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Implementing circular economy through bricolage, frugal innovation and technological turbulence

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Abstract

Scholars, practitioners, and policymakers are considering a circular economy (CE) to optimise resource utilisation and tackle issues linked to economic and environmental growth. This research investigates the association between entrepreneurial bricolage, frugal innovation (FI), technological turbulence, and the implementation of CE in Malaysia, an emerging market. The authors tested the hypothesised relationships using legged multi-source data and analysed them using the Smart-PLS-SEM technique. Data revealed that entrepreneurial bricolage is important in encouraging FI and CE. Meanwhile, the mediating role of FI amplified the link between entrepreneurial bricolage and CE. Furthermore, the moderation of technological turbulence amplified the link between entrepreneurial bricolage, FI, and CE. The findings indicate that firms employing a bricolage approach, characterised by accessing, storing, combining, and utilising readily available resources, exhibit enhanced performance during periods of technological turbulence through the implementation of CE and FI.

KEYWORDS
bricolage, circular economy, emerging markets, entrepreneurship, frugal innovation, technology turbulence

1 | INTRODUCTION

A global movement towards the implementation of circular economy (CE) is gaining momentum, with researchers, practitioners, and policymakers in China (Corvellec et al., 2022; Winans et al., 2017; Zhu et al., 2019), the USA (Corvellec et al., 2022), the European Union (Völker et al., 2020), Africa (Forum, 2020), and various local governments and corporations are actively exploring its potential (Foundation, 2017). There is a strong consensus that implementing CE holds immense potential as a solution to address intertwined challenges, particularly those related to economic and environmental growth (Dost & Umrani, 2024; Hu et al., 2019; Khan et al., 2021) and to optimise resource utilisation (Velenturf & Purnell, 2021). As (Ray & Ray, 2009) point out that businesses in developed and emerging markets are increasingly considering implementing CE, even if they operate in a resource-constrained environment. However, it is unclear what factors facilitate the successful implementation of CE in these resource-constrained contexts. There might be several factors, but we limit ourselves to entrepreneurial bricolage, frugal innovation (FI), and the contingency role of technological turbulence in implementing CE.

Evidence suggests that the firms that operate in deprived and resource-scarce environments may consider entrepreneurial bricolage and FI as a fit strategy to achieve innovative performance (Baker & Nelson, 2005; Garud & Karnøe, 2003), and implement CE (Eneh & Oluigbo, 2012). Frugal products are cost-effective, functional, and sustainable (Dost et al., 2019; Dost & Umrani, 2024). Meanwhile, CE prioritises the most efficient use of resources, significantly reducing the generation of waste (Eneh & Oluigbo, 2012). Much of the ongoing literature covers the conceptualisation of CE implementation

through bricolage and FI; nevertheless, little empirical evidence is available in emerging markets.

Resource utilisation is a critical attribute of entrepreneurship (Ghalwash & Ismail, 2022). Scholars consider entrepreneurship theories a useful lens for elucidating resourcefulness behaviour (MacArthur, 2013). Entrepreneurial bricolage as a local source of low-cost innovation (Busch & Barkema, 2021) is a crucial tool in low-tech and knowledge-intensive markets (Karagouni et al., 2013). With such importance, scholars suggest further empirical evidence on entrepreneurial bricolage and its outcomes (Tsilika et al., 2020), particularly when implementing CE through FI. For instance, leveraging local knowledge, networks, and readily available resources (bricolage) is essential for entrepreneurs across various stages of their ventures such as venture creation (Kwong et al., 2019), innovating products and services (Geissdoerfer et al., 2017; Witell et al., 2017), or scaling up (Busch & Barkema, 2021). However, a gap exists in the literature regarding how bricolage (i.e., accessing and utilising existing resources) facilitates the implementation of CE and FI.

Firms often achieve competitive performance through value creation. In particular, creating value through profitable social and environmental performance is one of the current competitive advantages, among other things (Zhu et al., 2023). In this vein, the successful implementation of CE can offer advantages to firms in achieving social, environmental, and financial performance (Ferasso et al., 2020). Implementing CE can be a fit strategy for firms operating in resource-constrained markets (Hu et al., 2019), through FI. Furthermore, FIs which possess the attributes of being cost-effective, functional, and sustainable (Dost et al., 2019; Hossain, 2020) have been critical solutions to combatting the COVID-19 pandemic (Dabić et al., 2022) by creating more value with fewer resources (Dabić et al., 2022). Further empirical evidence may be needed to investigate how FI's mediating role amplifies or attenuates the relationship between entrepreneurial bricolage and the implementation of CE.

The global economy experienced significant turmoil as a result of the pandemic (Li et al., 2022). Some industries witnessed unexpected growth, while others experienced substantial financial and market losses. Technological initiatives faced significant disruption during the pandemic, yet technological advancements continued to drive rapid change within industries and scientific communities. Firms had a short time window and opportunity to benefit from high accelerations. In such circumstances, the firms that operate in resource-scarce contexts may rely more on entrepreneurial bricolage to facilitate FI and CE. However, this relationship can be different in times of technological turmoil. Therefore, this research examines how technological turbulence acts as a moderator and amplifies or attenuates the relationship between entrepreneurial bricolage, FI, and the implementation of CE.

Subsequently, the study is organised as follows: Section 2 contains the theoretical background and hypotheses. Section 3 deals with the methodology. Section 4 follows the analysis of data and results. Section 5 discusses the results. Section 6 offers the theoretical and managerial implications. Section 7 presents the limitations and directions for future research.

2 | THEORETICAL BACKGROUND AND HYPOTHESES

By drawing on entrepreneurship and innovation theories, the authors investigate a vital link between entrepreneurial bricolage, FI, and the implementation of CE, as well as the mediating role of FI and the moderating role of technological turbulence in Malaysia, an emerging market. Figure 1 presents the conceptual framework of this research.

2.1 | Entrepreneurial bricolage

The essence of entrepreneurship is the efficient utilisation of resources (Ghalwash & Ismail, 2022). When resources are used effectively, it fosters the development of new products and the creation of new businesses. However, the process requires entrepreneurs to employ various tools and strategies to obtain resources for their establishment of ventures (Di Domenico et al., 2010). Accessing relevant resources facilitates product development, growth, and competitive advantage (Desa & Basu, 2013). In other words, resources are the source of competitive advantage. Most firms in emerging markets operate under resource constraints (Davidsson et al., 2017). In essence, firms operating in emerging economies must assemble and combine resources to build a platform of resources that will likely produce distinctive capabilities.

Bricolage in the entrepreneurial context refers to the ability to construct something new and valuable by creatively combining and adapting existing resources (Tsilika et al., 2020). Sarasvathy (2001) presents this concept as a 'bird-in-hand' principle of effectuation.

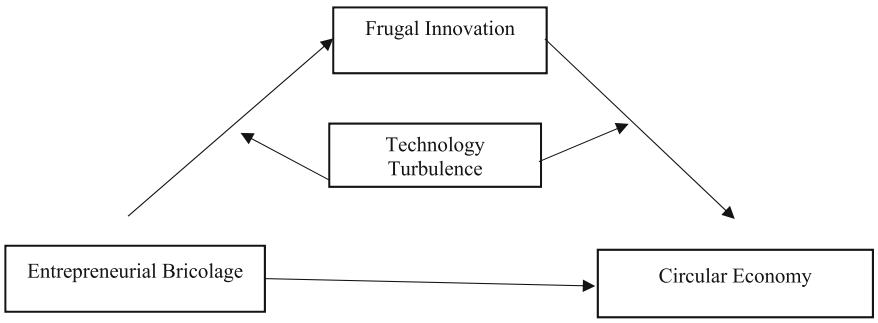

FIGURE 1 Conceptual model.

Others claim that bricoleurs borrow, improvise, and experiment with new elements or tinker with existing ones (Di Domenico et al., 2010). SMEs utilise bricolage to identify and pursue new opportunities (Guo et al., 2018). The behavioural theory of entrepreneurial bricolage, as outlined by (Senyard et al., 2009), explains how entrepreneurs navigate resource constraints. This concept is particularly relevant in the context of developing countries, where many firms operate under limited resources. As (Davidsson et al., 2017) highlight, these firms often turn to bricolage, relying on their ability to creatively combine and adapt existing resources to overcome challenges and pursue opportunities. In this research, the authors adopt Lvi-Strauss (1966) definition of entrepreneurial bricolage, emphasising the resourcefulness and improvisation of involved actors (Miner et al., 2001). This definition is particularly useful for analysing how individuals and groups creatively combine and adapt existing elements to solve problems, achieve goals, and construct meaning within their specific contexts.

Research on entrepreneurial bricolage primarily relies on inductive approaches. For example, Miner et al. (2001), investigated how improvisation is used in the creation of new products. They discovered a range of improvised products and factors that facilitated the development process. Meanwhile, some advocate for more studies on improvisation and the process of entrepreneurship. For example, it indicates that entrepreneurs do not carefully prepare ahead when launching new businesses. Instead, they react to the latest opportunities in ways that align with our understanding of entrepreneurial bricolage (Baker., 1995; Miner et al., 2001).

2.2 | Frugal innovation

Research on FI has looked at the uniqueness of its process as well as the attitude, beliefs, and philosophy of its innovators (Bhatti & Ventresca, 2013). Frugality is about doing more with less (Prabhu & Gupta, 2014; Radjou et al., 2012). Others believe it is about eliminating waste and making short-term sacrifices to achieve long-term goals (Bhatti & Ventresca, 2013). Individuals engaged in the FI process are characterised as quick thinkers and doers (Agarwal et al., 2016; Radjou et al., 2012). They can also turn resource-constraints environments into opportunities (Radjou et al., 2012). Sarasvathy (2001) conceptualised frugality as a distinctive behavioural trait related to bricolage and effectuation behaviours, that is, affordable loss and flexibility.

Frugal innovation has become more critical than ever before. Due to the intricacy of today's issues, there is a need for meaningful and innovative solutions (Kantola et al., 2017). Frugal innovation is essential to addressing urgent concerns (Hossain, 2020), especially in developing economies with scarce resources. Developing economies are attempting to create and amend business regulations to provide goods that satisfy growing demand and lessen the reliance on imports, as it has become increasingly difficult to meet local consumers. Consequently, innovations that promote economic growth are the main focus (Thun, 2018). Researchers consider FI a resource-scarce solution for businesses in emerging markets (Cai et al., 2019) to cater to the needs of underserved customers in low-income countries (Hossain, 2020) and new markets (Dost et al., 2019; Hossain, 2020). Advocates of ecological research acknowledge FI as an inclusive innovation approach that significantly reduces financial and natural resources while maximising value for shareholders, customers, and society (Rosca et al., 2017).

Existing literature show several definitions, concepts, and criteria for measuring FI. For example, Weyrauch and Herstatt (2017) recommend considering the three criteria of FI: reducing cost, concentrating on core functionalities, and augmenting performance. Similar criteria are included in the definition of FI in another recent research by Dost et al. (2019), which examines the influence of internal and external sources of knowledge on FI. These criteria include the extent to which products, processes, or services have been modified to make them affordable, functional, and sustainable. The authors operationalise the definition of FI proposed by Dost et al. (2019).

2.3 | Circular economy

Circular economy is a concept that is more widely accepted than it has ever been. Globally, this concept is promoted by numerous countries and businesses (Korhonen et al., 2018). However, there is also a debate among scholars that link CE to business model innovation (Ferasso et al., 2020); some argue that sustaining a successful company is mainly dependent on innovation in business models, which entails determining when a company has to undergo a significant transformation (Johnson et al., 2008). Whenever a business enterprise is established, it explicitly or implicitly employs a particular business model that describes its value creation, delivery, and capture mechanisms (Teece, 2010).

Despite the widespread use of the term 'business model', there is no commonly agreed definition of a business model (Sorescu et al., 2011). Instead, a wide range of definitions that vary in their emphases and scope can be found in the literature. Nevertheless, there is a broad consensus among researchers that a business model articulates a firm's value proposition, its revenue streams, the resources used to extract rents, and the governance structure that connects various stakeholders within the organisation (Sorescu et al., 2011; Zott & Amit, 2010). For example, Zott and Amit (2010) define a business model as 'a system of interdependent activities that transcends a focal firm and spans its boundaries. The activity system enables a firm, in concert with its partners, to create value and also to appropriate a share of that value'. Casadesus-Masanell and Ricart (2010) refer to 'the logic of the firm, the way it operates and how it creates value for its stakeholders.'. (Sorescu et al., 2011) claim that a business model describes the rationale of how an organisation creates, delivers, and captures value. To others, the business model represents a firm's distinctive logic for value creation and appropriation (Chesbrough & Rosenbloom, 2002; Gambardella & McGahan, 2010; Teece, 2010; Zott & Amit, 2010). Despite the proliferation of diverse definitions for 'business model' within the literature, the concept remains underdeveloped and under-theorised (Figge et al., 2022). Future research should focus on organisational integration,

TABLE 1 Operationalised definitions of variables.

Variable	Operationalised definition	Reference
Entrepreneurial bricolage	• Making do by applying combinations of available resources to new problems and opportunities	Lvi-Strauss (1966)
Frugal innovation	• Products or services that are affordable, functional, and sustainable.	Dost et al. (2019)
Circular economy	• A system that prioritises the most efficient utilisation of resources and empowers firms to significantly reduce waste generation.	Authors

measurement tools, and improvement strategies for CE to enhance eco-efficiency (Figge et al., 2022). A recent definition of CE refers to how natural resources influence the economy by providing inputs for production and consumption and acting as a sink for waste outputs (Geissdoerfer et al., 2017). Based on the various discussions and the research scope, the authors define CE as a system that prioritises the most efficient utilisation of resources and empowers firms to reduce waste generation significantly.

Circular economy has become a key topic in public debates due to its substantial environmental impact. For example, the EU declared the need for academic research on new and more sustainable economic models and strategies (Ferasso et al., 2020; Urbinati et al., 2017). Subsequent studies have found that CE has significant potential to solve sustainability-related challenges. Evidence in the literature shows that European and other governments are urging firms to implement CE (Khan et al., 2021). Some further classify CE according to the implementation of closed production systems, in which resources are recycled and maintained in a cycle of production and consumption, producing more value over an extended length of time (Urbinati et al., 2017). The following Table 1 presents the operationalised definitions of the variables.

2.3.1 | Entrepreneurial bricolage, CE and FI

Over seven decades ago, Lvi-Strauss (1966) defined intellectual bricolage as 'making do with what is at hand'. Now, scholars identify this concept as accessing, tinkering, and combining diverse resources for better outcomes (Meng et al., 2020) or scaling up social businesses (Busch & Barkema, 2021). Most studies focus on accessing and using available 'resources' to solve current and new problems. Notably, in resource-constrained environments, bricoleurs use abilities in local networks to get access to knowledge and other resources. They use various strategies to access local knowledge, networks, and resources throughout this process to create ventures (Kwong et al., 2019). The authors argue that entrepreneurial bricolage facilitates CE, prioritises the most efficient utilisation of resources, and minimises waste generation and FI. In other words, the ability of firms to access and combine valuable resources from their networks is crucial to facilitating new ventures (Kwong et al., 2019), product and service innovation (Geissdoerfer et al., 2017; Witell et al., 2017), and associate with CE and FI.

Why do firms intend to implement CE? Scholars have identified various compelling reasons, including solutions for resource-constraint challenges, waste mitigation, and sustainable benefits (Lieder & Rashid, 2016). Besides resources and capabilities, firms may require searching, gathering, and using different types of knowledge for varied outcomes. That may include solving complex problems, innovating products, processes, or services, acquiring competitive advantage, or enhancing financial and environmental performance. Furthermore, firms in resource-constrained markets may need additional access or assistance to purchase standard technology or competencies to attain CE. Therefore, they often rely on readily available information resources to overcome limitations. They creatively combine and recombine these resources, going beyond conventional constraints and biases, to take action and achieve their goals (Davidsson et al., 2017). That can result in achieving CE. In short, acquiring and using diverse resources through entrepreneurial bricolage facilitates CE. Thus, it can be hypothesised that:

> **Hypothesis 1.** Entrepreneurial bricolage is positively related to CE.

Start-up businesses and young ventures often operate within a context of resource scarcity (Davidsson et al., 2017). The primary reasons for resource constraints are due to context, personal or family wealth, borrowing reluctance, or unattractive investment opportunities. Entrepreneurial bricolage has been identified as a resource construction tool (Baker & Nelson, 2005). In the context of resource conservation, bricoleurs overcome resource constraints by engaging in help-seeking behaviours. Some of these activities can be very time-consuming while crucial for attracting investment (Senyard et al., 2009). Individuals engaged in bricolage behaviour access and use resources to achieve different goals. In bricolage, the act of 'making do' reflects a bias towards action (Baker & Nelson, 2005; Senyard et al., 2009). Rather than hesitating over whether a feasible solution can be generated from what is already at hand, the tendencies may be towards action and active involvement with challenges or possibilities (Baker & Nelson, 2005). The authors argue that bricoleurs' resourcefulness, where they actively seek and utilise what is available, fuels their ability to innovate frugally. Frugal innovation involves the development of affordable products, processes, or services that fulfil essential functions and are sustainable in use.

The essence of FI is about doing more with less (Dabić et al., 2022). Frugal innovation prioritises minimising waste by designing products with long-term benefits, even if it requires some initial adjustments or limitations (Bhatti & Ventresca, 2013). Frugal innovators who are described as quick thinkers and doers (Agarwal et al., 2016; Radjou et al., 2012) can convert constraints on environmental resources into opportunities (Radjou et al., 2012). Unlike those who wait for perfect conditions, bricoleurs actively seek and exploit

opportunities (Desa & Basu, 2013; Ghalwash & Ismail, 2022), using what is available to create frugal products. Under resource-constrained conditions, bricolage helps businesses adapt to exogenous disruptions (Tsilika et al., 2020), and promotes FI. Therefore, entrepreneurial bricolage is anticipated to require individuals to acquire, tinker, and improvise available resources to innovate frugally characterised products in resourced-constrained contexts. Thus, it can be hypothesised that:

Hypothesis 2. Entrepreneurial bricolage is positively related to FI.

2.3.2 | The direct and mediating role of FI on the link between entrepreneurial bricolage and CE

Sustainable innovation encompasses a broad spectrum of approaches, with recent trends including inclusive, reverse, grassroots, green, and social innovations (Tesfaye & Fougère, 2022). These diverse approaches all contribute to achieving sustainability goals. This research explores the recent rise of FI, a newcomer to sustainable practices. The word 'frugal' means 'simple,' 'plain,' or 'meticulously using money or supplies' (Tesfaye & Fougère, 2022). Firugal innovation is also associated with achieving more value with fewer resources (Dabić et al., 2022). They are finding ways to conserve resources while fostering innovation has become a key focus for researchers, businesses, and policymakers. Firugal innovation is an approach that thrives in resource-limited environments, particularly within emerging markets (Cai et al., 2019). Firms that operate in resource-constrained contexts may use limited resources to develop innovations for underserved customers (Hossain, 2020). Besides that, frugally innovative products create new markets and contribute to sustainability (Dost et al., 2019; Hossain, 2020) as well as economic growth (Thun, 2018).

Firugal innovation can be a powerful tool for businesses to embrace CE. By focusing on resourcefulness and minimising waste, FI aligns perfectly with CE's closed-loop system, where end-of-life products become resources for new ones (Stahel, 2016). As stated, many companies in emerging economies struggle to secure and utilise their needed resources. The application of CE models can be advantageous in certain resource-constrained situations (Ferasso et al., 2020) in terms of economic development (Hu et al., 2019), sustainable development (Merli et al., 2018), environmental, social, and financial benefits (Lewandowski, 2016) and improves resource productivity (MacArthur, 2013). These are the results of more efficient use and reuse of resources. By using resources more efficiently, businesses can achieve several positive outcomes simultaneously. This includes reducing their environmental footprint through lower resource consumption, energy use, emissions, and waste. This can be achieved without hindering economic growth or prosperity, ultimately leading to a more sustainable balance between economic, environmental, and social well-being (Ferasso et al., 2020; Geissdoerfer et al., 2018; Manninen et al., 2018). Therefore, it is argued that resource efficiency produces affordable, useful, and sustainable goods, which improves CE implementation. CE offers a win-win scenario for firms, fostering environmental responsibility and economic prosperity. Thus, it can be hypothesised that:

Hypothesis 3. FI is positively related to CE.

Earlier, the authors hypothesised that acquiring and using diverse resources through bricolage facilitates CE. The authors argue that this link may be strengthened when FI is mediating. Firms with strong resource management techniques achieve a competitive advantage. Utilising resources more efficiently, improving accessibility, and recombining them all contribute to creating new goods and acquiring a competitive edge (Meng et al., 2020). Frugality, doing more with less, is affordable, functional, and sustainable. These features make FI a viable option for production in resource-constrained contexts and valuable for implementing CE. Entrepreneurs who engage in bricolage are resourceful and make the most of their limited resources (Lvi-Strauss, 1966). Entrepreneurial bricolage involves individuals being resourceful by actively seeking and combining various resources from multiple sources (Meng et al., 2020). This approach fuels innovation, creating new products and services (Kwong et al., 2019), FIs, and implementing CE models. In other words, strong networks and the exchange of diverse knowledge act as a breeding ground for new businesses and innovative strategies. This, in turn, helps firms achieve superior performance and contribute to a CE. When firms develop the capability to create FIs, they have higher chances of achieving superior outcomes from entrepreneurial bricolage when implementing CE.

Circular economy is gaining traction as a strategic approach for businesses to address the interconnected challenges of resource scarcity, excessive waste generation, and achieving long-term sustainability (Lieder & Rashid, 2016). In addition to other pertinent resources and competencies, these firms might need to look for, collect, and apply various kinds of knowledge and such knowledge for multiple purposes. This could involve finding creative solutions to challenging issues, developing novel goods, services, or processes, gaining a competitive edge, and improving financial and environmental performance. Resource-constrained firms seeking CE may need help accessing or affording standard technologies and capabilities. Therefore, they use information resources to help them creatively reassemble existing resources, overcoming limits and action biases, to achieve circularity and overcome resource constraints (Davidsson et al., 2017). Firms that develop frugal innovations can leverage their resourcefulness to significantly enhance CE principles' implementation. In short, acquiring and using diverse resources through entrepreneurial bricolage increases FI, influencing CE. Thus, it can be hypothesised that:

Hypothesis 4. FI mediates the link between entrepreneurial bricolage and CE.

2.3.3 | The moderating role of technological turbulence

All industries are inherently dynamic, undergoing continuous, though variable, modifications to their products, processes, and

services. In particular, enterprises that deal with technological innovations are highly turbulent (Calantone et al., 2003)Technological advancements act as accelerants within industries and scientific communities, creating a more dynamic and potentially volatile environment due to the rapid pace of change. These accelerations give enterprises a brief window of opportunity to gain a competitive edge.

Additionally, a recent pandemic sparked a period of severe economic instability on a worldwide scale (Li et al., 2022). While some industries found unexpected benefits during the pandemic, others experienced significant setbacks. During a time of considerable uncertainty, companies are increasingly integrating technology into their operations. Technological advancements act as a catalyst for disruption, accelerating the pace of change in industries and scientific communities and leading to turbulent environments. Under turbulent technological times, the relationship between entrepreneurial bricolage, FI, and CE may differ. As discussed before, in this research, it is argued that the firms that operate in resource-scarce contexts may heavily rely on available resources and recombine those resources to facilitate affordable and valuable products, that are frugal products. Similarly, enhancing FIs can achieve high CE. Therefore, the authors consider using the moderating role of technological turbulence on the link between entrepreneurial bricolage, FI, and CE. Examining how FI and CE are affected by environmental and technical uncertainties in emerging economies during the pandemic is crucial. In other words, technological turbulence strengthens/weakens the link between bricolage, FI, and CE. Thus, it can be hypothesised that:

Hypothesis 5. The technological turbulence moderates the link between entrepreneurial bricolage and FI.

Hypothesis 6. The technological turbulence moderates the link between FI and CE.

3 | METHODOLOGY

3.1 | Measures

The present study applied different steps to ensure the reliability and validity of the data. First, the authors calculated Cronbach's Alpha and composite reliability for each construct. Next, the questionnaire items were measured with a 5-point Likert scale ranging from 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, and 1 = strongly disagree.

3.1.1 | Entrepreneurial bricolage

The authors incorporated entrepreneurial bricolage as an independent variable. The items of entrepreneurial bricolage were adopted from recent research by Davidsson et al. (2017).

3.1.2 | Circular economy

The authors incorporated CE as a dependent variable. The CE items were adapted from prior research (Jakhar et al., 2019).

3.1.3 | Frugal innovation

The authors incorporated FI as a dependent and mediating variable between entrepreneurial bricolage and CE. The items of FI were adapted from prior research (Bhatti & Ventresca, 2013; Dost et al., 2019).

3.1.4 | Technology turbulence

The authors incorporated technological turbulence as a moderating variable on the relationship between entrepreneurial bricolage, FI, and CE. The items of technological turbulence were adopted from the research Calantone et al. (2003). Table 2 presents the details of all the measures.

3.2 | Data collection

The authors chose SMEs in Malaysia for data collection. Malaysia's West Coast is famous for manufacturing companies (Musa & Chinniah, 2016). SME Corporation Malaysia (SME Corp. Malaysia) defines an SME in the manufacturing sector as having either a sales turnover of less than RM 50 million or a workforce of fewer than 200 employees (Kaliannan et al., 2016). The authors employed the purposive sampling technique to collect data from the target respondents. The sample population consisted exclusively of Chief Officers/Managers currently engaged in the operational management of their respective companies. For the selection of participating firms, this research adopted the following criteria: first, a firm must be in the manufacturing industry; second, a firm must have a maximum of 200 employees and a minimum of five employees; third, the sales turnover of a firm range minimum of RM300,000 and maximum RM50 million. The study eliminated firms with less than RM300000 in annual sales or less than five employees (Kaliannan et al., 2016).

As per the Federation of Malaysian Manufacturers (FMM) directory of 2019, there are a total of 2800 registered members who meet the requirements for SME manufacturing in Malaysia. A cross-sectional study was conducted to collect data from the CO/manager of the firm for a period of 4 months, from November 2021 to March 2022. In addition to the final sampling, the frame that met our study's criteria was 1709. Using the simple random sampling technique, the researcher used two methods for the survey. First, the authors sent a direct email with an online Google Form attached; second, the authors distributed questionnaires to 2000 manufacturing companies to complete the survey. To prevent respondents from declining to participate, the authors clearly stated the objective of this study in both the mail survey and Google Form. The respondents were assured that

TABLE 2 Questionnaire survey items of variables.

Variable	Item
Frugal innovation	• Products offer value. • Focus on core functionality. • Can easily be used. • Meet prescribed quality standards. • Offer 'good and cheap' solutions. • require significant cost reduction in the operational process. • Offer a reduction in the final price. • Have sustainability in the operational process. • During product/service development, our organisation partners with local companies in the operational process. • Offer solutions to customers' environmental needs. • The firm environment promotes the development of durable, low-cost, and maintaining products.
Entrepreneurial bricolage	• We usually find workable solutions to new challenges using our existing resources. • Typically take on a broader range of challenges than others with our resources would do. • Use any existing resource that seems helpful to respond to a new problem or opportunity. • Deal with new challenges by applying a combination of our existing resources and other inexpensive resources. • When faced with new problems or opportunities, we immediately act, assuming we find a workable solution. • Take on various new challenges by combining existing resources. • Put together workable solutions from existing resources when facing new challenges. • Combine resources to accomplish new challenges that the resources were not originally intended to achieve. • Access resources at low or no cost and combine them with what we already must deal with new challenges
Circular economy	• The implementation of CE offers financial incentives, that is, discounts and rebates. • Better access to recycling or composting facilities. • More information and education on the benefits. • Community programmes and support. • The regulations and policies that support the implementation of CE.
Technological turbulence	• The technology in our industry is changing rapidly. • Many new product ideas have been made possible through technological breakthroughs in our industry. • In our principal industry, the modes of production and service change often. • Virtually no R&D is done. • The modes of production and service change in major ways instead of slowly evolving.

TABLE 3 Measures, items, and sources.

No	Constructs	Items	Authors
1	Entrepreneurial Bricolage	9	(Davidsson et al., 2017)
2	Circular economy	6	(Jakhar et al., 2019)
3	Frugal Innovation	9	(Bhatti & Ventresca, 2013; Dost et al., 2019)
4	Technological turbulence	5	(Calantone et al., 2003)

their participation would remain confidential. For a better survey response, the manufacturing companies were contacted through websites and phones to get a speedy response, gentle reminders, and follow-up calls after 1 week. After 4 months, 351 companies responded to the questionnaire, representing around 35%. In previous studies, a 10% response rate was found to be shared among SMEs (Ho et al., 2016). Meanwhile, another study also explained that the ideal response rate ranges from 5% to 35% (Sekaran & Bougie, 2016). Therefore, a sample size of 351 meets the requirement and represents the population selected for this study. 13 questionnaires were excluded due to incomplete data, specifically missing responses in the central section. These 338 questionnaires were deemed appropriate for data analysis in SPSS and SmartPLS-3. The total receivable 338 questionnaires fulfil the sample size requirement for further data analysis (Ali et al., 2021). This response rate of the study is higher than prior research on SMEs in the manufacturing industry.

4 | ANALYSIS

4.1 | Using smart-PLS

The authors collected the data using questionnaire surveys and analysed it with the SmartPLS-3 technique. The purpose of using SmartPLS-3 was threefold. (1) it offers better scale reliability and validity (Ringle et al., 2015). (2) PLS-SEM technique with SmartPLS-3 software is often a complex conceptual model with the relationship hypothesised. that is, direct, moderation, and mediation level hypothesis. And (3) it handles complex models with many items and constructs. According to Ali et al. (2021), PLS-SEM ideally works on small sample sizes and non-normalised data.

4.2 | Measurement model assessment

The authors incorporated a two-step approach to SEM using PLS software. The first approach used a measurement model to assess item loading, average variance, composite reliability, R^2, and rho-A for convergent validity. The second approach used a measurement model to test the questionnaire's reliability, validity, and significance.

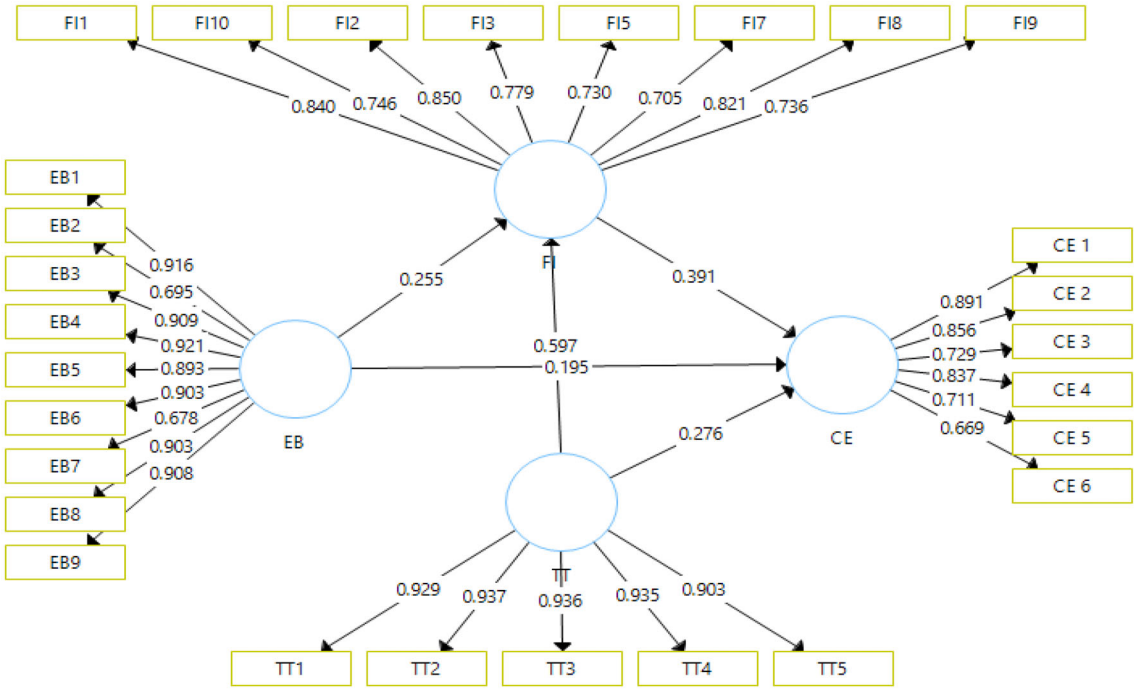

FIGURE 2 Measurement model.

Table 3 presents loadings of all items, average variance extracted (AVE), composite reliability, alpha, and R^2. All external loadings must exceed 0.5, as recommended by (Dijkstra & Henseler, 2015; Hair et al., 2017). Results confirm that apart from item 3 of FI and item 4 of CE, all loadings exceed 0.6, meeting the given requirement. The recommendation for AVE value is 0.5 (Hair Jr et al., 2014). Table 3 and Figure 2 show that the average variance ranged from .60 to .861, reaching the required acceptance level. The value needed for composite reliability is a minimum of 0.7. Table 4 and Figure 2 show that composite reliability exceeded their recommended values for all constructs, ranging from .969 to .906. Finally, the measurement model requires that the alpha recommended value is a minimum of 0.7 (Hair et al., 2017)—Table 4 and Figure 2 show that alpha exceeds .7, which meets the given recommendation.

Finally, to ascertain discriminant validity, Fornell and Larcker (1981) a criterion was employed, as shown in Table 5, that the square root of AVE was higher than the correlation values in rows and columns. In Table 3, the values highlighted show good discriminate validity and meet the requirement of Fornell and Larcker (1981). Second, a modern approach, HTMT, was also used on the suggestion of Kline (2015) to assess discriminate validity. Table 3 HTMT shows that the discriminant validity results meet criterion values of less than 0.85. The HTMT value of each pair construct did not exceed 0.85 the threshold.

4.3 | Structural model assessment

The second approach explains the relationship between the variables to examine the significance level for all hypothesised paths. In this step, the bootstrapping procedure was applied with 5000 samples and a one-tailed test, and 0.05 was set as a significance level for hypothesis testing—a second approach assessment of the structural model on the recommendation of (Hair et al., 2017).

Table 6 and Figure 3 summarise the findings of a structural model. H1 and H2 predicted the direct effects of entrepreneurial bricolage on FI and CE. The results revealed that entrepreneurial bricolage displayed significantly favourable effects on CE ($p < .00$, $\beta = .159$, $t = 3.445$) and FI ($p < .00$, $\beta = .253$, $t = 5.746$) accepting H1 and H2. H3 predicted the influence of FI on CE. Data revealed a significantly positive influence of FI on CE ($p < .00$, $\beta = .401$, $t = 6.616$), accepting H3. H4 predicted the mediating role of FI. Data revealed the mediating role of FI on the relationship between entrepreneurial bricolage and CE ($p < .00$, $\beta = .101$, $t = 4.141$), accepting H4. H5 and H6 predicted the moderating role of technological turbulence. Data revealed that the moderating role of technological turbulence strengthens the link between entrepreneurial bricolage and FI ($\beta = 0.117$, $t = 3.498$, $p < .000$) and FI and CE ($\beta = .129$, $t = 2.703$, $p < .004$), accepting H5 and H6.

4.4 | Predictive relevance

We examined R^2 on the amount of variance in endogenous constructs (CE and FI) explained by exogenous constructs. According to Cohen's (1992), the R^2 is considered if the R^2 value is .02, generally regarded as minor or weak. If R^2 values are .13, this value is usually considered a moderate effect size. If the R^2 value is .26, this is regarded as a generally substantial effect size. Following the guidance from Cohen (1992), the result of R^2 in the measurement model confirmed that entrepreneurial bricolage explained ($R^2 = .557$) a strong effects

TABLE 4 Measurement model.

Item	Loading	AVE	CR	Cronbach's alpha
		0.619	0.906	.874
CE1	0.892			
CE2	0.857			
CE3	0.730			
CE4	0.838			
CE5	0.710			
CE6	0.665			
		0.745	0.963	.956
EB1	0.916			
EB2	0.694			
EB3	0.909			
EB4	0.921			
EB5	0.893			
EB6	0.903			
EB7	0.677			
EB8	0.903			
EB9	0.908			
		0.606	0.924	.908
FI1	0.843			
FI2	0.744			
FI3	0.852			
FI4	0.782			
FI5	0.726			
FI6	0.708			
FI7	0.824			
FI8	0.732			
		0.861	0.969	.960
TT1	0.929			
TT2	0.937			
TT3	0.936			
TT4	0.935			
TT5	0.903			

TABLE 5 Heterotrait-monotrait ratio.

S#	Variable	1	2	3	4
1	Circular economy				
2	Entrepreneurial bricolage	0.547			
3	Frugal innovation	0.717	0.517		
4	Technological turbulence	0.695	0.458	0.719	

variance of CE. Entrepreneurial bricolage and technology turbulence were explained ($R^2 = .567$), and strong effects were variance in FI. The study's findings showed that the R^2 value of both CE and FI explained substantial variance effects size.

TABLE 6 Structural model.

Relationship	Beta	S.D	*T*-stats	*P*-values
EB–>CE	.159	.046	3.445	.000
EB–>FI	.253	.044	5.746	.000
FI–>CE	.401	.061	6.616	.000
EB–>FI–>CE	.101	.024	4.141	.000
Moderating effect 2–>FI	.117	.033	3.498	.000
Moderating effect 1–>CE	.129	.048	2.703	.004

This study also examines F^2 values for insight into the contribution of each latent construct. The F^2 test is complimented with R^2 to analyse the effects of specific latent variables on the dependent variables. Following guidance of Sawilowsky (2009), F^2 is effect size ($F^2 >= .02$ is small; $F^2 >= .15$ is medium; $F^2 >= .35$ is large) respectively. Table 5 shows that the effect size of entrepreneurial bricolage over CE ($F^2 = .039$) is small. FI effects on CE ($F^2 = .162$) are large effects. Turbulence effects ($F^2 = .91$) on CE are small. Entrepreneurial bricolage effects ($F^2 = .118$) on FI is medium, and technology turbulence effects ($F^2 = .646$) on FI is large effects size.

Consequently, in R^2 and F^2, this study also analysed Q^2 through the predictive relevance of all constructs with dependent variables. The result shown in Table 7 is that endogenous latent variable Q^2 scores greater than zero (Q^2_ CE = 0.464, FI = 562), which meets the guidance of Chin (1998). Therefore, the result indicated that our research model demonstrates predictive relevance.

5 | DISCUSSION

This research investigated the influence of entrepreneurial bricolage on CE and FI. It also explored FI's mediating role and technological turbulence's moderating role. Drawing on entrepreneurship and innovation theories, the authors argued that the more entrepreneurial bricolage there is, the higher the CE and FIs would be, and this relationship would be amplified when mediated by FI and moderated by technological turbulence. To test the hypothesised relationship, the authors gathered data from top management and analysed it using the Smart-PLS technique. The results supported all the hypothesised relationships and were consistent with the prior literature. The possible explanation may be that entrepreneurial bricolage is a behaviour that involves individuals making do with available resources, recombining these resources for new purposes, and refusing to enact limitations and bias for actions (Baker & Nelson, 2005; Davidsson et al., 2017; Kwong et al., 2019; Lvi-Strauss, 1966), breakthrough innovations (Garud & Karnøe, 2003), eventually impacting FIs and CE (Dost et al., 2019; Fuglsang, 2020). Bricolage is associated with solving problems and implementing CE to achieve sustainable performance (Fuglsang, 2020).

As predicted, FI displayed an impact on CE. Suggesting that innovation in products or services that are characterised as affordable, functional, and easy to use (Bhatti & Ventresca, 2013; Dost

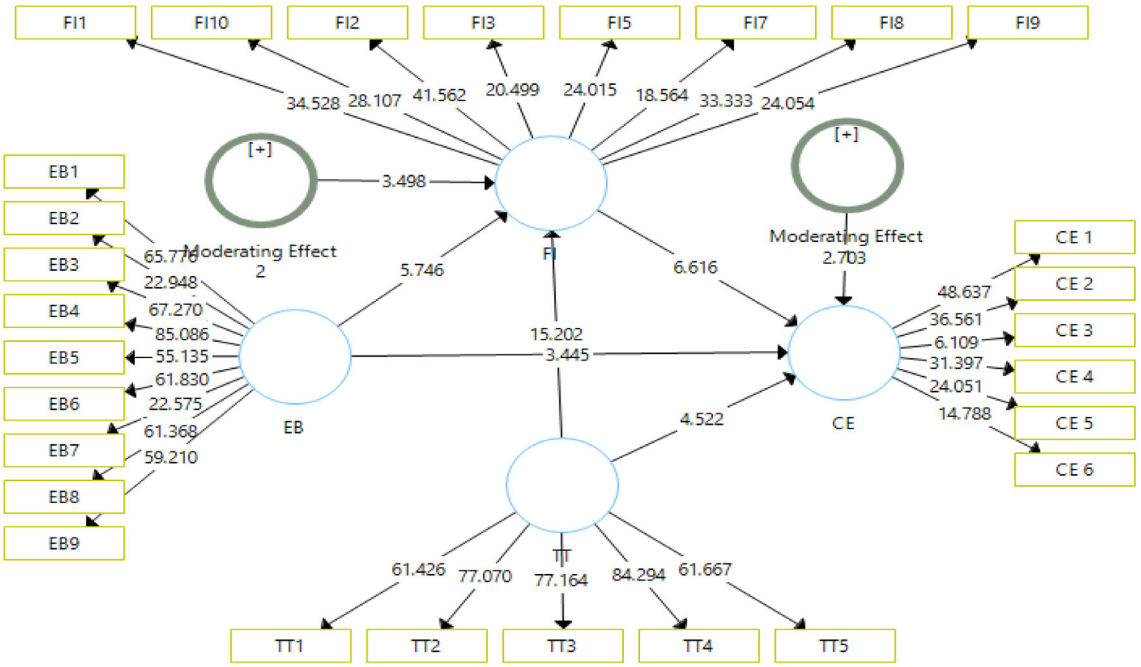

FIGURE 3 Structural model assessment.

TABLE 7 Predictive power assessment.

Variable	R^2	Q^2
Circular economy	.545	.464
Frugal innovation	.556	.562

et al., 2019) facilitates CE (Figge et al., 2022; Forum, 2020; Foundation, 2017; Manninen et al., 2018; Urbinati et al., 2017). The findings validate the assumptions about the CE that a new relationship with goods and materials can save energy and resources and create jobs locally (Stahel, 2016). Further, it indicates that FIs benefit from resource-saving or job creation and cater to the growing local demand for products and services.

FI also mediated the link between entrepreneurial bricolage and CE. Implies that the presence of FI strengthens the influence of available resources (bricolage) on CE. The finding may be explained by the fact that firms that are fully engaged in economic production can develop better strategies and use available resources for CE. Resource scarcity is an essential condition of bricolage (Welter et al., 2016). At the same time, FI is about achieving more value while using fewer resources (Dabić et al., 2022). This finding aligns with (Baker & Nelson, 2005) concept of bricolage, where resourcefulness is key. By creatively utilising and recombining available resources, firms can break free from limitations and effectively implement CE.

Technological turbulence's moderating role amplified entrepreneurial bricolage's influence on FI and CE. Data supporting this connection reveals that flexible firms can benefit from the ongoing technological changes to enhance the utilisation of resources with higher FI and CE. As technological changes are inevitable, improving one's ability to adapt and use technology contributes to the firm's performance. Contextually, it was apparent that the epidemic caused a record-breaking spike in demand for technical goods and services. Every industry found itself embracing technologies for their FIs and CE.

6 | IMPLICATIONS – THEORY AND PRACTICE

The findings contribute to theory and practice. Theoretical contributions are in entrepreneurial bricolage, FI, and sustainability. In entrepreneurial bricolage, when actors use available sources to tackle persistent issues in novel ways or devise new techniques, there is an undefined opportunity in resource-constrained environments (Welter et al., 2016). Available resources and the extent of improvisation can facilitate innovations that are easy to afford and sustainable in use (FIs). When engaging in bricolage, actors primarily rely on networks to obtain resources. They then use their improvised resource-building skills to create new solutions, often requiring minimal resources. With that in mind, findings validate that entrepreneurial bricolage involves using resources available to become the source of FIs and CE.

Second, literature often associates FIs with emerging markets (Dabić et al., 2022). However, recent evidence indicates that these innovations are not merely for resource-constrained markets but can also solve the issues related to resource scarcity in developed contexts. Keeping taking, making, and discarding the economic model is not sustainable. Now is the evolving era of CE. Therefore, CE has emerged as a potential solution for better use of resources (Velenturf & Purnell, 2021). The rapid depletion of available natural

resources is accelerating the decline of economic activities. A paradigm shift is required to address this scarcity, moving towards a more circular approach known as a 'make, share, and re-make' model, which emphasises resource production and growth. This shift is crucial for the sustainability of FIs in the years to come. Our findings shed light on this transition, identifying that the inherent attributes of FIs play a pivotal role in enabling the implementation of CE.

Third, resources that contain the attributes of usefulness and scarcity make them an important source for firms to create value and achieve competitive advantage. In that process, these firms put real effort into ensuring access to such resources. The nature of resources makes them scarce and hard for firms to access quickly. The better strategy for accessing and using these resources is to do more with less. In other words, firms can create products that consume fewer resources and are affordable to customers. Doing so enables production FIs, reduces waste, and contributes to achieving social and environmental performance while being profitable. To achieve higher and better CE results, the role of FI is critical for entrepreneurial bricolage. This term refers to the innovative use of limited resources to create new products or services.

Fourth, in turbulent times, firms are compelled to optimise available resources. Technological turbulence, characterised by dynamic changes in techniques and equipment, is a key player in this process. Theoretical research consistently supports the moderating role of technological turbulence. For instance, a recent study found that technological turbulence moderates the relationship between a firm's relational competence and knowledge generation through inter-organisational relations and internal dissemination and sources of knowledge and FI (Dost et al., 2019). Similarly, the authors found that firms that embrace technological changes could leverage entrepreneurial bricolage to innovate products frugally and enhance the implementation of the CE model. In other words, technologies are not just tools, but catalysts that can significantly improve the production efficiency of firms and help them achieve sustainability goals.

The findings have several managerial implications. First, they contribute to the current understanding of how managers can solve existing and new problems related to innovation and sustainability with available resources. In this research, managers exhibit entrepreneurial bricolage behaviour, which facilitates the proper utilisation of available resources to innovate cost-effective and sustainable products (FI) and implement CE. The attributes of FI contribute to the firm's efforts to achieve more value while using fewer resources (Dabić et al., 2022). These firms can also achieve superior competitive advantage through cost leadership and better utilisation of available resources. Managers' efforts ensure FIs in the firms.

Second, resource-efficient firms creating FI (e.g., affordable and functional products with minimal resources affordable products) are primed for sustainable success through CE, aligning with research showing CE fosters sustainable development (Merli et al., 2018) and improves resource productivity (MacArthur, 2013). It aims to eliminate waste by turning goods into resources for new ones at the end of their life cycle (Stahel, 2016). As a result of this benefit, governments, corporations, society, and academics are becoming increasingly interested in CE (Ferasso et al., 2020). Creating CE is a fit strategy for facilitating economic growth in nations with a high concentration of SMEs (Hu et al., 2019). In other words, innovations that are easy to afford, functional, and sustainable can enable CE.

Managers are recognising the need for innovation during turbulent times, turning to FI and CE principles. Fuelled by rapid technological advancements, firms optimise resource utilisation with FI and implement CE to minimise waste. Digital platforms, emerging alongside these advancements, provide valuable tools for knowledge management. By effectively storing and categorising diverse knowledge, these platforms can empower firms to drive innovation that leads to positive CE outcomes.

7 | LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

This research, like other behavioural studies, had some limitations. First, the study developed and tested a model to explore the impact of entrepreneurial bricolage on FI, CE, and the moderating role of technological turbulence in manufacturing firms in Malaysia. While the findings were robust, they may be limited in generalising to other contexts. Therefore, future researchers are encouraged to test the research model in other developing markets to generalise the findings. Future research could also investigate the effects of entrepreneurial bricolage on different degrees of innovation, such as incremental and radical, which would help understand the extent to which bricolage resources facilitate other innovations.

Second, the research explored the impact of FI on CE. Future researchers could study the effects of different innovations on CE and a firm's financial and non-financial performance (Dost & Umrani, 2024). These findings would provide valuable insights into theory and practice regarding the outcomes of implementing CE.

Third, the research examined the moderating role of technological turbulence on the link between bricolage, FI, and CE. However, further research could consider the mediating influence of technological turbulence. Understanding how technology can mediate the link between bricolage and CE would be helpful.

Lastly, the study investigated the complex relationship between entrepreneurial bricolage and FI and their influence on CE. However, a more comprehensive investigation into the reciprocal effects of CE on FI and entrepreneurial bricolage is needed. Furthermore, exploring the impact of technological turbulence within this framework is also important. This presents an opportunity to further test the model by addressing these reverse effects and filling the identified gap in our research.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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REFERENCES

Agarwal, N., Grottke, M., Mishra, S., & Brem, A. (2016). A systematic literature review of constraint-based innovations: State of the art and future perspectives. *IEEE Transactions on Engineering Management*, *64*(1), 3–15.

Ali, F., Ciftci, O., Nanu, L., Cobanoglu, C., & Ryu, K. (2021). Response rates in hospitality research: An overview of current practice and suggestions for future research. *Cornell Hospitality Quarterly*, *62*(1), 105–120.

Baker, T., & Nelson, R. E. (2005). Creating something from nothing: Resource construction through entrepreneurial bricolage. *Administrative Science Quarterly*, *50*(3), 329–366.

Baker, T. (1995). *Stodgy too fast: Human resource practices and the development of inertia in start up firms*. University of North Carolina at Chapel Hill.

Bhatti, Y. A., & Ventresca, M. (2013). How can 'frugal innovation' be conceptualized?.

Busch, C., & Barkema, H. (2021). From necessity to opportunity: Scaling bricolage across resource-constrained environments. *Strategic Management Journal*, *42*(4), 741–773.

Cai, Q., Ying, Y., Liu, Y., & Wu, W. (2019). Innovating with limited resources: The antecedents and consequences of frugal innovation. *Sustainability*, *11*(20), 5789.

Calantone, R., Garcia, R., & Dröge, C. (2003). The effects of environmental turbulence on new product development strategy planning. *Journal of Product Innovation Management*, *20*(2), 90–103.

Casadesus-Masanell, R., & Ricart, J. E. (2010). From strategy to business models and onto tactics. *Long Range Planning*, *43*(2–3), 195–215.

Chesbrough, H., & Rosenbloom, R. S. (2002). The role of the business model in capturing value from innovation: Evidence from Xerox Corporation's technology spin-off companies. *Industrial and Corporate Change*, *11*(3), 529–555.

Chin, W. W. (1998). *Commentary: Issues and opinion on structural equation modeling* (pp. 7–16). JSTOR.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155–159.

Corvellec, H., Stowell, A. F., & Johansson, N. (2022). Critiques of the circular economy. *Journal of Industrial Ecology*, *26*(2), 421–432.

Dabić, M., Obradović, T., Vlačić, B., Sahasranamam, S., & Paul, J. (2022). Frugal innovations: A multidisciplinary review & agenda for future research. *Journal of Business Research*, *142*, 914–929.

Davidsson, P., Baker, T., & Senyard, J. M. (2017). A measure of entrepreneurial bricolage behavior. *International Journal of Entrepreneurial Behavior & Research*, *23*(1), 114–135.

Desa, G., & Basu, S. (2013). Optimization or bricolage? Overcoming resource constraints in global social entrepreneurship. *Strategic Entrepreneurship Journal*, *7*(1), 26–49.

Di Domenico, M., Haugh, H., & Tracey, P. (2010). Social bricolage: Theorizing social value creation in social enterprises. *Entrepreneurship Theory and Practice*, *34*(4), 681–703.

Dijkstra, T. K., & Henseler, J. (2015). Consistent partial least squares path modeling. *MIS Quarterly*, *39*(2), 297–316.

Dost, M., Pahi, M. H., Magsi, H. B., & Umrani, W. A. (2019). Effects of sources of knowledge on frugal innovation: Moderating role of environmental turbulence. *Journal of Knowledge Management*, *23*, 1245–1259.

Dost, M., & Umrani, W. A. (2024). Managerial Proactiveness, frugal innovation and firm performance. *The Journal of Entrepreneurship*, *33*(2), 393–417. https://doi.org/10.1177/09713557241256212

Eneh, A. E., & Oluigbo, S. N. (2012). Mitigating the impact of climate change through waste recycling. *Research Journal of Environmental and Earth Sciences*, *4*(8), 776–781.

Ferasso, M., Beliaeva, T., Kraus, S., Clauss, T., & Ribeiro-Soriano, D. (2020). Circular economy business models: The state of research and avenues ahead. *Business Strategy and the Environment*, *29*(8), 3006–3024.

Figge, F., Thorpe, A. S., Manzhynski, S., & Gutberlet, M. (2022). The us in reUSe. Theorizing the how and why of the circular economy. *Business Strategy and the Environment*, *31*, 2741–2753.

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. In *Structural equation models with unobservable variables and measurement error: Algebra and statistics* (Vol. 18, p. 382). Sage Publications Sage CA.

Forum, W. E. (2020). Transforming African economies to sustainable and circular models. https://www.weforum.org/impact/the-african-circular-economy-alliance-impact-story

Foundation E. M. (2017). *Strategic partners*. Foundation E. M.

Fuglsang, L. (2020). *Innovation, bricolage, and legitimacy handbook of business legitimacy: Responsibility, ethics and society* (pp. 1567–1579). Springer.

Gambardella, A., & McGahan, A. M. (2010). Business-model innovation: General purpose technologies and their implications for industry structure. *Long Range Planning*, *43*(2–3), 262–271.

Garud, R., & Karnøe, P. (2003). Bricolage versus breakthrough: Distributed and embedded agency in technology entrepreneurship. *Research Policy*, *32*(2), 277–300.

Geissdoerfer, M., Morioka, S. N., de Carvalho, M. M., & Evans, S. (2018). Business models and supply chains for the circular economy. *Journal of Cleaner Production*, *190*, 712–721.

Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017). The circular economy–a new sustainability paradigm? *Journal of Cleaner Production*, *143*, 757–768.

Ghalwash, S., & Ismail, A. (2022). Resource orchestration process in the limited-resource environment: The social bricolage perspective. *Journal of Social Entrepreneurship*, 1–28.

Guo, Z., Zhang, J., & Gao, L. (2018). It is not a panacea! The conditional effect of bricolage in SME opportunity exploitation. *R&D Management*, *48*(5), 603–614.

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., & Thiele, K. O. (2017). Mirror, mirror on the wall: A comparative evaluation of composite-based structural equation modeling methods. *Journal of the Academy of Marketing Science*, *45*(5), 616–632.

Hair, J. F., Jr., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review*, *5*, 105–115.

Ho, T. C., Ahmad, N. H., & Ramayah, T. (2016). Competitive capabilities and business performance among manufacturing SMEs: Evidence from an emerging economy, Malaysia. *Journal of Asia-Pacific Business*, *17*(1), 37–58.

Hossain, M. (2020). Frugal innovation: Conception, development, diffusion, and outcome. *Journal of Cleaner Production*, *262*, 121456.

Hu, M.-C., Ni, F.-C., & Wu, C.-Y. (2019). Starting from poor: How Taiwan's network-based collaborative bricolage enables the development of a circular economy. *Academy of Management Global Proceedings*, *2019*, 86.

Jakhar, S. K., Mangla, S. K., Luthra, S., & Kusi-Sarpong, S. (2019). When stakeholder pressure drives the circular economy: Measuring the mediating role of innovation capabilities. *Management Decision*, *57*, 904–920.

Johnson, M. W., Christensen, C. M., & Kagermann, H. (2008). Reinventing your business model. *Harvard Business Review*, *86*(12), 57–68.

Kaliannan, M., Abraham, M., & Ponnusamy, V. (2016). Effective talent management in Malaysian SMES: A proposed framework. *The Journal of Developing Areas*, *50*(5), 393–401.

Kantola, J., Liu, Y., Peura, P., de Leeuw, T., Zhang, Y., Naaranoja, M., Segev, A., & Huisingh, D. (2017). Innovative products and services for sustainable societal development: Current reality, future potential and challenges. *Journal of Cleaner Production*, *162*, S1–S10.

Karagouni, G., Aimilia, P., & Caloghirou, Y. (2013). The impact of autotelic and dynamic capabilities on the performance of knowledge-intensive, low-tech ventures. *International Journal of Innovation and Regional Development*, *5*(2), 210–225.

Khan, O., Daddi, T., & Iraldo, F. (2021). Sensing, seizing, and reconfiguring: Key capabilities and organizational routines for circular economy implementation. *Journal of Cleaner Production*, *287*, 125565.

Kline, R. B. (2015). *Principles and practice of structural equation modeling*. Guilford publications.

Korhonen, J., Honkasalo, A., & Seppälä, J. (2018). Circular economy: The concept and its limitations. *Ecological Economics*, *143*, 37–46.

Kwong, C. C., Cheung, C. W., Manzoor, H., & Rashid, M. U. (2019). Entrepreneurship through bricolage: A study of displaced entrepreneurs at times of war and conflict. *Entrepreneurship & Regional Development*, *31*(5–6), 435–455.

Lewandowski, M. (2016). Designing the business models for circular economy—Towards the conceptual framework. *Sustainability*, *8*(1), 43.

Li, X., Voorneveld, M., & de Koster, R. (2022). Business transformation in an age of turbulence–lessons learned from COVID-19. *Technological Forecasting and Social Change*, *176*, 121452.

Lieder, M., & Rashid, A. (2016). Towards circular economy implementation: A comprehensive review in context of manufacturing industry. *Journal of Cleaner Production*, *115*, 36–51.

Lvi-Strauss, C. (1966). *The savage mind*. University of Chicago Press.

MacArthur, E. (2013). *Towards the circular economy, economic and business rationale for an accelerated transition* (pp. 21–34). Ellen MacArthur Foundation.

Manninen, K., Koskela, S., Antikainen, R., Bocken, N., Dahlbo, H., & Aminoff, A. (2018). Do circular economy business models capture intended environmental value propositions? *Journal of Cleaner Production*, *171*, 413–422.

Meng, M., Lei, J., Jiao, J., & Tao, Q. (2020). How does strategic flexibility affect bricolage: The moderating role of environmental turbulence. *PLoS One*, *15*(8), e0238030.

Merli, R., Preziosi, M., & Acampora, A. (2018). How do scholars approach the circular economy? A systematic literature review. *Journal of Cleaner Production*, *178*, 703–722.

Miner, A. S., Bassoff, P., & Moorman, C. (2001). Organizational improvisation and learning: A field study. *Administrative Science Quarterly*, *46*, 304–337.

Musa, H., & Chinniah, M. (2016). Malaysian SMEs development: Future and challenges on going green. *Procedia-Social and Behavioral Sciences*, *224*, 254–262.

Prabhu, G. N., & Gupta, S. (2014). Heuristics of frugal service innovations. Paper presented at the Proceedings of PICMET'14 Conference: Portland International Center for Management of Engineering and Technology; Infrastructure and Service Integration.

Radjou, N., Prabhu, J., & Ahuja, S. (2012). *Jugaad innovation: Think frugal, be flexible, generate breakthrough growth*. John Wiley & Sons.

Ray, P. K., & Ray, S. (2009). Resource-constrained innovation for emerging economies: The case of the Indian telecommunications industry. *IEEE Transactions on Engineering Management*, *57*(1), 144–156.

Ringle, C. M., Wende, S., & Becker, J.-M. (2015). *SmartPLS 3* (p. 584). SmartPLS GmbH.

Rosca, E., Arnold, M., & Bendul, J. C. (2017). Business models for sustainable innovation–an empirical analysis of frugal products and services. *Journal of Cleaner Production*, *162*, S133–S145.

Sarasvathy, S. D. (2001). Causation and effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of Management Review*, *26*(2), 243–263.

Sawilowsky, S. S. (2009). New effect size rules of thumb. *Journal of Modern Applied Statistical Methods*, *8*(2), 26–599.

Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill building approach*. john wiley & sons.

Senyard, J., Baker, T., & Davidsson, P. (2009). Entrepreneurial bricolage: Towards systematic empirical testing. *Frontiers of Entrepreneurship Research*, *29*(5), 5.

Sorescu, A., Frambach, R. T., Singh, J., Rangaswamy, A., & Bridges, C. (2011). Innovations in retail business models. *Journal of Retailing*, *87*, S3–S16.

Stahel, W. R. (2016). The circular economy. *Nature News*, *531*(7595), 435–438.

Teece, D. J. (2010). Business models, business strategy and innovation. *Long Range Planning*, *43*(2–3), 172–194.

Tesfaye, L. A., & Fougère, M. (2022). Frugal innovation hijacked: The co-optive power of co-creation. *Journal of Business Ethics*, *180*(2), 439–454.

Thun, E. (2018). Innovation at the middle of the pyramid: State policy, market segmentation, and the Chinese automotive sector. *Technovation*, *70*, 7–19.

Tsilika, T., Kakouris, A., Apostolopoulos, N., & Dermatis, Z. (2020). Entrepreneurial bricolage in the aftermath of a shock. Insights from Greek SMEs. *Journal of Small Business & Entrepreneurship*, *32*(6), 635–652.

Urbinati, A., Chiaroni, D., & Chiesa, V. (2017). Towards a new taxonomy of circular economy business models. *Journal of Cleaner Production*, *168*, 487–498.

Velenturf, A. P., & Purnell, P. (2021). Principles for a sustainable circular economy. *Sustainable Production and Consumption*, *27*, 1437–1457.

Völker, T., Kovacic, Z., & Strand, R. (2020). Indicator development as a site of collective imagination? The case of European Commission policies on the circular economy. *Culture and Organization*, *26*(2), 103–120.

Welter, C., Mauer, R., & Wuebker, R. J. (2016). Bridging behavioral models and theoretical concepts: Effectuation and bricolage in the opportunity creation framework. *Strategic Entrepreneurship Journal*, *10*(1), 5–20.

Weyrauch, T., & Herstatt, C. (2017). What is frugal innovation? Three defining criteria. *Journal of Frugal Innovation*, *2*(1), 1–17.

Winans, K., Kendall, A., & Deng, H. (2017). The history and current applications of the circular economy concept. *Renewable and Sustainable Energy Reviews*, *68*, 825–833.

Witell, L., Gebauer, H., Jaakkola, E., Hammedi, W., Patricio, L., & Perks, H. (2017). A bricolage perspective on service innovation. *Journal of Business Research*, *79*, 290–298.

Zhu, J., Fan, C., Shi, H., & Shi, L. (2019). Efforts for a circular economy in China: A comprehensive review of policies. *Journal of Industrial Ecology*, *23*(1), 110–118.

Zhu, X., Yu, S., & Yang, S. (2023). Leveraging resources to achieve high competitive advantage for digital new ventures: An empirical study in China. *Asia Pacific Business Review*, *29*(4), 1079–1104.

Zott, C., & Amit, R. (2010). Business model design: An activity system perspective. *Long Range Planning*, *43*(2–3), 216–226.

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