



BRICOLAGE AS AN ENABLER FOR FRUGAL INNOVATION IN THE DIGITAL TRANSFORMATION PROCESS OF MICROENTERPRISES

A BRICOLAGEM COMO FATOR HABILITADOR PARA INOVAÇÃO FRUGAL NO PROCESSO DE TRANSFORMAÇÃO DIGITAL EM MICROEMPRESAS

EL BRICOLAJE COMO FACTOR FACILITADOR DE LA INNOVACIÓN FRUGAL EN EL PROCESO DE TRANSFORMACIÓN DIGITAL DE LAS MICROEMPRESAS

ABSTRACT

Objective: This study investigates how microenterprises utilize digital technologies to create frugal innovations that enable digital transformation in the context of emerging markets. The objective includes characterizing these innovations, identifying knowledge processes related to entrepreneurial bricolage, and examining how different bricolage patterns influence digital technology solutions.

Methodology: The research is qualitative and exploratory, based on a case study of ten microenterprises located in an emerging region of Brazil. Semi-structured interviews and secondary data analysis were conducted. The analysis was supported by thematic categorization techniques using Atlas.ti software for data systematization, coding, and interpretation.

Results: The microenterprises demonstrated dynamic capabilities of sensing, seizing, and transforming, as well as absorptive capacity, highlighting the use of bricolage to adapt simple technologies such as social networks (WhatsApp, Instagram), messaging applications, and marketplaces. These technologies were transformed into low-cost solutions for sales, marketing, logistics, and customer relations. The bricolage processes involved imitation and personalization, combining creativity and efficiency to overcome financial and structural constraints. The findings underscore frugal innovation as a central strategy for digital transformation, fostering organizational competitiveness and resilience.


Originality and Value: This research contributes theoretically by integrating concepts of dynamic capabilities, bricolage, and frugal innovation, demonstrating their applicability in resource-constrained contexts. Practically, it offers insights for microenterprises and policymakers on overcoming financial and technological barriers through accessible and sustainable solutions.

Keywords: Digital transformation. Frugal innovation. Bricolage. Dynamic capabilities. Microenterprises. Digital solutions.

 Max Vanderbil Lopes Sobrinho Júnior

Master

maxvanderbil@hotmail.com

 Andre Moraes dos Santos

PhD

Universidade do Vale do Itajaí - Brazil

amsantos@univali.br

 Evertom Waltrick da Silva

PhD Candidate

Universidade do Vale do Itajaí - Brazil

evertom.waltrick@edu.univali.br

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RESUMO

Objetivo: Este estudo investiga como as microempresas utilizam tecnologias digitais para criar inovações frugais capazes de habilitar a transformação digital em contextos de mercados emergentes. O objetivo inclui caracterizar essas inovações, identificar processos de conhecimento relacionados à bricolagem empreendedora e verificar como diferentes padrões de bricolagem influenciam soluções de tecnologias digitais.

Método: A pesquisa é de natureza qualitativa e exploratória, baseada em estudo de caso com dez microempresas localizadas em uma região emergente no Brasil. Foram realizadas entrevistas semiestruturadas e análise de dados secundários. A análise foi apoiada por técnicas de categorização temática com o software Atlas.ti para sistematização, codificação e interpretação dos dados.

Resultados: As microempresas demonstraram capacidades dinâmicas de sensing, seizing e transforming, bem como capacidade absorptiva, evidenciando o uso de bricolagem para adaptar tecnologias simples, como redes sociais (WhatsApp, Instagram), aplicativos de mensagens e marketplaces. Essas tecnologias foram transformadas em soluções de baixo custo para vendas, marketing, logística e relacionamento com clientes. Os processos de bricolagem envolveram imitação e personalização, combinando criatividade e eficiência para superar restrições financeiras e estruturais. Os achados destacam a inovação frugal como estratégia central para a transformação digital, promovendo competitividade e resiliência organizacional.

Originalidade e Valor: A pesquisa contribui teoricamente ao integrar conceitos de capacidades dinâmicas, bricolagem e inovação frugal, demonstrando sua aplicabilidade em contextos de recursos limitados. Praticamente, oferece insights para microempresas e formuladores de políticas sobre como superar barreiras financeiras e tecnológicas por meio de soluções acessíveis e sustentáveis.

Palavras-chave: Transformação digital. Inovação frugal. Bricolagem. Capacidades dinâmicas. Microempresas. Soluções digitais.

RESUMEN

Objetivo: Este estudio investiga cómo las microempresas utilizan tecnologías digitales para crear innovaciones frugales que posibiliten la transformación digital en contextos de mercados emergentes. El objetivo incluye caracterizar estas innovaciones, identificar los procesos de conocimiento relacionados con el bricolaje emprendedor y verificar cómo los diferentes patrones de bricolaje influyen en las soluciones de tecnología digital.

Método: La investigación es de carácter cualitativo y exploratorio, basada en un estudio de caso con diez microempresas ubicadas en una región emergente de Brasil. Se realizaron entrevistas semiestruturadas y análisis de datos secundarios. El análisis se apoyó en técnicas de categorización temática mediante el software Atlas.ti para la sistematización, codificación e interpretación de datos.

Resultados: Las microempresas demostraron capacidades dinámicas de detección, captación y transformación, así como capacidad de absorción, evidenciando el uso del bricolaje para adaptar tecnologías simples, como redes sociales (WhatsApp, Instagram), aplicaciones de mensajería y marketplaces. Estas tecnologías se han transformado en soluciones de bajo costo para ventas, marketing, logística y relaciones con los clientes. Los procesos de bricolaje implicaron imitación y personalización, combinando creatividad y eficiencia para superar limitaciones financieras y estructurales. Los hallazgos destacan la innovación frugal como una estrategia central para la transformación digital, promoviendo la competitividad y la resiliencia organizacional.

Originalidad y Valor: La investigación contribuye teóricamente integrando conceptos de capacidades dinámicas, bricolaje e innovación frugal, demostrando su aplicabilidad en contextos de recursos limitados. En la práctica, ofrece ideas para microempresas y formuladores de políticas sobre cómo superar las barreras financieras y tecnológicas mediante soluciones asequibles y sostenibles.

Palabras clave: Transformación digital. Innovación frugal. Bricolaje. Capacidades dinámicas. Microempresas. Soluciones digitales.



INTRODUCTION

Microenterprises play a fundamental role in economic growth and development, particularly in developing countries, where they often constitute the majority of businesses and provide significant employment opportunities. To survive and thrive in highly competitive environments, these enterprises must adapt to changing market conditions. In this context, digital transformation can enhance their competitiveness. Digital transformation involves integrating digital technologies, redesigning business processes, and altering organizational structures to foster innovation and create value-generation opportunities.

The literature highlights that digital transformation enables small organizations to enhance their competitiveness (Vial, 2019), improve responsiveness (Warner & Wäger, 2019), develop products and services, expand their customer base, and boost business performance (Skare et al., 2023). Consequently, digital transformation has emerged as a topic of growing interest and strategic relevance across various industries (Elia et al., 2024; Freitas Junior et al., 2023).

Despite its economic importance, microenterprises in emerging markets face numerous barriers to digital transformation, including limited financial resources, insufficient digital capabilities, and difficulties accessing qualified personnel and advanced technologies (Skare et al., 2023). These constraints hinder the transformation of business processes, reducing efficiency and competitiveness in dynamic markets.

In response to these challenges, enterprises have increasingly turned to frugal innovation to foster innovation in resource-scarce contexts (Radjou, Prabhu & Ahuja, 2015), particularly in emerging markets with low purchasing power (Lange, Hüsigg & Albert, 2021; Velananda, Disanayake & Wickramasinghe, 2023). Frugal innovation is characterized by creating effective solutions from existing resources, emphasizing simplicity, low cost, and robustness (Houssain, 2017). Through frugal innovation, businesses can overcome constraints and develop products and services that meet both operational and customer needs (Khanal et al., 2021).

Although the themes of microenterprises in emerging economies, digital transformation, and frugal innovation have received increasing attention in the literature (Cai, Ying, Liu & Wu, 2019; Sarkar & Mateus, 2022), studies analyzing the relationship between frugal innovation and digital transformation remain scarce. By providing flexible solutions in restrictive situations, frugal innovation demonstrates potential to enable the digital transformation process under conditions of scarcity. Within the scope of frugal innovation, the use of bricolage facilitates mobilizing existing resources to create solutions that address contextual limitations at minimal cost (Bouvier-Patron, 2021). In the context of digital transformation, value creation can be achieved through the intelligent combination of these resources, employing simple, accessible, and low-cost technologies and processes (Hossain, 2021).

It is therefore important to investigate how microenterprises can achieve digital transformation in environments characterized by digital and contextual resource limitations. This study seeks to answer the following question: How can frugal innovation enable the digital transformation of microenterprises in an emerging market?

Thus, the primary objective of this research is to analyze how microenterprises utilize digital technologies to create frugal innovations that facilitate digital transformation in the context of emerging markets. Additionally, the study aims to characterize the frugal innovations in the use of digital technologies developed by microenterprises, identify the knowledge processes necessary for entrepreneurial bricolage, and examine how different bricolage patterns influence information and communication technology (ICT) solutions.

To achieve these objectives, a case study was conducted involving microenterprises located in a region within an emerging country. The case analysis confirmed the presence of knowledge acquisition processes and bricolage capacity in generating frugal ICT innovations. The enterprises adapted technologies such as social networks, messaging applications, office tools, and e-commerce platforms to meet their business needs creatively and efficiently.



The remainder of this article presents the theoretical framework, methodological procedures, results and final discussion.

THEORETICAL BACKGROUND

The combined study of dynamic capabilities, digital transformation, and frugal innovation is still in its early stages. Therefore, it is necessary to present these foundational concepts before outlining the theoretical framework proposed in this research.

Digital Transformation

Digital transformation refers to the process by which a company reconfigures and develops processes based on the use of digital technologies to establish a new digital business model aimed at generating and capturing value for the organization (Warner & Wäger, 2019). Digital transformation is particularly important for businesses in emerging economies, as it enables improved performance, value generation, and competitiveness through the combination of technological, human, and procedural resources (Omoush et al., 2023). However, the literature emphasizes that emerging economy environments pose critical challenges to digital transformation due to limited financial resources, high costs of information technologies, insufficient technological infrastructure, a shortage of digital expertise, and nascent supplier markets (Benatiya Andaloussi, 2024).

The technological constraints of emerging economies encourage adaptive responses in digital transformation models. To remain competitive, companies innovating with information technologies must seek low-cost solutions that address essential business needs (Hossain, 2016). This can be observed in communication technologies tailored to mobile devices, which are more accessible than laptops or desktops and offer

mobility along with communication tools such as email, internet access, social networks, and mobile instant messaging systems (MIM) (Wu et al., 2017). Digital assets thus become pillars of digital transformation, playing a crucial role in the survival of companies operating under restrictive conditions. The use of digital resources to acquire knowledge, access new markets and suppliers, and explore opportunities has been evidenced in studies focusing on emerging economies (Khanal et al., 2017).

Dynamic Capabilities and Absorptive Capacities

Dynamic capabilities have become a central topic in business strategy research due to their relevance to competitiveness in dynamic environments. These capabilities represent an organization's ability to integrate, develop, and reconfigure both internal and external competencies, enabling effective adaptation to continuous changes in the business environment (Cohen & Levinthal, 1990; Ribeiro Siqueira et al., 2024).

To achieve digital transformation, organizations must possess dynamic capabilities to reconfigure and adapt their resources in rapidly changing digital environments. Through the mechanisms of sensing, seizing, and transforming, companies can innovate and adapt to constant market changes (Teece et al., 1997). Sensing involves identifying and evaluating technological opportunities aligned with business needs. Seizing focuses on mobilizing resources to capitalize on these opportunities, facilitating the adoption and integration of digital technologies to develop new business models. Transforming supports the continuous renewal and reconfiguration of resources to sustain competitive advantage in a digital environment (Warner & Wäger, 2019). Aligning technological resources with dynamic capabilities enables organizations to respond



agilely to dynamic environments, creating solutions for sustainable competitiveness.

Dynamic capabilities rely on subroutines that capture and integrate knowledge from the external environment, essential to transformation processes (Teece, 2007). These processes are directly facilitated by absorptive capacities, which involve acquiring and assimilating knowledge through mechanisms such as environmental monitoring and information sharing (Nonaka & Takeuchi, 2008). Absorptive capacities also include the transformation and application of knowledge to create or enhance processes and innovations (Flatten et al., 2011). Effective incorporation and utilization of this knowledge support dynamic capabilities, demonstrating that external knowledge flows alone cannot guarantee organizational performance without transformation and creative use (Zhao et al., 2020).

Absorptive capacities enable organizations to identify, assimilate, transform, and exploit external knowledge (Zahra & George, 2002), providing the foundation for dynamic capability mechanisms like sensing, seizing, and transforming to operate effectively (Teece, 2007). For instance, the ability to sense opportunities depends directly on acquiring valuable external knowledge, while seizing opportunities relies on assimilating and transforming this knowledge strategically. Finally, transforming resources and processes requires applying this knowledge creatively to sustain competitive advantage.

The sensing capability, which identifies changes and opportunities in the environment, directly relies on the acquisition of external knowledge, a critical component of absorptive capacity. Knowledge acquisition refers to an organization's ability to identify and acquire valuable external knowledge. Organizations must recognize the importance of this knowledge and establish structures and processes for acquiring

it. Participation in formal and informal knowledge networks is a critical capacity for obtaining external knowledge (Ritala et al., 2018).

The seizing phase, which involves mobilizing resources to capitalize on identified opportunities, is supported by the assimilation and transformation of knowledge facilitated by absorptive capacity. Knowledge assimilation involves an organization's ability to process and interpret acquired knowledge, making it accessible internally (Zahra & George, 2002). The internal sharing of knowledge and its promotion for practical use significantly enhance assimilation (Ritala et al., 2018). Knowledge transformation occurs by combining internal and external knowledge, forming new insights, ideas, and mental models. According to Flatten et al. (2011), transformational capacity is evidenced by an organization's ability to structure and apply this new knowledge internally.

In the transforming stage, resources and processes are reconfigured to sustain competitive advantage. This stage is facilitated by previously assimilated and exploited knowledge, demonstrating how absorptive capacity provides the cognitive foundation for dynamic capabilities to drive effective and innovative changes. Knowledge exploitation refers to an organization's ability to apply and extract value from generated knowledge, resulting in innovations (Zahra & George, 2002). External knowledge flows alone cannot significantly impact organizational performance. To achieve this, transformation and application processes, supported by the organization's creative capacity, are essential (Zhao et al., 2020).

Without the ability to incorporate new knowledge, organizations may fail to develop dynamic capabilities. Therefore, the integration of dynamic and absorptive capacities is crucial for organizations to remain agile, innovative, and competitive in environments characterized by



high uncertainty and constant transformation.

Frugal Innovation and Bricolage

In emerging environments, the ability to digitally transform is often linked to the capability to innovate using scarce or non-existent resources (Qin, 2024). In this scenario, frugal innovation emerges as a strategic approach to addressing innovation challenges in resource-constrained contexts (Radjou, Prabhu & Ahuja, 2012). Frugal innovation is characterized by creating effective solutions from available resources, prioritizing simplicity, low cost, and robustness (Hossain, 2017). These solutions address the internal and external needs of organizations (Khanal et al., 2021). According to Weyrauch and Herstatt (2017), frugal innovation meets three main criteria: significant cost reduction (at least one-third compared to comparable products), a focus on essential functionalities, and optimized performance with an emphasis on the user perspective. Velananda et al. (2023) further emphasize characteristics such as durability, time efficiency, ease of use, and low maintenance needs, which make frugal innovation particularly relevant in challenging scenarios.

The guiding principles of frugal innovation align with digital transformation processes, particularly in developmental contexts where entrepreneurs leverage digital solutions to overcome resource constraints and institutional gaps while exploring new business opportunities (Khanal et al., 2021). A central mechanism in generating frugal innovations is bricolage, which involves recombining and adapting existing resources. In the business context, bricolage refers to the improvised use of resources, reinterpreting their utility and combining them in innovative ways previously deemed unviable (Baker, Miner & Easley, 2003; Santos et al., 2018). This approach is particularly effective for small and microenterprises facing restrictive conditions (Baker & Nelson, 2005). Recent studies indicate that bricolage can evolve into scalable and replicable routines, pro-

moting organizational survival in resource-constrained contexts (Bush & Barkema, 2020; Iqbal et al., 2024). Consequently, bricolage is closely associated with frugal innovation processes.

Frugal innovation has garnered increasing attention from academics, policymakers, businesses, and social organizations due to its potential impact on delivering innovative solutions to underserved populations (Pisoni, Michelini & Martignoni, 2018). Frugality is a practice adopted by both businesses and consumers in developed and developing countries as a strategy to address resource constraints (Bhatti, 2012). As a cost-oriented innovation approach, frugal innovation is particularly aligned with the needs of low-income populations and emerging economies (Hossain, 2016). Companies operating in contexts of scarcity can also adopt frugal innovation to serve low-income markets, offering affordable and efficient solutions (Khanal et al., 2017). The use of frugal innovation can be particularly effective in creating sustainable business models, developing new activities, and building partnerships to link processes, people, and technologies in innovative ways (Hossain et al., 2024). This approach allows traditionally neglected markets and organizations to benefit from cost-effective solutions that are tailored to their demands.

Conceptual Framework

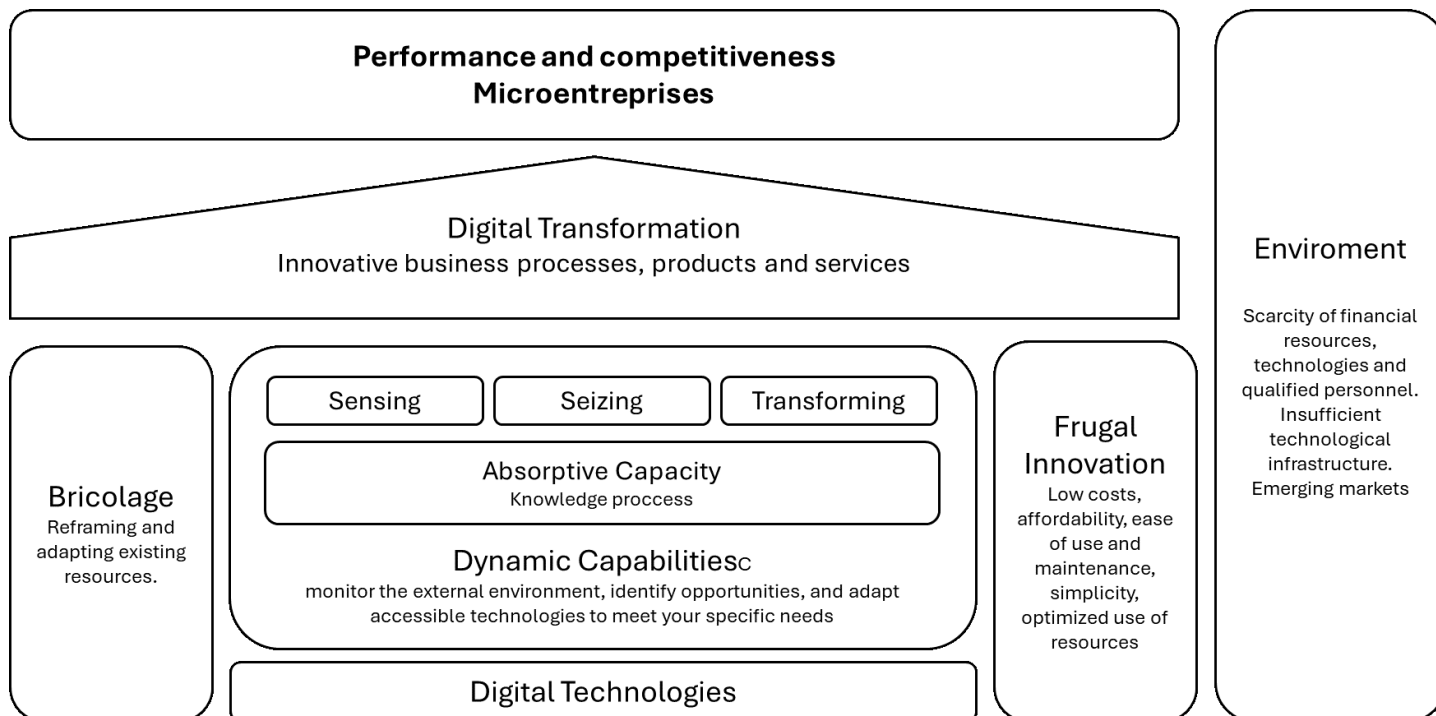
Based on the reviewed literature, microenterprises are expected to demonstrate distinct dynamic capabilities to enable digital transformation, achieving agility and competitiveness in resource-constrained environments. This conceptual framework (Figure 1) emphasizes the principles of frugal innovation as key drivers for creating technological solutions to overcome restrictive environmental barriers. Through the processes of sensing, seizing, and transforming, microenterprises monitor the environment to identify opportunities using available digital technologies. These technologies can then be adapted or combined to meet business and customer needs frugally. Knowledge processes, characterized by absorptive capacities, play a vi-



tal role in continuous learning to address gaps in the application of digital technologies. Bricolage is positioned as a foundational capability support-

ting and enabling dynamic capabilities in the digital transformation process.

Figure 1.
Conceptual elements for digital transformation



Source: Developed by the authors (2024)

METHODOLOGY

This study is exploratory in nature, adopting a qualitative approach based on the case study method. Primary data collection was conducted through 10 semi-structured interviews with representatives of microenterprises, predominantly located in the state of Acre, Brazil, during 2021. The central aim was to investigate how bricolage practices and frugal innovation are applied in the use of digital technologies to foster digital transformation in the context of emerging economies. The interviews were audio-recorded, fully transcribed, and resulted in a data corpus comprising 47 pages.

Additionally, secondary data were collected from various sources, including social media and websites, to corroborate the evidence obtained and strengthen the interpretations and observations made, following Yin’s (2016) recommendations. According to the author, in

qualitative studies, the triangulation of different techniques and data sources, such as documents, questionnaires, interviews, and observations, is essential for enhancing the robustness and reliability of the analyses. The adopted analytical strategy focused on identifying core themes, followed by categorization aligned with predefined theoretical constructs. To support this process, the qualitative analysis software Atlas.ti was employed, enabling systematic, coded, and rigorous interpretation of the collected interview data.

The empirical field was selected to represent microenterprises operating in an emerging economy environment characterized by notable scarcity and constraints. Consequently, the study focused on microbusinesses in Acre, a Brazilian state located in the Amazon region, distant from major commercial and industrial centers, and lacking in technological resources compared to



more developed regions. The need for research on the Amazon region is underscored by deVincenzi et al. (2023), who emphasize the importance of studies in economic, social, environmental, and institutional domains to advance scientific knowledge about the region. Approximately 95% of Acre's businesses are small enterprises, primarily concentrated in the services and commerce sectors (SEBRAE, 2022). This type of small business environment is generally characterized by resource constraints and scarcity, making it conducive to research objectives focused on frugality (Lange, Hüsigg & Albert, 2021).

Based on the geoeconomic delineation of the empirical field, the selected cases adhered to specific criteria: they were microenterprises, operated businesses based on new digital technologies, and targeted national markets. This choice allowed for a clearer demonstration of the resource constraints and technological and logistical barriers these organizations face in their operations. Ten microenterprises located in Acre's capital, Rio Branco, were selected. These businesses operated within the "geek" segment, selling their products electronically through frugal internet technologies. The geek segment in-

cludes consumers and enthusiasts of technology, electronics, video or board games, comics, manga, anime, books, movies, and series (Gonçalves, 2021). This specific segment requires businesses to reach a broad geographic scope to access their target audience, making exclusively physical transactions unviable in non-central regions. Furthermore, the technological affinity of this segment was expected to increase the likelihood of identifying innovative uses of digital resources for digital transformation.

Field access was facilitated through contacts associated with the geek culture market for collectible items and action figures. Using initial contacts, the snowball sampling method was employed to identify relevant cases. The advantage of this technique is the increased likelihood that selected participants are willing to take part in the research, as a trust-based relationship is presumed between the researcher and the individual referring the participant (Becker, 1993). A total of 10 cases were selected, one of which was used as a pre-test but later included in the results to enrich the study. Table 1 presents the ten cases and their characteristics.

Table 1
Analyzed Cases

N	Company	Business model	Products	Foundation	Nº Workers	Size/Status
1	TEMPLO1	Auction and sales	Knife and artisanal cutlery	1984	8	Formal microenterprise
2	LEILO1	Auction	Action Figures	2018	6	Informal microenterprise
3	MERCAD1	Auction	Comic Books	2019	1	Informal microenterprise
4	MULT1	Sales	Comic Books	2017	1	Informal microenterprise
5	COLECT1	Sales	Accessories, electronics, stationery, Action Figures, and parts in 3D printing	2018	2	Formal microenterprise
6	EMPÓRI1	Sales	Accessories. Cosplay Costumes; Collectibles	2018	5	Formal microenterprise
7	YUUMI1	Sales	Women's Asian Fashion Products; Fantasies; Colsplay	2019	4	Formal microenterprise
8	TENPO1	Sales	Card games Garments Accessories & Collectibles	2012	2	Formal microenterprise
9	AKAME1	Sales	Accessories	2020	5	Formal microenterprise
10	MAHOU1	Sales	Anime, Cosplay Costumes	2021	2	Informal microenterprise

Source: Developed by the authors (2024).



To ensure the internal validity of the research, a case study protocol was developed. The protocol provides an overview of the case study project, field procedures, and the questions for the case study and research. This ensures internal validity by maintaining a consistent framework across all investigated cases, enabling comparative analysis, enhancing the reliability of the case study, and guiding the researcher throughout the process (Yin, 2015). The protocol used in this research is presented in the Appendix of this article.

For the interviews, semi-structured scripts with open-ended questions were developed, allowing the microenterprise representatives to share their experiences with technology usage and the motivations behind their improvisation using free tools and social media in their ventures. Based on the theoretical framework, the interview script covered the following aspects:

- Technological elements of the digital transformation process (digital technologies).
- Elements of the Dynamic Capabilities of Sensing, Seizing, and Transforming related to the digital transformation process.
- Elements of the Dynamic Capabilities of Sensing, Seizing, and Transforming associated with frugal innovations.
- Processes of bricolage in the use of digital technologies.

FINDINGS

This section examines how microenterprises leverage entrepreneurial bricolage to generate frugal innovations using digital technologies, addressing the central objective of the study. The findings highlight creative strategies employed

to overcome constraints and seize opportunities for digital transformation, showcasing dynamic capabilities such as sensing, seizing, and transforming to reconfigure processes and enable sustainable innovations.

Digital Technologies

The analyzed microenterprises exhibit intensive use of digital technologies in their business models. Aligned with the principles of digital transformation, the technologies employed offered multiple advantages, particularly in areas such as communication, operational efficiency, and market reach. By employing simple and low-cost technologies, these organizations developed processes and adaptations to meet both internal and customer needs. Unlike larger companies, which often utilize proprietary websites or major platforms for their operations, microenterprises redefined existing technologies to achieve their objectives with minimal cost, simplicity, accessibility, and ease of use.

The study revealed extensive use of social media platforms such as Facebook and Instagram, as well as instant messaging applications like WhatsApp. Other technologies, including blogs, websites, and YouTube channels, were also identified, though their usage was more specific and limited, as outlined in Table 2.



Table 2
Digital technologies used by companies

Case	WhatsApp	Instagram	Facebook	Website	Other Technologies or Features
LEILO1	Yes	No	No	No	None
MERCAD1	Yes	No	Yes	No	None
TEMPLO1	Yes	No	Yes	Yes	YouTube, Blogger
MULT1	Yes	Yes	Yes	No	None
COLECT1	Yes	Yes	Yes	Yes	None
EMPÓRI1	Yes	Yes	Yes	No	None
YUUMI1	Yes	Yes	Yes	Yes	None
TENPO1	Yes	Yes	No	Yes	Paid traffic on Instagram
AKAME1	Yes	Yes	Yes	No	None
MAHOU1	Yes	Yes	Yes	No	None

Source: Developed by the authors (2024).

Bricolage

Bricolage played a central role in adapting the technologies used by the microenterprises analyzed to achieve their business objectives. Through this creative approach, the companies modified social media tools (e.g., Instagram, Facebook), instant messaging applications (e.g., WhatsApp), and office tools (e.g., Word, Excel) to meet their needs. Originally designed for other purposes, these technologies—often associated with larger, costlier systems—were reinvented to perform essential functions such as customer relations, marketing, sales, and logistics. For instance, using WhatsApp as a platform for auctions replaced more expensive commercial solutions, requiring only a smartphone to facilitate transactions. This adaptive capability transformed widely accessible technologies into effective and sustainable solutions for microenterprises. Table 3 outlines the main technologies and how they were utilized to perform various business functions.

Two primary processes emerged in bricolage: imitation and personalization.

- **Imitation:** Companies replicated externally observed solutions, adapting them to their context. An example is the use of WhatsApp for auctions, a practice that spread among en-

trepreneurs through knowledge networks. The owner of MERCAD1 reported migrating to WhatsApp after noticing declining engagement on Facebook and recognizing the new platform's effectiveness for their needs.

- **Personalization:** Companies created original innovations using existing resources. A notable example is the combined use of online sales platforms such as Shopee and Mercado Livre to address logistical challenges. While these platforms were designed for product promotion and negotiation, some companies used them solely to secure more affordable delivery options, reducing shipping costs by up to 80%.

Additionally, many companies combined bricolage with outsourced resources, such as specialized services for managing social media. This integration highlights the complementarity of knowledge assets, enabling low-cost and sustainable solutions. For instance, the owner of MAHOU1 explained how WhatsApp complemented Instagram in the sales process, facilitating negotiations and logistical coordination. Similarly, the owner of AKAME1 noted that Instagram, initially used as a hobby, became an essential tool for her business due to its features that support commercial management.



Table 3
Main technologies and functions performed

Business Processes	Main digital technologies used	Business function performed
Communication with Customers	WhatsApp, Instagram, Facebook	Promote products/services and increase visibility through visual content and ads.
Outreach and Marketing	Instagram, Facebook, YouTube, Blogger	Promover produtos/serviços e aumentar visibilidade por meio de conteúdos visuais e anúncios.
Sales	WhatsApp, Instagram, Sites, Facebook	Sell directly on platforms, including auctions and online catalogs.
Inventory Management	Sites, WhatsApp	Monitor and organize available products, especially for large inventories.
Logistics and Deliveries	WhatsApp	Coordinate deliveries and facilitate communication between customers and couriers.
Customer Capture	Facebook, Instagram	Attract new customers using social media engagement strategies.
Learning and Adaptation	Facebook, Instagram	Acquire knowledge for efficient use of technologies and adapt them to needs.
Networking and Partnerships	WhatsApp, Facebook	Build and manage networks of contacts with customers, suppliers and partners.

Source: Developed by the authors (2024).

The owner of MAHOU1 highlights WhatsApp as the primary tool for finalizing orders, where product selection is made on Instagram and sales are completed on WhatsApp. This approach serves both as a customer database and a mechanism to streamline deliveries. Delivery personnel receive location details via WhatsApp and, if unsure about an address, can call the client directly. As the respondent explained:

“On Instagram, we collect the person’s contact information, and we finalize the sale on WhatsApp to arrange delivery, send the location, and access the person’s number for both our database and for the driver making the delivery.” (MAHOU1)

Similarly, the owner of AKAME1 shared that she initially started her store on Instagram as a hobby, which later evolved into a full-fledged business. Through Instagram, people discovered her work. She emphasized that Instagram offers features like messaging, calling, and the ability to set up a business profile, which simplifies managing her business. As she stated:

“People can send messages and even call, so Instagram itself facilitates this by giving

us the option to conduct business through a profile. I use that option there.” (AKAME1)

Frugal Innovation in the Use of Digital Technologies

The technologies employed by the analyzed businesses demonstrate a strong alignment with the principles of frugal innovation, highlighting their effectiveness in resource-constrained contexts. Table 4 provides a summary of this relationship. The companies successfully leveraged widely available technologies, such as WhatsApp and Instagram, in innovative ways, transforming them into low-cost solutions that enabled and optimized their operations. The affordability of these tools is a central feature of frugal innovation, allowing microenterprises and informal businesses to implement communication, marketing, and sales systems without significant investments. This approach enables operations with minimal resources while maintaining efficiency and accessibility.

Another critical aspect of frugal innovation identified is the adaptability of these technologies to meet the specific needs of businesses. For instance, WhatsApp was adapted to create auction groups, while social networks like



Instagram and Facebook were used to reach local and international markets. This flexibility demonstrates how simple and accessible solutions can be creatively repurposed to address specific business challenges. Furthermore, the user-friendly interfaces of these technologies allow individuals without formal technical training to adopt and maximize their potential, enhancing efficiency and lowering barriers to entry.

These practices of adaptation and creative use underscore the role of these technologies as indispensable tools for businesses operating under financial constraints. They illustrate how the principles of frugal innovation can lead to accessible, effective, and sustainable solutions for microenterprises in challenging contexts.

Table 4
Digital technologies and the relationship with Frugal Innovation

Advantage	Description	Relationship with Frugal Innovation	Examples of uses by companies
Low Cost	Free or low-cost use of tools such as WhatsApp and Instagram, optimizing the budget.	Reduces operating costs, enabling business with minimal resources.	LEILO1, MERCAD1 and TEMPLO1 used WhatsApp to hold auctions at no additional cost. COLECT1 and YUUMI1 created profiles on social networks for dissemination without the need for physical stores.
Ease of Use	Simple and intuitive interfaces allow for efficient use, even without formal training.	Promotes accessibility and efficiency, maximizing impact with simplicity.	EMPÓRI1 and AKAME1 reported informal learning to use Instagram and WhatsApp, becoming proficient without formal training. MULT1 used Facebook to communicate with customers with ease, due to previous experience.
Wide Range	Access to local and international markets.	Possibility to scale and allow accessibility for the customer.	TEMPLO1 and MAHOU1 used social networks to reach customers in different regions of Brazil and even internationally. EMPÓRI1 took advantage of local events to attract customers and direct them to his Instagram page.
Speed and Agility	Instant communication and fast customer support.	Quick and effective troubleshooting	AKAME1 and MAHOU1 used WhatsApp to send locations and coordinate deliveries with customers and couriers. YUUMI1 used WhatsApp to quickly respond to customer inquiries.
Adapting to Local Needs	Technologies tailored for specific functions, such as auctions and logistics.	Creative reuse of technologies to solve specific problems.	LEILO1 and MERCAD1 have adapted WhatsApp to create auction groups. TEMPLO1 innovated by using multiple platforms (WhatsApp, Blogger, YouTube) to diversify its sales.
Application Flexibility	Application in multiple processes, such as sales, marketing, inventories and logistics.	Creative use of a single technology for diverse needs.	COLECT1 used a website for inventory management and product visualization, complementing the promotion on Instagram. YUUMI1 has combined Instagram (for product display) and WhatsApp (for communication and sales).
Efficient Dissemination	It allows clear and attractive exposure of products through accessible social networks.	Amplifies the reach of simple and affordable tools.	EMPÓRI1 and AKAME1 explored the features of Stories and Instagram posts to engage followers. MAHOU1 used Instagram to showcase products and capture leads for sales on WhatsApp.
Networking and Partnerships	It assists in the creation of networks of contacts and business partnerships.	Creation of networks for the exchange of knowledge and maximization in the search for complementary resources.	LEILO1 and MERCAD1 used WhatsApp and Facebook groups to establish connections with potential customers and partners. EMPÓRI1 took advantage of face-to-face events to strengthen networking and redirect customers to its digital platforms.

Source: Developed by the authors (2024).



Relationship Between Dynamic Capabilities, Absorptive Capacity, and Frugal Innovation in Digital Transformation

The analyzed cases demonstrate that microenterprises relied on dynamic capabilities and absorptive capacity as central factors for digital transformation in resource-constrained contexts. These competencies were enabled through the use of frugal digital technologies, allowing the businesses to adapt creatively to structural and operational challenges.

The sensing capability, which involves identifying opportunities and threats in the external environment, was clearly evident. Companies like YUUMI1 and COLECT1 recognized the migration of users from Facebook to Instagram and quickly adjusted their strategies to capitalize on the reach and engagement of this social media platform. As the owner of YUUMI1 explained:

"We decided to use Instagram as our main platform because we noticed a significant migration of users to it. Today, everything we post on Instagram gets seen first." (YUUMI1)

This ability to monitor trends was also demonstrated by EMPÓRI1, which identified specific demands through interactions with customers at local events. The owner noted:

"After customers approached me at the Potter Day event, I realized I needed to create an Instagram page to sell the products they wanted." (EMPÓRI1)

The seizing capability, or the mobilization of resources to capture opportunities, was evident in how the companies integrated frugal technologies into their operations. WhatsApp and Instagram were widely adopted as channels for sales, communication, and marketing. For example, MULTI1 utilized the Shopee marketplace exclusively to address logistical issues, reducing shipping costs by up to 80%. According to the owner:

"I realized that using Shopee solely for shipping was cheaper than conventional methods, so I adjusted our processes to take advantage of it." (MULTI1)

Similarly, MAHOU1 expanded its communication channels by creating WhatsApp groups for direct customer interaction, linking this strategy to Instagram. The owner explained:

"We finalize sales through WhatsApp because it's faster and easier to coordinate details with customers." (MAHOU1)

The transforming capability, which involves reconfiguring resources and processes to sustain changes, was demonstrated through the integration of digital channels with physical operations. EMPÓRI1 exemplified this by connecting its physical store to digital channels, creating a multichannel customer experience. The owner remarked:

"Customers can choose products online and pick them up at the physical store, which makes things much easier for them." (EMPÓRI1)

Additionally, AKAME1 personalized processes to meet specific demands by combining digital tools with tailored operations. The owner shared:

"We use Instagram to showcase products and WhatsApp to coordinate deliveries, receiving customers' locations directly." (AKAME1)

Another example is TENPO1, which adopted paid Instagram advertisements to expand its reach, supported by a marketing manager. The owner noted:

"Paid traffic has been essential for reaching new customers, and our marketing manager ensures everything works smoothly." (TENPO1)



Beyond dynamic capabilities, the businesses demonstrated absorptive capacity, which was critical for enabling frugal innovation. This competency encompassed acquiring, assimilating, and transforming knowledge from external sources such as social networks, partners, and online resources. Improvisation and learning through trial and error were also emphasized. The owner of EMPÓRI1 shared how she overcame initial challenges with Instagram:

"I took free courses and asked friends how to post photos and use tools. That's how I learned through practice." (EMPÓRI1)

Similarly, the owner of TENPO1 leveraged prior experience with social media to adopt more advanced practices:

"I was already using social media, but I learned how to work with paid traffic to improve results." (TENPO1)

These cases illustrate how dynamic capabilities and absorptive capacity complement each other to enable frugal innovation and digital transformation. The companies not only identified external opportunities but also creatively mobilized resources and reconfigured processes to meet market demands. By integrating accessible technologies with adaptive strategies, these organizations overcame financial and operational barriers, promoting competitiveness and resilience in dynamic environments.

The evidence suggests that even in resource-constrained contexts, organizations can identify and exploit digital innovations, seize opportunities, and reorganize processes with agility and creativity. The analyzed cases highlight the importance of integrating frugal technologies with organizational reconfiguration strategies to drive innovation and competitiveness in dynamic and challenging markets.

DISCUSSION

The case analysis provides robust evidence that enhances the understanding of the relationship between knowledge processes, entrepreneurial bricolage, and the generation of frugal innovations using digital technologies in microenterprises. The analyzed businesses stood out for their ability to monitor the external environment, identify opportunities, and adapt accessible technologies to meet specific needs, creating solutions that would typically require significant investments in larger companies. This adaptive process, which combines creativity and efficiency, is illustrated in the model shown in Figure 5, depicting the cycle of frugal solutions through bricolage.

Accessible tools such as social media platforms (Instagram, Facebook), instant messaging applications (WhatsApp), and office software (Word, Excel) were extensively adapted for customer relations, sales, marketing, and logistics. These technologies, initially designed for general purposes, were transformed into systems capable of meeting the demands of small businesses at minimal costs. This transformation underscores the role of bricolage and frugal innovation as central strategies for the competitiveness of microenterprises in resource-constrained contexts.

Theoretical contributions of this study include demonstrating how bricolage processes and absorptive capacity enable businesses to achieve frugal innovations. The evidence revealed that to generate such innovations, entrepreneurs not only monitored their environment and acquired external knowledge but also learned through trial and error, self-teaching, and networking. This highlights the relevance of dynamic capabilities—sensing, seizing, and transforming—as fundamental frameworks for adaptation and digital transformation in microenterprises. The companies detected changes in the digital environment (sensing), mobilized accessible resources to seize opportunities (seizing), and reconfigured processes to sustain their operations in the new context (transforming).



From a practical perspective, the businesses demonstrated resilience and creativity in managing risks and experimenting with low-cost technologies. Sharing mistakes and solutions within entrepreneurial networks proved crucial for overcoming challenges and enhancing collective capabilities. Practical examples, such as auctions conducted via WhatsApp and the use of online sales platforms to address logistical issues, illustrate the direct application of these strategies. For instance, MULT1 reduced shipping costs by up to 80% by leveraging marketplaces like Shopee for logistics, while companies such as LEILO1 adapted WhatsApp for auctions, replacing expensive commercial solutions.

The COVID-19 pandemic further accelerated these processes, forcing many companies to digitalize their operations. The study revealed how digital technologies enabled operational ambidexterity—combining local and virtual activities—and even the reverse movement, from digital to physical operations. EMPÓRI1, for example, connected its physical store with its digital channels, creating a multichannel experience that improved customer satisfaction and operational efficiency.

These findings reinforce the practical contribution of the study, demonstrating how microenterprises can integrate bricolage, frugal innovation, and digital transformation to achieve competitiveness in challenging markets. By creatively and strategically adapting and reconfiguring resources, these businesses not only overcome resource limitations but also create sustainable solutions that can inspire other organizations in similar contexts.

Finally, the study advances theoretical understanding by exploring the intersection of dynamic capabilities, bricolage, and frugal innovation, demonstrating their practical relevance in an increasingly digitalized environment. It highlights that digital transformation does not have to be an exclusive strategy of large organizations but can also be enabled frugally and effectively by microenterprises through the combination of creativity, learning, and adaptation.

CONCLUSION

Based on the analyzed cases, this research advances scientific knowledge by exploring the relationship between knowledge acquisition processes, entrepreneurial bricolage, and the generation of frugal innovations using digital technologies. The results demonstrate how micro and small enterprises can adapt and combine accessible resources to create effective solutions that meet their business needs, even in contexts of significant constraints. The businesses exhibited dynamic capabilities aligned with opportunity identification, resource mobilization, and process reconfiguration, showing how digital technologies can be used creatively to overcome financial, logistical, and structural limitations.

The findings offer relevant practical implications. Bricolage and the creative use of digital technologies enable entrepreneurs to access new markets, optimize internal processes, and explore new business models at reduced costs. Examples such as using WhatsApp for auctions and marketplaces for logistics highlight how digital tools, initially designed for other purposes, can be transformed into strategic and accessible solutions for small businesses. These solutions emphasize the importance of frugal technologies as enablers of innovation and competitiveness, particularly for microenterprises.

Despite these contributions, some limitations must be acknowledged. This exploratory study focused on a limited number of cases and sectors, so caution is advised when generalizing the results to other contexts. Additionally, the study did not examine long-term aspects such as sustainability or risks associated with frugal innovations, including data security and scalability challenges.

Bricolage emerged as an essential element for adaptation and innovation in the use of digital technologies. However, future research could further explore individual factors, such as the characteristics and skills of entrepreneurs that influence their bricolage capacity. Environments with more severe constraints, such as remote regions or contexts with limited technological infrastructure, also offer opportunities to expand this field of inquiry.



This article makes a theoretical contribution by highlighting how microenterprises employ bricolage and frugal innovation practices to drive digital transformation in resource-limited contexts. The study underscores the central role of dynamic and absorptive capabilities as foundations for identifying, appropriating, and reconfiguring digital technologies into innovative and accessible solutions capable of advancing digital transformation. Thus, the research reinforces the importance of creative adaptation and strategic use of available resources as critical elements for the success of microenterprises in challenging markets.

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- Appendix 1 – Semi-Structured Interview Script

This script was used as a data collection instrument to conduct interviews with those responsible for the micro-enterprises participating in the study.

Section 1: Knowledge Processes

1. What strategies does your company use to acquire new knowledge about Information and Communication Technologies (ICTs)?
2. How do you identify and apply this knowledge in your daily operations?

Section 2: Tinkering and Improvisation Processes

1. What available resources does your company use to overcome operational challenges?
2. Have you ever had to improvise solutions using limited resources? How was this done?
3. How have changes in rules or challenges impacted the strategies adopted?

Section 3: Technological Characteristics and Frugal Innovation

1. What specific technologies does your company use on a daily basis?
2. Why did you choose these technologies over other available ones?
3. What were the most significant results of the solutions adopted at low cost?

Section 4: Adaptation and Creativity

1. How does your company adapt to market changes or operational challenges?
2. What creative actions have been implemented to improve business performance?

Section 5: Success and Failure Situations

1. Can you share an example of success in relation to the practices adopted?
2. Was there any attempt that did not have the expected results? How was this dealt with?