretical reasoning. The data were first coded with keywords that emerged from the data and were chosen following a practice-based epistemological approach (Renstam & Ashcraft, 2014). The transcribed data were coded into five themes that were generated by merging 47 open into 14 axial codes. The fourth and final stage comprises the thematic analysis of the interviews to identify major themes and categories of challenges encountered by frugal eco-innovative startups.

As the research participants were expected to expose some issues related to those governing bodies with which they will interact in the future, confidentiality was assured. Each research participant was provided with a “participant information sheet”, giving a clear view of the interview's aims and objectives (Appendix 3). Furthermore, every respondent was requested to sign a consent form (Appendix 4), declaring his/her will to be a part of the research study as an interviewee. For maintaining privacy, the names of research participants and their companies were assigned special codes used in the study findings.

Findings and analysis

Based on interviews and thematic analysis, the findings of the study shed light on the challenges faced by startups in emerging economies. The interview data confirmed that startups showed great concern for sustainability. All the interviewees perceived the government, in addition to organisational and market-based challenges, can serve as a significant entity guaranteeing sustainable business. However, interview data also indicated that a lack of understanding and information about the financial aspect and awareness about eco-innovation had been vital factors of failure. An empirical analysis of the data also shows that the startups in the emerging economies struggle indigenously to handle the challenges, but such efforts need the business ecosystem's support Table 2.

Governmental challenges

One of the major challenges faced by startups is related to the government of the host country. There is a lack of assistance-ship while interacting with the government

Super-ordinate theme	Themes	Categories	Themes' description	
Challenges	Market-based challenges	Business eco-system	Social mindset of the people Difficulty in coordinating with partner organisations Complex bank credit policies Lack of understanding and knowledge Lack of owners will	
		Market realisation	Lack of understanding innovation concept Overestimation of profits by startups Inappropriate timing of pitching idea Availability of skilled labour Experience of the startup owners Age and maturity of startup owners	
		Entrepreneurial Qualification		
	Governmental challenges	Governmental assistance	Lack of support from government bodies Providing technical consultancies	
		Government regulations	Government complex regulatory procedures Difficulty in dealing with business regulatory authorities Absence of proper legislation for startups	
		Government bureaucracy	Non-cooperative culture in government organisations Lack of communication between government departments	
		Organisational mismanagement	Organisational readiness Wrong perception of innovation Problems created by the competitor with substitute products Lack of collaboration No focus on marketing and branding strategies	
	Organisational challenges	Training and development	Lack of skill inventory Lack of knowledge and understanding No proper guidance and mentorship Difficulty in time management Lack of capacity building programmes	
		Organisational cohesion	Lack of motivation in employees Lack of trust on each other Non-cooperative organisational culture	
		Financial challenges	Financial cognisance Perception of financial requirements Lack of funding Financial trade-offs Price sensitivity Quick ROI Fear of financial transparency of client organisations	
			Money management	

Table 2.
Themes and categories with themes' description

(continued)

Table 2.

Super-ordinate theme	Themes	Categories	Themes' description
Diagnostics	Dynamic capabilities	Out of box management	Adoption of concept marketing approach Resource sharing strategy Developing a crowdfunding strategy
		High-performance work practices	Adopting the practice of rewards Promoting the idea of expressive culture in employees Providing in-house training
		Lean management	Continuous improvement approach Making product affordable to the target market Adopting a cost efficiency approach Developing workable work protocols

departments in the early stages of the business life cycle related to technical consultancies and other supporting activities. An IT industry expert clarifies how Tech-startups are facing challenges when it comes to interacting with government bodies while trying to expand their operations:

90% of our IT/ITeS industry comprises of Startups that are less than 25 people in size. International presence for them is a luxury and with all the costs at hand, they can't travel often. Result its under-developed Founders who are restricted to small tickets sales of 20,000 dollars and less from online channels. Hence not only their sales are underwhelming, the workforce they employ also does not grow due to lack of vision exposure of their leadership. (SuA.TW.28th March 2019)

Owing to government regulations' complexities, the research participants argued that their abilities to implement frugal eco-innovative culture are undermined. Such complexities, found in concerned business regulatory authorities, drastically impact the business operations of lean startups.

Another challenge faced by new startups is the lack of communication between government departments due to governmental bureaucracy. As mentioned earlier, there is a lack of understanding at the government level regarding modern business operations and the subsequent government SOPs formulation. The communication gap between different government departments has worsened the situation:

The problem is that there is no proper dissemination of information regarding business and their ecosystem and the challenges that you are going to face and how you are to cater those challenges. (Bu.Dis.4th April 2019)

The results show that legislation is absent at the government level, complexity in rules and regulations, lack of supportive culture that hinders government from playing its role in supporting new startups to be frugally eco-innovative.

Along with government policies and assistance, the government bureaucratic structure plays a significant role in any country's economic uplift. Such inflexible bureaucracy in emerging economies puts a ceiling on inventive solutions to the problems faced by startups. Research participants reveal that government organisations' non-cooperative culture and non-acquaintanceship to new business modes is the main challenge leading to discouraging investors who want to set an innovative startup. The results show that legislation is absent

at the government level, complexity in rules and regulations, lack of supportive culture that hinders the competitive position of startups to be frugally eco-innovative.

Market-based challenges

Empirical evidence also reveals market-based challenges to be a set of challenges having a significant effect on a startup's success. The lack of a properly functioning business ecosystem is highly dependent on financial institutions. In emerging economies, bank credit policies can play a huge role in an entrepreneurial culture, but banks refrain from advancing loans in innovative startups. There is a need to change the social mindset from traditional business operations to innovative ways of doing business. Social mindset, another component of the business ecosystem, has a significant impact on new startups. Such a mindset does not give space to new startups to develop intellectual breeding ground to nurture their ideas. A tech-innovative expert shares his experience of interacting with people with an orthodox management approach:

Only decade old traditional modes to incentivize business are acceptable. These are from the time of Gen. Ayyub industrial era reforms. I.e. How to reduce cost of doing business (input tax, subsidies etc.), How to give incentives (cash rewards trade-show etc.), How to create HR supply (skill development trainings, short courses etc.). Most people's sitting at the top are like 'lakeer kay faqeer' for whom how it's been done for past few decades is the only kosher way of doing it. Any innovation, way new model will be seen negatively and casted away. This put IT companies at a disadvantage since none of the industrial era model work effectively for services and IT/ITeS sector. And none of these folks at the top understand IT services sector. (SyA.TW.28th March 2019)

Findings also reveal that incubation centres fail to change such mindset and bring new ways of doing business based on out of box solutions. The lack of entrepreneurial education leads to market realisation failure, making it difficult for startups to come to frugal eco-innovation. One respondent shared his view about the causes of startup failure:

Let me clarify you it's not because they are way too innovative it's because of the overestimation when a startup guy or a team comes up with the idea they overestimates things you know in those overestimation can lead to a failure of an organisation (UbK.DeW.2nd April 2019)

The realisation of market realities is one of the important challenges in the success of the startup. Findings reveal that startup owners do not give due attention to study the market in which they want to operate competitively, and hence, leads to the failure of the venture.

Financial challenges

Another set of challenges is varying perceptions about the role of finances. Findings reveal that most startup owners have a perception of huge financial requirements for environment-friendly innovation. It is the presence of this psychological barrier that leverages the inability of startups. In technological innovation, innovative startup owners face one other challenge: the lack of partnering with other businesses due to financial transparency. A digital payment startup owner share this view:

Again there are some small businesses like small schools who opposes it just because they know if they started using it there will be time when government will be asking them look you are receiving so much revenue so you should be taxed. So the tax is one reason small organisations are opposing it and transparency is another reason the government organisations are opposing it but this is technology and this is inevitable. (HK.PP.21st Feb.2019)

Analysing money management data shows that one of the main issues in green innovation is a quick return on investment (ROI). Investors believe that investing in frugal eco-innovative ventures should provide quick returns, the failure of which leads to winding up the venture. One respondent shares his opinion:

There is a pre-occupied belief that any investment in such ventures should give quick return and that's really inappropriate. (Ni.SW.7th March 2019)

Organisational challenges

Data also reveal that in addition to external challenges, startups performance is significantly influenced by internal challenges. These organisational challenges result in low organisational cohesion due to a lack of motivation in employees. Lack of collaboration amongst employees, proper management resulting in negatively affecting employee readiness for low-cost eco-innovative ventures, and perception about job loss due to tech-innovation constitute competitiveness challenges. Thus, lack of capacity building and guidance and mentorship programmes as an influencing factor in the competitiveness. A lack of understanding has also been found as a noteworthy factor in the sustainability of such startups:

There is a general resistance to change the traditional work protocol, right from planning to designing and manufacturing of end product. This is due to lack of awareness and understanding of managers of the concept of environment friendly innovation and associated benefits. (SuB.KG.7th May 2019)

The data analysis also shows that the startup's lack of proper management sometimes becomes a barrier to achieve the targets. Research participants indicated organisational and employee readiness as significant factors in startups to be frugal eco-innovative. As one respondent stated:

Moving from nothing to something or changing the ways of doing something always require efforts both physical, mental and psychological. As the human nature is, humans do not want to go out of their comfort zone. The bigger challenge as we see is nurturing our staff and our consumers on the changing paradigms. (UbK.DeW.2nd April 2019)

Building upon the results mentioned above, the evidence suggests that the eco-innovative startups face several kinds of challenges both outside (government, market and financial) and inside (organisational) the organisation. These challenges play a significant role in the startups' competitiveness. The results also indicated that the intensity of challenges varies from industry to industry, but their role cannot be denied.

Dynamic capabilities

The interview data indicate that startups in Pakistan and Bangladesh are making attempts to devise ways to tackle the challenges mentioned above. These toddling efforts aim at overcoming the challenges faced by lean startups is providing some leverage. Startups seek to influence organisational challenges by adopting contemporary work practices. For promoting frugal eco-innovative culture, some startups regularly arrange training, encourage employees to express their ideas and reward them accordingly. Data also reveal that concept marketing, resource sharing and crowdfunding are some of the new startups' strategies to address the financial challenges as out of box solutions. A ride-sharing startup owner shares a perfect example of eco-frugal innovative way resource utilisation:

We found a guy who was running a franchise. He wanted to make his customer feel that the office is having loads of work by giving a look of busy office. We need a free office so we had a partnership. In exchange when his guests visited they saw us working in this office so his reputation was building as if so much work is going on in his office. (Ni.SW.7th March 2019)

The data analysis shows that some startups' owners attempt to adopt "lean management" an approach by continuously improving their products, minimising costs, making the product affordable and continually improving work protocol. Research participants hope that such measures can help them to be in a position to compete with already established large organisations and break their monopoly. This comprehensive set of challenges, highlighted in the study, significantly influences frugal eco-innovative startups in emerging economies. Hence, it is likely to state that the key role of these constraints lies in the combination of the core aspects that should be taken into consideration by startups, not only in an external perspective but in an internal perspective and also by policymakers, aimed at increasing the probability of success of frugal eco-innovative startups.

Based on the results mentioned above, data further suggest that lean startups face many challenges when addressing the durability issues concerning frugality. There is multicollinearity amongst challenges affecting lean startups' durability, and hence, require a more holistic approach. Table 3 presents the challenges faced by frugal eco-innovative startups to achieve durability to encapsulate and integrate these results. The analysis of these results leads to the identification of significant challenges faced by startups. In most cases, these data affirm that startup owners consider issues related to the business ecosystem having a significant impact on sustainability (R^2 , R6, R8, R10 and R12). Based on these findings, the possibility of the impact of government complex regulations and lack of government support (R^2 , R4, R5, R5, R7, R8, R12 and R17) on the startups cannot be ignored. The lack of employee motivation and organisational readiness for the adoption of frugal eco-innovation has also been found to influence sustainability significantly.

This research also used NVivo and Voyant Tools for visualisation and further analysed themes and categories generated in thematic analysis. Figure 1 shows the hierarchy chart of themes generated by using NVivo for the study. The size of the plot segment shows the proportionate impact of challenges on the frugal eco-innovative startups. Under the theme of organisational challenges, lack of motivation, lack of knowledge and understanding and organisational readiness have more empirical evidence than other factors. Similarly, in market-based challenges, social mindset is found to be the highest contributing factor. Under the theme of governmental challenges, the lack of government assistance-ship is found to have the highest number of evidence from the interviews as a contributing factor to success as compared to the other factors. In the last theme of financial challenges, financial cognisance is found to have a more significant impact on frugal eco-innovative startups' sustainability.

Figure 2 shows the empirical evidence of the most frequent words and relative frequencies. A high degree of association is found in eco and innovation. Similarly, the degree of association between frugal and sustainability is also high throughout the data structure. However, there is less empirical evidence of the degree of association between frugal, eco, innovation, sustainability and startups are found while analysing the entire data set.

Similarly, Figure 3 shows the empirical evidence of different challenges faced by startup owners belonging to different age groups both in the services and manufacturing sector. The crosstab analysis of the data shows that startup owners belonging to the age group 26 to 35 are mostly affected by different challenges. The people below this age group are either completing their education or struggling to get the seed money to start their venture.

Challenges	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17
The mindset of the people about frugal eco-innovation importance	✓			✓	✓	✓		✓		✓		✓	✓		✓		✓
Customers' preferences to use frugal eco-innovative produces		✓		✓			✓	✓	✓			✓		✓			✓
Lack of knowledge and understanding in the business eco-system	✓	✓	✓	✓		✓		✓		✓		✓		✓	✓		✓
Barriers because of partner organisation		✓		✓	✓		✓		✓		✓		✓				✓
Poor industry-academia linkages	✓		✓			✓		✓		✓				✓			✓
Lack of innovation-oriented bank's credit policies				✓		✓				✓							
The need for upgrading technological infrastructure	✓	✓	✓		✓		✓		✓	✓		✓	✓	✓	✓	✓	✓
Understanding innovation and ROI by startup owners			✓				✓	✓		✓	✓			✓			✓
Lack of exposure and relevant qualification			✓	✓						✓					✓	✓	
Lack of support from relevant government bodies	✓	✓		✓		✓			✓	✓		✓	✓	✓	✓	✓	✓
The absence of technical consultancies for startups	✓		✓	✓	✓	✓		✓		✓		✓					✓
Complex regulations and lack of legislations for startups		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
Government bureaucratic culture		✓		✓		✓		✓		✓			✓		✓		✓
Perception about funding requirements and sources for startups	✓			✓	✓	✓								✓			✓
Organisational readiness for adopting frugal eco-innovation	✓		✓	✓	✓		✓	✓	✓		✓	✓	✓		✓		✓

Table 3.
Challenges faced by frugal eco-innovative startups

The people above this age group mostly quit giving time to startups and started doing the job in large firms or very few managed to expand their business to SME. The results also demonstrate that startups belonging to both the manufacturing and services sector face a high intensity of governmental and market-based challenges. However, the study finds more empirical evidence for the services sector's financial and organisational challenges than manufacturing. This is because the services sector is yet to establish itself as a sustainable industry.

Discussion

The conceptual model (Figure 4), based on data structure, explains the study results and connects them with the extant theory. To understand the influence of market-based challenges on frugal eco-innovative startups, this study explores the business ecosystem, market realisation and entrepreneurial qualification as significant antecedents. Extending the previous research findings focussing on the use of technology (Vilchez & Leyva de la Hiz, 2018), this research suggests an alternative interaction mechanism based on customers taste and preferences, change in the social mindset, development of knowledge and

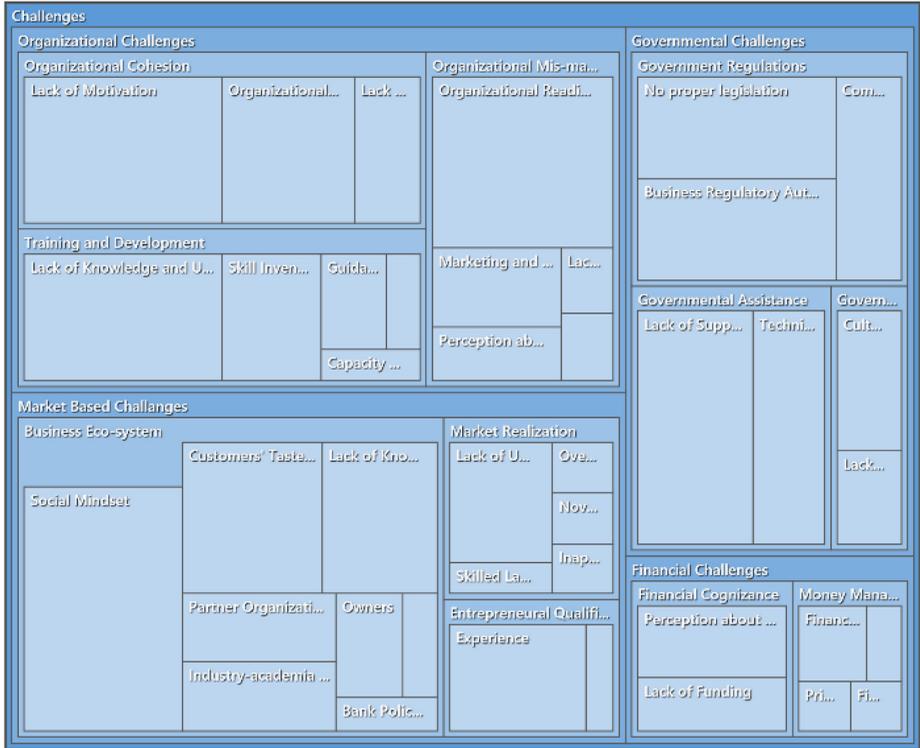


Figure 1. Barriers faced by frugal eco-innovative startups

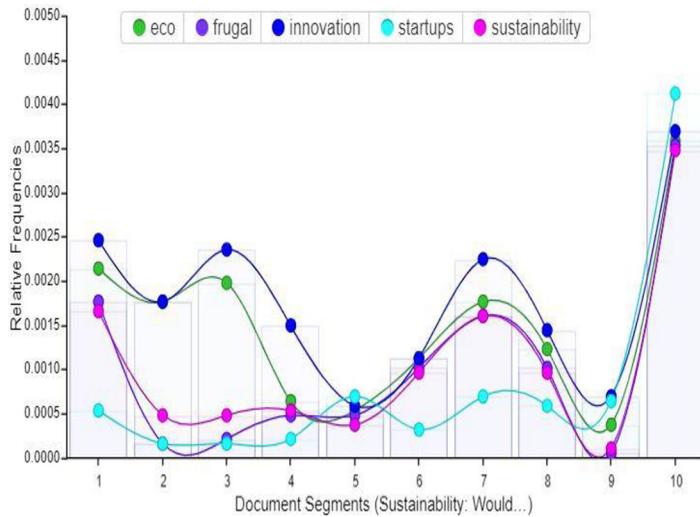


Figure 2. Association of most frequent words

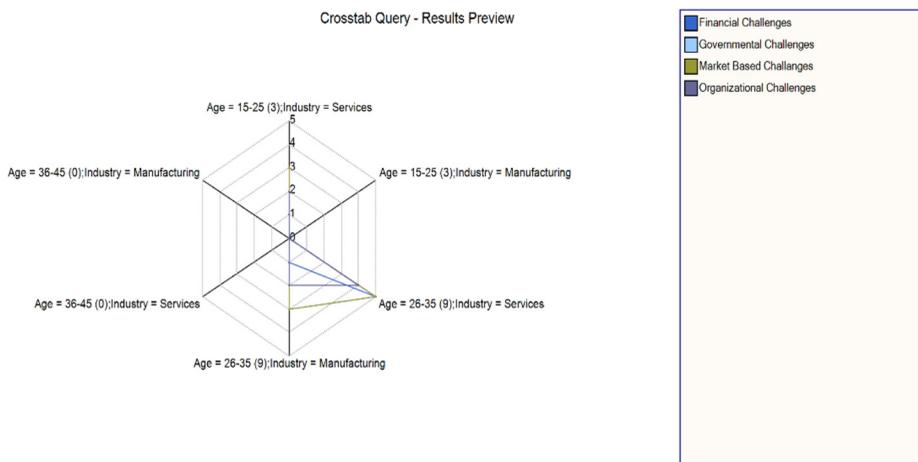


Figure 3. Crosstab query results showing cross-sectional results of barriers, age and industry

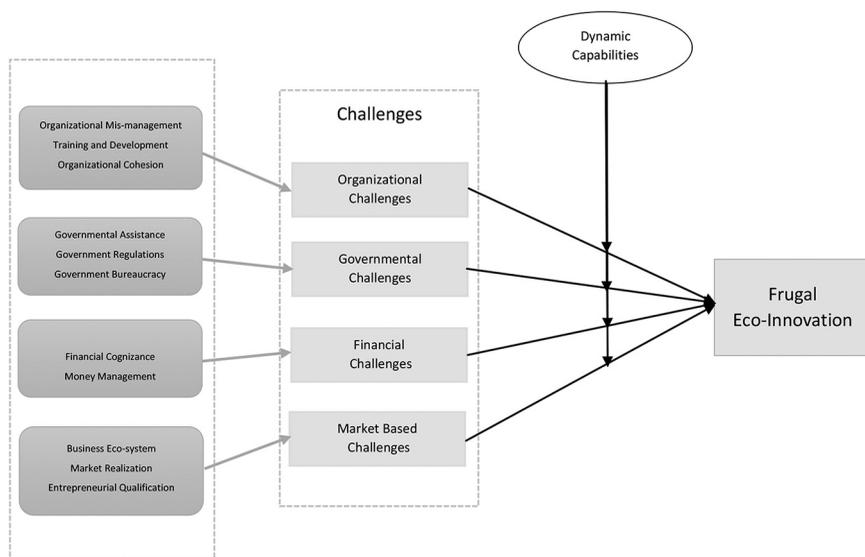


Figure 4. Consolidated model of frugal eco-innovation

understanding through the implementation of industry and academia linkages. Unlike large and medium-size organisations acquiring soft loans from banks and other financial institutions, frugal eco-innovative startups face a financing challenge. Thus, extending the research of [Kerr and Nanda \(2015\)](#) on the role of financing policies on innovation, this paper suggests redesigning bank and other financial institution’s policies customised to new startups’ requirements. Following the inquiry of challenges to frugal eco-innovative startups at the market level, this study suggests redesigning the business ecosystem ([Gonzaga, Figueiredo, da Cruz Souza, & Passos, 2020](#)) along with providing skilled labour and education for reading market trends. The study further explores that lack of willingness by

partner organisations and over-estimations of profits by new startups add to the market-based challenges that negatively influence the durability of frugal eco-innovative startups. Thus, this research proposed the proposition:

- P1.* A complex business ecosystem and an inability to read the market situation, and a lack of exposure hinder a frugal eco-innovative startup's success.

Government occupies a significant position as an important stakeholder in the conceptual model of frugal eco-innovative startups. In line with the findings of [Klewitz, Zeyen, and Hansen \(2012\)](#) regarding local authorities' role in triggering the eco-innovation in SMEs, the study found a significant impact of government specifically in the success of frugal eco-innovative startups. The lack of governmental assistantship, complex government regulations and the government's rigid bureaucratic channels as antecedents of governmental challenges significantly affect sustainability, as professed by [Horbach et al \(2012\)](#), [Xie, Huo, and Zou \(2019\)](#). Given the specific research focus on government significance in implementing eco-innovation, this research encompasses frugality concerning startups. Thus, contributing to the study of [Kanda, Rio, Hjelm, and Bienkowska \(2019\)](#) analysing government intermediaries' role in developed economies, this paper introduces the amalgam frugality to eco-innovation and fruit for thought for studying the complex interaction between different antecedent of governmental institutions. Thus, this research proposed the proposition:

- P2.* The complex interaction between different government institutions is significantly influencing the frugal eco-innovative startups.

In contrast, innovation management tends to argue that the sustainability of eco-innovative firms is triggered by finances' availability ([Kerr & Nanda, 2015](#)). The companies with high innovative capability but a low fiscal base are likely to be inhibited ([Hottenrott & Peters, 2012](#)) because investors are more concerned about the outcome than innovative skills. This study contributes to the existing research by contradicting the role of finance as a promoter of new startups ([Singh, Ashraf, & Arya, 2019](#)) on the grounds of inclusion of the concept of frugality. The study supports its findings by arguing that it is not the availability of finance but the wrong perception about the requirement of finance and demand for a quick ROI that serves as a barricade to frugal eco-innovation. Thus, the third proposition of the study is:

- P3.* The perception of high capital intensity has a significant effect on the probability of frugal eco-innovative startups to be constrained.

The results also indicate that in addition to the external challenges discussed above, the role of internal challenges, which previous studies did not fully explore, has a tangible impact on lean startups. Organisational mismanagement, lack of training and development and organisational cohesion as antecedents of organisational challenges limit frugal-eco innovative startups' success. Extending the previous findings of the impact of the organisational approach on economic performance and innovativeness ([Hadjimanolis, 1999](#); [Zhu, Wittmann, & Peng, 2012](#)), this article proposes internal organisational challenges, if not addressed properly, can have a significant negative effect on frugal eco-innovative startup. For instance, lack of organisational readiness to eco-innovate frugally, lack of innovation-oriented training ([Stock, Totzauer, & Zacharias, 2014](#)) and development programmes and innovative culture, and lack of motivation all contribute to organisational challenges having

an adverse effect on frugal eco-innovative startups. Hence, this research proposes the fourth proposition as:

- P4.* Organisational mismanagement, lack of innovative-oriented training and development and low organisational cohesion contributing to organisational challenges significantly influence the frugal eco-innovative startups.

Given the explicit research emphasis on innovation management, this research extends the understanding of frugal eco-innovative organisations' efforts. Looking differently from exiting research on the direct effect of innovative organisation efforts on firm performance (Santos, Basso, Kimura, & Kayo, 2014) and the impact of innovative strategies on employment growth (Vu, 2017), this article proposes a new research agenda of investigating complex interaction of organisational efforts at organisational-level on the relationship between various challenges and frugal eco-innovation of new startups. Following the inquiry of the influence of multiple challenges to sustainability at the organisational level, this study suggests dynamic capabilities such as out-of-box management, high-performance work practices and sig sigma approach influence the relationship between various challenges frugal eco-innovative startups' success. This research proposes the fifth proposition as:

- P5.* Dynamic capabilities comprising of out of box management, high-performance work practices and sig sigma approach influence the relationship between various challenges and the success of startups.

Theoretical implications

This study thereby elaborates the prevailing theory by refining sustainability in emerging economies by developing a frugal eco-innovation perspective and contributing to the existing literature in sustainability and innovation management. Hence, we provide a deeper understanding of the concept of frugal eco-innovation and explore how emerging economies' startups are addressing frugal eco-innovation. The literature reveals that adopting a frugal eco-innovative model is subject to many challenges in emerging economies (Hottenrott & Peters, 2012; Kanda et al, 2019). The authors argue that these challenges can pose severe threats to startups endurance unless handled tactfully. Hence, this research's conceptual development will become increasingly pertinent for the area under study at large.

Secondly, refining the concept of challenges to frugal eco-innovative startups, the article extends research from external challenges to intra-organisational challenges. The traditionally perceived challenges of government role and finances (Horbach et al, 2012; Kerr & Nanda, 2015) were considered the determinant of innovative startups' sustainability. Contrary, this study indicates that internal challenges, lack of motivation and wrong perception about the role of finances in establishing frugal eco-innovative startups are the significant players. Finally, by providing empirical evidence that eco-innovation is conducted in resource-constrained environments, we challenged the scholarly and managerial assumption that finances' availability plays a significant role in eco-innovation (Sica, 2018). Instead, the findings reveal that cost-efficient innovation having lesser environmental impacts is possible by adopting a proper strategy.

Managerial implications

The study aims to develop a sustainable business model for frugal eco-innovative startups in emerging economies. Furthermore, this framework will guide the startups in growing

their business model innovation process by planning the influencing activities and potential challenges with their impact on sustainability. The research also recommends the startup owners to capitalise on their strengths and develop their weaknesses. This will establish a framework for leveraging personal management tools and pool them into comprehensive and potentially synergistic toolboxes.

Aiding startup owners by providing supervision and the anticipation of constraints associated with the frugal eco-innovative businesses will have societal implications. The study's findings will result in a higher adoption rate of more sustainable business models. The results would be an effective and efficient deployment of sustainable technologies and solutions (Rashid, Asif, Krajnik, & Nicolescu, 2013), creating more customer and shareholder value leading to economic growth. Furthermore, the multifaceted, interdependent model presented in this study leads the decision-makers, with the scarcity of time, information and financial resources, to better understand the business ecosystem, thus helping them to be timely develop the strategies accordingly. The research also has a policy guideline for the governments struggling with socio-economic development and dealing with environmental issues. Identifying the government side's area to develop eco-friendly business culture can surely help the government of emerging economies to safe and healthy societies, thus saving many expenditures on the health sector.

This study has several significant contributions. Firstly, we provide a deeper understanding of the concept of frugal eco-innovation and explore how startups in Pakistan and Bangladesh are addressing frugal eco-innovation. Furthermore, the study also unveils the challenges faced by such startups in implementing such a model. Secondly, by providing empirical evidence that eco-innovation can be conducted in a resource-constrained environment, this study challenged the scholarly and managerial assumption of the availability of finances as a significant player in eco-innovation (Sica, 2018). Instead, this study finds innovation with non-deteriorating environmental impact is possible without high financing. The methodological contribution of this research stems from the development of a frugal eco-innovation model. To the best of our knowledge, rarely researchers have presented such a comprehensive model. The majority of the researchers have presented conceptual viewpoints related to the area (Brem & Ivens, 2013; Diaz-Garcia et al, 2015; Khan, 2016; Mario Pansera, 2018; Mario Pansera & Owen, 2015). Finally, the study provided a holistic model of the challenges and diagnostics of frugal eco-innovation better to understand the concept from an academic and practical perspective.

Conclusion

Drawing upon the conceptual model of frugal eco-innovation management, see Figure 4, the article draws its research attention to the sustainability of lean startups in emerging economies. Empirical evidence provided in this study insight into how various challenges influence lean startups in their quest for frugal eco-innovation? The results demonstrate the complex interaction mechanism between multiple challenges and their impact on startups. From the asymmetric flow of evidence in the findings, this study shed light on the controlling role of out of box management, high-performance work practices and sig sigma as dynamic capabilities efforts when it realises the influence of various challenges frugal eco-innovative startups. This research offers a comprehensive analysis of frugal eco-innovative startups by exploring the interplay between different challenges and organisational capabilities, leveraging corporate competitiveness. Furthermore, our study challenges the existing scholarly discourse about financial pre-requisites for eco-innovation. The study contributes to the existing body of knowledge by elaborating the prevailing competitiveness theory in emerging economies.

This research, like any other study, has some limitations. Being qualitative, this study was conducted in a specific context. Due to time and other constraints, the data is collected from only two countries. The information from other emerging economies and BRIC nations can provide some useful insights. Therefore, the study results cannot be generalised and can only be applied to a specific context. Despite lacking data breadth resulting in the more comprehensive statistically-based investigation, this research's strength is rooted in its ability to umbrella the depth of topic chosen in its relevant perspective.

This research also provides some future research directions for researchers to enhance startups' development in emerging economies. Giving a central position to the idea of sustainability, this study suggests how the government develops strategic endeavours in certain areas, including technology and innovation, evaluating relevant network structure that promotes the tech-innovative eco-startups. Being exploratory, future research can be conducted using a quantitative approach and the relevant impact of mentioned challenges on startups' sustainability. Furthermore, a study of more than two emerging and developed economies can also add some useful insights into the existing body of knowledge by providing a cross-culture comparison.

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Appendix 1

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Table A1.
Demographic
analysis of research
participants

Demographic characteristic	Sub-level	Count <i>n</i> = 17	%
Gender	Male	10	58
	Female	07	41
Age	15–25	02	11
	26–35	11	64
	36–45	04	23
Qualification	Bachelors	04	23
	Masters	08	47
	MS/MPhil	05	29
Industry	Services	10	59
	Manufacturing	05	29
	Experts	02	12

Interviewee ID	Encoded name	Encoded company	Country	Industry	Interview date	Duration
RP1	AnK	WDS	Pakistan	Services	3rd Feb 2019	51 min
RP2	AsK	SAS	Bangladesh	Manufacturing	9th Feb 2019	49 min
RP3	SA	DS	Bangladesh	Services	12th Feb 2019	43 min
RP4	FaS	FW	Pakistan	Manufacturing	16th Feb 2019	41 min
RP5	HK	PP	Bangladesh	Services	21st Feb 2019	35 min
RP6	Ha	MS	Pakistan	Services	2nd March 2019	50 min
RP7	Mu	SS	Bangladesh	Services	5th March 2019	48 min
RP8	Ni	SW	Pakistan	E-commerce	7th March 2019	58 min
RP9	Sh	Bi	Pakistan	Services	22nd March 2019	43 min
RP10	Sha	NC	Bangladesh	Manufacturing	28th March 2019	46 min
RP11	SyA	TW	Bangladesh	Services	28th March 2019	53 min
RP12	UbK	DeW	Pakistan	Services	2nd April 2019	40 min
RP13	Bu	DiS	Bangladesh	Service	4th April 2019	39 min
PP14	AfG	K	Pakistan	Expert	14th April 2019	44 min
RP15	FiB	BW	Pakistan	Services	28th April 2019	42 min
RP16	MaG	N	Pakistan	Expert	2nd May 2019	46 min
RP17	SuB	KG	Bangladesh	Manufacturing	7th May 2019	41 min

Table A2.
Interview schedule of
research participants

Participation information sheet

The investigators of this study

Syed Mudasser Abbas PhD Scholar (under the supervision of Professor Liu, Zhiqiang) at School of Management, Huazhong University of Science and Technology, Wuhan China.

What are the research aims?

The purpose of this study is to investigate the issues and barriers faced by new startups in sustainable frugal eco-innovation. The study aims to highlight the relevant impact of barriers explored through interviews with research participants.

Why have I been invited to participate?

You have been invited to participate in this study as you have experience of working/ exposure in a startup sector of Pakistan and Bangladesh.

What will I be asked to do?

- You will be asked to participate in a one-on-one interview with the researcher that will go for approximately half an hour.
- You will be asked a series of questions on your experience of running a startup and what challenges you are facing and what coping strategies work best.
- The answers you give will be recorded using a voice recorder. You will be asked to sign a consent form to ensure that you give the researcher permission to record this information about yourself.
- However, if you find voice-recording uncomfortable, you may choose to answer the questions in writing, after which a meeting with the researcher can be set for the clarification of the written answers without using a voice recorder.

Will my answers be kept confidential?

All information that is collected during the interview will remain confidential. The information gained from you during the interview will be analysed along with that of the other participants in this study. Personal or identifying data will be included subject to the consent of the participants. A research study will be submitted at the completion of this study, the information may also be used in academic articles. Only the researcher will have access to the transcript information.

How do I consent to participate?

A consent form is attached. By completing this form and bringing it on the day of the interview with the researcher and complying with the interview process, consent will be formally given.

What if I change my mind about participation?

At any time during the study, you have the right to withdraw your consent.

How will I benefit from participating in this study?

This study may not in the short run be of any benefit to you personally. The findings that will come from this study may be used in the researcher's study and academic articles. Short report outlining the main issues and a presentation if asked for will be delivered, which may become helpful for in addressing issues faced by startups.

Will participating in this study be harmful to me in anyway?

It is not estimated that this study will you harm in anyway. However, the interview questions will be investigating the personal and professional issues faced by startups, and therefore, might cause emotional strain. If this does occur during the interview, emotional support will be offered, along with counselling services.

Who can I ask any questions I have about this study?

If you have any further questions about this study, please contact

Name of Researcher: Syed Mudasser Abbas.

Contact email: smabbas_7@yahoo.com.

Enrolment Degree: PhD Scholar.

Supervision Team: Professor Liu, Zhiqiang.

University: School of Management, Huazhong University of Science and Technology, Wuhan P.

R China.

Note: You will also have the opportunity to ask questions before and during the interview.

Appendix 4. Consent form for research study

Title of Project: Orchestrating Frugal Eco-innovation: The Plethora of Challenges and Diagnostics in Lean Startups of Emerging Economies

Name of Researcher: Syed Mudasser Abbas

Please tick
to confirm

- I confirm that I have read and understand the information sheet for the above study.

- I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

- I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my legal rights being affected.

- I permit to include any personal and identifying data

- I agree to take part in the above research study.

Name of Participant Date Signature

Name of Researcher Date Signature

About the authors

Syed Mudasser Abbas is a Doctoral Candidate at the School of Management, Huazhong University of Science and Technology, China and a faculty member at Institute of Business Studies, Kohat University of Science and Technology, Kohat Pakistan. His research interests include creativity and innovation management, artificial intelligence and human interaction. He has published research articles in the *International Journal of Research in Business and Social Sciences*, *International Journal of Information, Business and Management*, *International Journal of Business and Social Research*, *Journal of Human Resource and Sustainability Studies* and *Public Policy and Administration Research*. Some of his research is under review in the *International Journal of Innovation, Creativity and Change*. Abbas is also a reviewer of a *Social Science Citation Indexed (SAGE)* journal [E-mail: smabbas_7@yahoo.com].

Zhiqiang Liu is a Professor at the Management School, Huazhong University of Science and Technology, China. His research interests include status competition in organisations, creativity, breakthrough innovation and LMX. He has published in *Journal of Organisational Behaviour*, *Journal of Vocational Behaviour*, *Human Relations*, *Journal of Business Ethics*, *Asia Pacific Journal of Management*, *International Journal of Human Resource Management* and *Cornell Hospitality Quarterly*, etc. [Email: zqliu@hust.edu.cn]. Zhiqiang Liu is the corresponding author and can be contacted at: zqliu@hust.edu.cn

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