

Frugal innovation and operational performance: the role of organizational learning capability

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Abstract

Purpose – This study aims to analyze the organizational learning capability relationship with operational performance and frugal innovation across Brazilian companies.

Design/methodology/approach – Quantitative research was performed using collected data from 154 firms, which were analyzed using structural equation modeling.

Findings – The results showed that organizational learning capability is an antecedent of frugal innovation. The results also predict a better operational performance for companies that actively innovate cost-effectively. Another result was the positive relationship between the organizational learning capability and the operational performance. The authors found that the indirect and positive relationship between organizational learning capability, frugal innovation and operational performance was confirmed, reinforcing the literature.

Research limitations/implications – A theoretical implication of this study can be seen in the establishment of the relationship between organizational learning capability, frugal innovation and operational performance since no studies linking these variables together were found. Therefore, the organizational learning capability and the frugal innovation can be considered facilitators of the operational performance.

Practical implications – Managers should consider organizational learning and frugal innovation when thinking about firms' operational performance. In this way, to facilitate and achieve higher performance, it was found that organizational learning capability and frugal innovation have a great deal of impact on operational performance.

Social implications – At frugal innovation, the needs of citizens are prioritized. It is a great instrument to face crises since it consists of developing simpler and cheaper products and services quickly, making them accessible to a larger group of consumers.



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Originality/value – This study seeks to understand whether Brazilian companies are moving toward a more frugal innovation strategy. The study opens the possibility of showing whether the organizational learning capability has also impacted this change.

Keywords Frugal innovation, Organizational learning capability, Operational performance

Paper type Research paper

1. Introduction

Organizational learning capability (OLC) is important to innovation and performance. OLC is responsible for measuring and analyzing firms' organizational learning factors (Chiva, Alegre, & Lapedra, 2007). OLC fosters innovation capabilities (Ning & Li, 2016). In this way, the literature about OLC shows that it is associated with product innovation performance (Alegre & Chiva, 2008; Gomes, Seman, & Carmona, 2022). Consequently, the literature opens the opportunity to suggest the association of OLC with operational performance (OP) (Migdadi, 2021), especially when OP entails the combination of certain aspects, such as process improvements, short lead times and quality conformity in the product manufacturing process (Kotabe, Martin, & Domoto, 2003).

Both the association of OLC with innovation and the suggested association of OLC with OP consider traditional forms of innovation, more specifically, product and service innovation. However, in the past decade, we can observe research on the emergence of the discussion about frugal innovation (FI) (Hossain, 2018; Berndt, Gomes, & Borini, 2023). FI challenges traditional business worldwide and retains the attention of scholars. FIs are typically built on new product architectures that enable entirely new applications at much lower price points than existing solutions (Zeschky, Winterhalter, & Gassmann, 2014). FI represents the desire to improvise while taking advantage of developing markets (Pitelli, 2011) to create new products and processes that increase consumers' affordability power (Bhatti, 2012).

This innovation seeks to shift all sectors toward a frugal economy, enabling sustainability while being concerned about the use of scarce resources (Prabhu, 2017). In other words, even though FI is a product and service innovation, it has peculiarities that challenge preestablished relationships stated or suggested in the literature. For example, until now, the antecedents and outcomes (Hossain, 2018) did not list the association of FI with OLC and OP.

Then, we note that OLC antecedes FI for some logical reasons. First, to develop FI, the company needs to revisit the questions of cost, functionality and sustainability. It means firms learn to search for and recognize new opportunities for FI. Second, FI depends on new market approaches. Again, OLC must be able to explore new venues. Finally, FI is the result of new processes, in which case, the company needs the capability to learn new routines and activities.

In this way, what is the role of OLC as it interfaces with FI and OP? We support the central hypothesis that a firm with OLC can generate more FI and increase the impact on OP. To test this hypothesis, quantitative research analysis was performed using data collected from a sample of firms in Brazil, an emerging market propitious for observing FI (Isacsson & Melkas, 2018; Hyypä & Khan, 2018; Bernardes, Borini, & Figueiredo, 2019).

Bringing answers to this research's main question is important for several reasons. First, for the literature of OLC, FI and performance (Migdadi, 2021; Berndt, Gomes, & Borini, 2023), we contribute to extending the empirical investigation into OLC and OP. Second, for the literature of FI (Hossain, 2018), we bring OLC as an important antecedent to boost FI in the firms. Third, our results add to the literature of FI (Hossain, 2018) and innovation (Ning & Li, 2016) that although FI has its own peculiarities, there is behavior very similar to product and service innovation when related with OLC. Finally, in a managerial contribution, this article complements the assumptions of FI as a company strategy (Santos,

Borini, & Oliveira, 2020), showing that one of the capabilities needed to increase FI innovation is the learning capability. Managers with an interest in developing FI need to invest in attributes of OLC like experimentation, interaction with the external environment, dialogue, participative decision-making and risk-taking.

2. Conceptual background and hypotheses

2.1 Organizational learning capability and operational performance

OP can be defined as the degree of fulfillment of the goals of a manufacturing process (Shah & Ward, 2003). It is also related to a combination of other aspects, such as process improvements, product development efficiency, short lead times and quality conformity (Kotabe, Martin, & Domoto, 2003). Systematically, OP is also an option whenever investigating the effects of organizational activity (Turkulainen & Ketokivi, 2013).

OLC can be defined as the ability of an organization to process knowledge, that is, the ability to create, acquire, transfer and integrate knowledge and also to modify the firm's behavior to reflect the new cognitive situation, with the aim of improving organizational innovation and performance (Jerez-Gomez, Cespedes-Lorente, & Valle-Cabrera, 2005; Gomes & Wojahn, 2017). Both innovation and performance have a positive relationship with organizational learning. Nevertheless, the effect of innovation on performance might be greater than what the organization gains in terms of knowledge (Jiménez-Jiménez & Sanz-Valle, 2011). For Zhu, Liu, and Chen (2018), organizational learning allows the organization to achieve better performance. As organizational learning is seen as an antecedent of organizational learning capabilities, OLC has also proved to have a positive effect on performance (Chiva et al., 2007; Berndt, Gomes, & Borini, 2023).

Considered a requirement of firms' effectiveness (Alegre & Chiva, 2008), OLC fosters organizational characteristics and determines organizational behavior toward learning. Once recognized as an organizational learning process facilitator, OLC's importance lies in its effect on performance. Hence, as a consistent option for analyzing firms' organizational characteristics that enable the process of learning, OLC—through knowledge sharing—can contribute to OP improvement (Alegre & Chiva, 2013; Berndt, Gomes, & Borini, 2023).

As it is considered a creator of an organizations' learning process (Argote & Hora, 2017), OLC is expected to foster better firm OP (Ning & Li, 2016). Once knowledge helps organizations to achieve a competitive advantage, firms are encouraged to apply their capital in the form of experience, skills and knowledge to also improve its performance (Argote & Hora, 2017; Qurnain & Hidayati, 2020). Finally, Alegre & Chiva (2008) have stated that OLC is necessary for performance.

To achieve high performance, companies need to exercise continuous organizational environment scanning, as well as experimentation and creativity support (Gomes, Seman, & Carmona, 2022). OLC is seen then as a vital component when it comes to firms' success and effectiveness (Alegre & Chiva, 2008). OLC is a key required to accomplish organizational success and enhance performance (Oh & Han, 2020). Hence, positive results have been found concerning OLC and performance relationships (Qurnain & Hidayati, 2020; Ferreira, Cardim, & Coelho, 2021). Therefore, this hypothesis is given:

H1. Organizational learning capability is positively related to operational performance.

2.2 Frugal innovation and operational performance

A positive relationship between firm innovativeness and firm performance was previously found (Calantone, Cavusgil, & Zhao, 2002). FI is conceptualized as a conglomerate of

features, including cost reduction, the creation of a sustainable-shared engagement (frugal ecosystem) and the concern with core functionality (Weyrauch & Herstatt, 2016; Zeschky et al., 2014). However, improvements to performance are believed to be engendered by quality as a result of reductions in waste, human resources and machine-hours. The latter represents some of FI's core values and, therefore, agrees with today's search for frugality within the firm (Prabhu, 2017).

Belkadi et al. (2016) see the adaptation of products for emergent markets under FI perspectives as a strategic move for companies' competitiveness. However, this competitive advantage should be built on a full understanding of consumer needs, competitors' actions and technological development, as firms lacking these attributes are less likely to innovate (Calantone, Cavusgil, & Zhao, 2002). This mindset shift further entails a production system adaptation, which also needs to be affordable; otherwise, it will impact on general performance (Belkadi et al., 2016).

OP is also observed as not only regarding product quality but also as leading to less costly and faster processes (Shah & Ward, 2003). In accordance with this view, Kotabe, Martin, & Domoto (2003) see OP as a combination of aspects: process improvement, product development efficiency, short lead times and quality conformity. Both previously presented visions are also core functionalities of FI, where FIs are conceptualized as features that encompass cost reduction, sustainable-shared engagement and product/service functionality.

Internally, it is expected that the company's leaders stimulate innovation in the operational process in all departments (Sutanto, 2017). This frugal way of thinking then consists of FIs, which are, ideally, faster, cheaper and better solutions (Prabhu, 2017). Once the search for technological change is seen as an OP improvement (Luu, 2017), it is possible to conclude that FI also positively affects overall OP (Shan, Song, & Ju, 2016).

Knowledge acquisition and transfer are also a part of OLC that fosters firm innovation (Ning & Li, 2016; Berndt, Gomes, & Borini, 2023) and FIs (Hossain, 2018). No matter the result, for Sutanto (2017), the more people involved, the bigger and faster the innovation process will be. Finally, as innovation is an FI antecedent, and once a positive relationship between firm innovativeness and OP are found, it is expected that FI also has some kind of relationship with firms' OP. Hence, another hypothesis can be proposed:

H2. Frugal innovation is positively related to operational performance.

2.3 Organizational learning capability and frugal innovation

Innovation is seen as the result of learning processes, as firms usually seek knowledge accumulation to be able to promote innovations (Tambosi, Gomes, & Amal, 2020). Research on organizational learning has already proven a positive relationship with innovation (Jiménez-Jiménez & Sanz-Valle, 2011; Zhang & Zhu, 2019). As is known, OLC has a direct and positive impact on innovation (Chiva, Alegre, & Lapiedra, 2007). However, leaders should be active, engaging and fostering creative ideas on the operational process as a way to increase innovation within the firm (Sutanto, 2017).

While capturing an organization's propensity to learn, OLC is proven to generally enhance innovation performance (Alegre & Chiva, 2008). Migdadi (2021) also considered OLC as an antecedent of innovation. Therefore, managers should consider the OLC measurement scale when setting firms' innovation objectives (Alegre & Chiva, 2008) once knowledge-sharing practices have been found relevant to facilitate innovation (Wang & Wang, 2012). As knowledge-sharing results in learning (Argote & Hora, 2017), its relationship with innovation may provide managers with key information to foster higher

performance through making the correct use of both innovations and knowledge (Wang & Wang, 2012).

Evidence that OLC impacts business sustainability, which can be linked with FI (Pisoni, Michelini, & Martignoni, 2018), was also found. As sustainability is one of the major concerns and trends (McKinsey & Company, 2019) when it comes to innovation, these resource-constrained innovations (Zeschky et al., 2014) are challenging traditional businesses worldwide (Prabhu, 2017). By frugally innovating, firms could elevate their innovation leverage by increasing openness, experimentation and knowledge transfer (Qurnain & Hidayati, 2020), which are some of the OLC factors (Chiva, Alegre, & Lapiedra, 2007).

Results suggest that to remain competitive, organizations should pay full attention to OLC (Tambosi, Gomes, & Amal, 2020). Thus, innovation research should include OLC's factors (Alegre & Chiva, 2008). Research also showed the positive relationship between organizational learning and innovation, confirmed by production process improvement, such as reducing costs (Gomes & Wojahn, 2017), which is also an FI core value.

OLC is considered an asset that allows companies to transform and appropriately use their resources for innovation. Thus, emphasis on innovation requires a high and effective OLC (Migdadi, 2021). Therefore, as OLC represents a firm's initiative to change through learning (Chiva, Alegre, & Lapiedra, 2007) and factors that facilitate organizational learning should be taken into consideration once they exert a direct relationship on innovation (Gomes & Wojahn, 2017), the following hypothesis can be put forward:

H3. Organizational learning capability is positively related to frugal innovation.

2.4 Organizational learning capability, frugal innovation and operational performance

As FI is seen as an alternative for competitiveness in times of crisis, studies such as the one by Rossetto, Borini, Bernardes, and Frankwick (2023) suggest that companies differentiate themselves, developing a frugal mindset within the firms' culture and processes. Likewise, for Ferreira et al. (2021), FI activities could trigger OP when new knowledge is added. As Zeschky et al. (2014) believe, developing a frugal mindset and culture within the firm is important; hence, OLC may also be combined with other capabilities to impact performance favorably.

As FI results in new opportunities for business models (Knorringa, Peša, Leliveld, & van Beers, 2016), countries like Brazil now have business models focused not only on resource-constrained environments but also on a large number of value-conscious consumers (Prabhu, 2017). Hence, Salvador, Forza, Rungtusanatham, and Choi (2001) consider that firms can expect better time-related OP when firms interact with customers and suppliers. Moreover, according to the authors, this change in the relationship will further enhance performance in speed (Shan, Song, & Ju, 2016) and delivery punctuality terms (Salvador et al., 2001) once firms become more conscious when innovating.

This is an example of FI features that are showing themselves to be crucial for competitiveness in times of scarce resources. Yet for FI to become a normal way of life within the firm, a frugal mindset is necessary to be cultivated (McMurray, de Waal, & Etse, 2019). Therefore, embedding FI to the company's organizational culture and mindset is of key importance (McMurray, de Waal, & Etse, 2019) to enable simple solutions and low-resource approaches (Bedi & Vij, 2016) such as those of FI (Prabhu, 2017). Whatever the result, the importance of FI results from the benefit generated for all involved while developing the innovation process, product or relationship.

Ferreira et al. (2021) have explained how OLC culture exerts a significant influence on performance, consequently impacting innovation. The contrary was also proven: OLC can

have a positive impact on innovation, which consequently affects performance (Qurnain & Hidayati, 2020). Hence, Tambosi, Gomes, and Amal (2020) consider that innovation is a result of learning processes. Likewise, it is possible to infer that, in general, innovation shows itself as an important factor in intensifying performance (Ferreira et al., 2021).

Organizational learning allows an organization to develop capabilities to improve innovation, and it is precisely this that positively affects performance (Pudjiarti & Priagung Hutomo, 2020). In accordance, Migdadi's (2021) study shows innovation's positive impact on OP and sheds a light on the indirect relationship between OLC, innovation and OP. Future research should contribute to the literature presenting different variables in different contexts (Migdadi, 2021). It is also important to understand if FI could be a mediator of OLC's relationship with OP. Thus, this hypothesis is proposed:

H4. Frugal innovation acts as a mediator variable between organizational learning capability and operational performance.

Finally, based on the discussions presented above concerning FI, OLC and OP, a conceptual model is presented in Figure 1. Both FI and OLC are considered second-order constructs, while OP is a first-order construct.

3. Methodology

We adopted a quantitative method approach for this analysis. We collected the data by using an online survey in 2017. The survey focused on managers at decision level from Brazilian companies as key informants, as these are a valuable source of information to analyze different aspects within the organization and the phenomena studied here. This survey of Brazilian managers allowed us to study the subject to translate into the unique context of one of the world's biggest emergent markets.

We adopted nonprobability sampling by convenience, targeting an initial population of the survey formed from an obtained list of 4,283 managers representing Brazilian product and service companies from manufacturing industries. The e-mails inviting the recipient to answer the survey were addressed to the managers, and 4,242 e-mails were successfully sent. However, only 267 managers' responses were received. Also, not all the respondents completed all of the questionnaires were completed by addressing all the variables used in this article because we did not force the managers to answer all the questions to finish the survey. Then, we excluded all the answers with any missing data (cases with one or more variables not answered) for the constructs used here (FI, OLC and OP). The final sample used in the resulting analyses was 154 answers from managers.

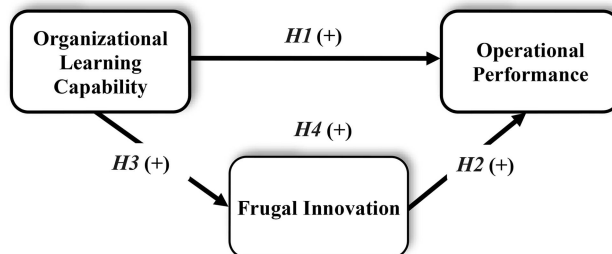


Figure 1.
Research model

Source: Figure by authors

To avoid carryover effects, a randomization feature was included in the questionnaire (MacFie, Bratchell, Greenhoff, & Vallis, 1989). Once all measurements were collected with the same response format, collection mode, type of respondent and time, the common method variance (CMV) effect may occur. Hence, the Harman's single-factor test was performed, and the results showed a 41.20% variation for the first factor (adequate < 0.5) (MacKenzie & Podsakoff, 2012). Thus, this suggests that the CMV effect did not affect the results of this research.

Once the data were collected, the second step of this study was carried out, which was composed of an evaluation of the measurement model. The analysis was performed through the extensive use of SmartPLS software. After all the statistical requirements were met, the third stage was executed by the structural equation modeling (SEM) statistical analysis. The chosen method is adequate when the research objective lies between needing to predict patterns and to test a theory (Hair et al., 2017).

3.1 Construct measurement

Operational performance is a first-order construct and is calculated according to six variables, defined by Calantone, Cavusgil, and Zhao (2002): delivery time performance, speed to introduce new products/services into the operational process, compliance with product/service specifications, flexibility to change the product/service mix, unit cost of production and flexibility to change the volume of operations. The construct was measured through a seven-point Likert scale, ranging from 1 = totally disagree to 7 = totally agree.

As the *frugal innovation* variable is a second-order construct, it was measured by three dimensions, initially conceived by Rossetto et al. (2023). These three dimensions were substantial cost reduction, sustainable shared engagement and focus on core functionality. Each of these dimensions encompassed other items and was also answered through a seven-point Likert scale for all items, varying from 1 = totally disagree to 7 = totally agree.

Third and last, *organizational learning capability* is a second-order construct and is formed by five dimensions that were initiated by Chiva, Alegre, and Lapiedra (2007) and further adapted by Gomes and Wojahn (2017). The five dimensions are experimentation, interaction with the external environment, dialogue, participative decision-making and risk-taking. Once again, measurement was obtained by applying a seven-point Likert scale for all items, ranging from 1 = totally disagree to 7 = totally agree.

Company size was also looked at, and the classification used to do this was the Brazilian micro and small business support service. This agency considers employee numbers to classify firms into micro (1–19 employees), small (20–99 employees), medium (100–499 employees) and large (500+ employees) organizations (SEBRAE, 2020). Again, this ranking choice was adopted due to the reluctance of company employees to disclose some types of data.

4. Results

4.1 Sample characteristics

This section of the study conveys the main research results, starting with the sample characterization. We extracted our sample from a list of 4,283 managers representing Brazilian product and service companies from manufacturing industries. We selected only C-level employees, focusing the survey on managers, directors, chief executive officers and owners as key informants. This action resulted in fewer respondents (154 responses); however, Memon et al. (2020) point out that a smaller and carefully selected sample is preferable than a large sample selected without criteria.

In this study, we used the partial least squares structural equation modeling (PLS-SEM) method and the statistical software SmartPLS4. PLS-SEM offers solutions with small

sample sizes when models comprise many constructs and a large number of items (Hair et al., 2019). With previous studies having identified a sampling threshold for PLS-SEM in the order of 100 samples, the current sample size of 154 is considered as adequate for PLS-SEM (Reinartz, Haenlein, & Henseler, 2009). Thus, we understand that this sample contributes to understanding the phenomenon under study.

The final sample used in the result analyzes was 154 responses from managers. First, company size was analyzed through SEBRAE's (2020) classification. The majority of respondents were from microcompanies (37%), while 30% were from large, 17% from small and 16% from medium companies. Finally, the company's national or foreign investment was also analyzed. In the sample studied here, 87% had only domestic investments, while 13% also had foreign investments.

4.2 Measurement model

Literature parameters (Hair et al., 2017) were tested to verify the research model reliability. The first parameter looked at was the squared outer loading (λ^2), which must be greater than 0.5 in exploratory studies (Chin, 1998). In this analysis, three indicators turned out to be below the recommended index. Therefore, presence of cross-functional work teams (dialogue), resources for projects involving new situations (risk) and cost per unit (performance) were excluded, and the following tests were performed without them.

The variance inflation factor was initially analyzed and presented values below five for all constructs and indicators. This shows that the data multicollinearity is not considered severe. The model has enough internal consistency (Table 1), with most variables having a Cronbach's alpha (CA) value greater than 0.7 (only two did not, but were near 0.7), most variables with rho_A greater than 0.7 (only one did not, but was near 0.7) and all variables with a composite reliability greater than 0.7 and an AVE greater than 0.5 (Hair et al., 2017).

Consequently, discriminant validation was followed, as presented in Table 1. Therefore, the Fornell and Larcker (1981) approach was chosen as it represents the extent to which the model's indicators are distinct and independent from others. As presented above, the discriminant validation of all dimensions was carried out. Thus, as all criteria were met for all of the correlations, there was no need to withdraw any construct or indicator. Therefore, based on the previous results, it is possible to infer that the constructs of this study demonstrated acceptable limits enabling the SEM analysis.

Dimension	CA	Rho_a	CR	AVE	1	2	3	4	5	6	7	8	9
1	0.665	0.676	0.817	0.599	0.774								
2	0.816	0.828	0.880	0.648	0.470	0.805							
3	0.838	0.839	0.903	0.756	0.452	0.347	0.869						
4	0.903	0.906	0.932	0.775	0.470	0.463	0.846	0.880					
5	0.684	0.713	0.824	0.613	0.339	0.384	0.724	0.768	0.783				
6	0.859	0.861	0.914	0.781	0.424	0.401	0.823	0.829	0.730	0.884			
7	0.838	0.841	0.886	0.609	0.339	0.387	0.518	0.562	0.494	0.545	0.780		
8	0.719	0.764	0.840	0.641	0.404	0.330	0.793	0.825	0.761	0.800	0.518	0.800	
9	0.781	0.801	0.873	0.699	0.501	0.542	0.346	0.471	0.468	0.458	0.456	0.410	0.836

Table 1. Discriminant validity and reliability measures

Notes: 1 = core functionalities; 2 = substantial cost reduction; 3 = dialogue; 4 = experimentation; 5 = interaction with the external environment; 6 = participative decision-making; 7 = operational performance; 8 = risk-taking; 9 = sustainable-shared engagement; CR = Composite Reliability
Source: Table by authors

Cohen (1988) suggests that R^2 values greater than 26% are expected to have a great effect. All dimensions here showed an R^2 greater than 0.260, with FI having an adjusted R^2 equal to 0.301 and OP having an adjusted R^2 equal to 0.368. As for the Q^2 results, all indicators were >0 and, therefore, confirmed the model accuracy, which also highlights the model's predictive power.

4.3 Structural model results – relationship analysis

After all the previously shown analysis, the next step taken was to analyze the relationship of the constructs and also to present β coefficient, p -values, t -values and f^2 .

Focusing on measuring the model's significance, t -values and p -value tests were taken. As observed, all t -values showed ≥ 1.96 values, and all p -values were also <0.05 , as was stipulated by Hair et al. (2017). Cohen (1988) guidelines were used to measure the f^2 effect, where small effects present a value of 0.02, medium effects present a value of 0.15 and large effects present a value of 0.35. The direct relationship between the dimensions has its significance confirmed through a bias-corrected and accelerated bootstrapping with 5,000 replications.

Therefore, if Table 2 is analyzed, it is possible to infer that OLC's second-order construct shows validity between its first-order variables: dialogue ($\beta = 0.921$), experimentation ($\beta = 0.949$), interaction with the external environment ($\beta = 0.857$), participative decision ($\beta = 0.920$) and risk propensity ($\beta = 0.908$). Concerning FI, it also shows validity between its first-order variables: core functionalities ($\beta = 0.755$), cost ($\beta = 0.858$) and sustainable-shared engagement ($\beta = 0.833$). The hypothesis testing is presented in Table 3.

$H1$ was accepted. The direct relationship test presents a positive and significant relationship ($\beta = 0.450$) between OLC and OP. $H2$ was accepted, too. The FI presented a significant and positive relation toward OP ($\beta = 0.236$). $H3$ was accepted ($\beta = 0.553$) as OLC also proved to have a significant and positive relationship with FI. Likewise, $H4$ was also validated as OLC has proven to have a significant and positive indirect relationship with FI and OP ($\beta = 0.131$), affirming the mediation role of FI.

Analyzed relationship	Coef (β)	t -values	p -values	(f^2)
<i>Second-order construct – OLC</i>				
OLC → Dialogue	0.921	64.385	0.000	5.583
OLC → Experimentation	0.949	93.781	0.000	9.153
OLC → Interaction with the external environment	0.857	33.368	0.000	2.764
OLC → Participative decision-making	0.920	58.727	0.000	5.485
OLC → Risk-taking	0.908	54.314	0.000	4.711
<i>Second-order construct – FI</i>				
FI → Core functionalities	0.755	15.134	0.000	1.329
FI → Substantial cost reduction	0.858	35.464	0.000	2.786
FI → Sustainable-shared engagement	0.833	30.976	0.000	2.266
<i>Relations</i>				
OLC → Operational performance	0.450	5.725	0.000	0.225
FI → Operational performance	0.236	2.845	0.004	0.062
OLC → Frugal innovation	0.553	7.275	0.000	0.440
OLC → FI → Operational performance	0.131	2.623	0.009	–

Source: Table by authors

Table 2.
Structured model results

5. Discussion

This study contributes to the development and advancement of the FI managers and literature. Thus, some remarks are to be made to indicate some theoretical and practical implications.

5.1 Theoretical implications

H1 shows the positive association between OLC and OP. In a way, this was foreseen by several authors (Gomes, Seman, & Carmona, 2022; Berndt, Gomes, & Borini, 2023; Wang & Wang, 2012). This study then contributes toward Jiménez-Jiménez and Sanz-Valle (2011) statement and brings more evidence concerning empirical findings that support theories about learning capabilities having a positive relationship with OP. As the research confirmed, OLC facilitates learning within the company, which in return makes learning processes possible (Argote & Hora, 2017), transforming OLC into an OP key influencer. This occurs once the development of new ideas becomes an essential element of the company's construction of more efficient ways of working and producing. Hence, firms should continuously improve their learning capabilities. Finally, OLC contributes positively to the enhancement of OP. More precisely, it becomes clear that risk-taking, experimenting with new ideas, and changing valorization could affect product delivery time, the company's production flexibility and product quality.

H2 shows the positive association between FI and OP. This supports Shan, Song, and Ju's (2016) belief that FI has a positive effect on the overall OP. Therefore, FI should be used as a way to maximize solutions to as many people as possible while making use of minimal resources as a way to enhance a firm's OP. Although complementing Zeschky et al. (2014), it became clear that not only large but all firm sizes (micro, small, medium and large) are seeking to transform their business models into a more frugal one. Thus, as FI results in new opportunities and business models, emergent countries should be seeking models enabled for resource-constrained environments while also searching for value-conscious consumers (as those two are clear examples of crucial features that could enhance a firm's OP).

H3 has also proved to have a significant and positive association between OLC and FI. This confirms this study suspicions that, once OLC affects innovation, it also has the power to affect FI. Therefore, this confirmation demonstrates the importance of OLC in a firm's frugality and innovation processes once it impacts on the firm's sustainability and production processes. Also, it became clear that it is not operational process cost reduction that impacts the most on OP. Rather, good-value products, savings and rearrangement of operational resources could positively contribute to a firm's search for a greater OP while acting in a more frugal way.

Finally, *H4* also validated the mediation role of FI in the path between OLC and OP. This sheds light on studies like one by McMurray, de Waal, and Etse (2019) that proclaim the

Hypotheses	Result
<i>H1</i> (+) Organizational learning capability is positively related to operational performance	Supported
<i>H2</i> (+) Frugal innovation is positively related to operational performance	Supported
<i>H3</i> (+) Organizational learning capability is positively related to frugal innovation	Supported
<i>H4</i> (+) Frugal innovation acts as a mediator variable between organizational learning capability and operational performance	Supported

Table 3.
Hypotheses test

Source: Table by authors

importance to the organization of sharing and embedding FI. Thus, as proposed by Migdadi (2021), studies in different contexts, such as the scarce-goods context, in which FI companies are, have become interesting for analyzing the role of OLC. This includes being open to new ideas and listening to employees, which can lead to higher OP in a frugal environment.

From another perspective, firms can make use of FI capabilities whenever they are in a crisis or risky situation. Therefore, this can generate a higher preoccupation with its consumers, which could indicate the need to bring companies' teams (like sales and marketing) to decision-making and dialogue sessions more often once these areas are the ones closer to the company's clients. Hence, the greater the communication between the company, its teams and its clients, the greater the data available, thus, facilitating OP. Finally, it is important to look in a more overall analysis of the variables studied.

Therefore, results imply that organizations engaged in FI activities while proactively making use of their OLC tend to have a greater OP. Hence, ease of product use and sustainability, local partnerships and resource organization could positively impact activities, such as taking risks, communicating effectively and making team decisions. These adjustments can be made so as to also improve product and operational flexibility and make faster deliveries and product market introductions while being faithful to product specifications.

Thus, in a more embracing analysis, the results brought the possibility to see how resource-constrained innovations are challenging the Brazilian companies toward a change through learning. It has become clear that relevant FIs are usually related to a high community involvement within the learning process, such as in firms' local partnerships and social/environmental activities. However, as is also known, emerging countries like Brazil are likely to have its consumer spending dampened due to the current political situation (McKinsey & Company, 2019). Therefore, these consumers are beginning to alter their behavior seeking faster change while aligned to a more sustainable way of living. Hence, the product life cycle is affected, and consequently, firms' OP is affected. Thus, FIs are seen as firms' most needed mindset, as a way to rapidly conceptualize and introduce new business models, products and processes in emergent countries.

Furthermore, the main research evidence highlights the fact that OLC is an FI and OP driver. In this sense, OLC must, then, be developed and executed as an integral part of firms' strategies, and eventually, the acquired organizational learning practices will drive companies toward the development of FI. Accordingly, companies need to develop and maintain OLC that allows them to create, integrate and continually reconfigure new and existing resources while also enhancing and/or maintaining OP.

Although the studied literature already suggested a positive relationship between OLC, FI and performance (Berndt, Gomes, & Borini, 2023), so far, few researchers have analyzed those relationships empirically, all together in a single model, especially analyzing and focusing on FI. Therefore, the major contribution of the present study to the literature was to examine such relationships.

5.2 Practical implications

First, results showed that OLC applies a great impact on FI. As a unique form of innovation, FI has greater organizational learning requirements. Thus, the managers should focus on developing learning capabilities to enable frugal environments to foster FIs. This implies creating more open communication between the company and the employers and committing to experiment and value new ideas and employee initiatives to learn and grow together.

Second, results also predict a better OP for firms that actively innovate frugally. Therefore, the use of local resources and focusing on product durability and sustainability play major roles in improving a company's flexibility, speed and compliance. This leaves companies with a major learning path to overcome, which was discovered possible to be achieved by the use of OLC. Another important result was also found: the positive relationship of OLC with OP. We suggest that organizations seek information about the external environment and share information within the market. Yet it is also important to be able to take risks and make decisions that will not harm the organization when the full panel of information is not met or possible to acquire and which, therefore, impacts on several OP factors.

When evidencing the direct relationship between the variables, it is suggested that managers promote learning to stimulate FI and for it, in turn, to increase OP. For this, the organizations must develop a culture that encourages learning. To develop such a culture, it is necessary to form a management team committed to learning, encouraging experimentation, interaction with the external environment, dialogue, participatory decision-making and risk-taking. Once such a culture is in place, managers will be able to assess the managerial practices that can be used and determine the degree of effort and resources needed to improve the OLC.

Managers should consider organizational learning and FI when considering firms' OP. In this way, to facilitate and achieve higher performance, it was found that OLC and FI have a great deal of impact. Thus, companies must be oriented toward learning. This could be done by promoting innovation contests focused on developing products or processes with local partners or even a sustainability prize for ideas that align the company's objective with social and environmental community issues on emergent markets. Also, the experimentation of employees' ideas and maintaining open and transparent communication within the company are the most effective ways of implementing learning and change. Another suggestion is to seek for external inputs and learn from the market.

Finally, as one of the major contributions of this study, the indirect and positive relationship between OLC, FI and OP was confirmed, reinforcing the literature. Hence, it became clear that companies should be able to be open and communicate freely with their employees as a way to cooperate and bring new ideas to develop FI, consequently enhancing OP. The important role of communication within firms as an OLC driving factor toward easier and faster decision-making was also understood.

6. Conclusion

This research had the purpose of analyzing OLC and its direct relationship with OP and FI. Additionally, the study sought to confirm FI's direct positive relationship with OP and the indirect relationship between OLC, FI and OP.

6.1 Limitations and future studies

This study has also presented some limitations. The collected data represents a limitation as it is transversal, and it is known that longitudinal data could be more useful to make it possible to truly test the model's causality. We worked with a sample of innovative companies. Therefore, for future research, it is necessary to confirm these results in different study contexts and under different environmental circumstances. The replication of this research also corroborates the development of the study area in view of the scarcity of empirical work on organizational learning and its interaction with the development of frugal products. Furthermore, one could investigate the influence of geographic-spatial distribution or clustering among the control variables in the researched relationships.

References

- Alegre, J., & Chiva, R. (2008). Assessing the impact of organizational learning capability on product innovation performance: an empirical test. *Technovation*, 28(6), 315–326, doi: <https://doi.org/10.1016/j.technovation.2007.09.003>.
- Alegre, J., & Chiva, R. (2013). Linking entrepreneurial orientation and firm performance: the role of organizational learning capability and innovation performance. *Journal of Small Business Management*, 51(4), 491–507, doi: <https://doi.org/10.1111/jsbm.12005>.
- Argote, L., & Hora, M. (2017). Organizational learning and management of technology. *Production and Operations Management*, 26(4), 579–590, doi: <https://doi.org/10.1287/mnsc.49.4.571.14424>.
- Bedi, H. S., & Vij, S. (2016). Antecedents and consequences of frugal innovation: a conceptual model. In K. Ghuman, A. Sharma and A. Garg (Eds), *Indian Management: Proceeding of International Conference on Indian Management*. Thapar University (pp. 253–269).
- Belkadi, F., Buergin, J., Gupta, R. K., Zhang, Y., Bernard, A., Lanza, G., . . . Urgo, M. (2016). Co-Definition of product structure and production network for frugal innovation perspectives: towards a modular-based approach. *Procedia CIRP*, 50, 589–594, doi: <https://doi.org/10.1016/j.procir.2016.04.160>.
- Bernardes, R., Borini, F., & Figueiredo, P. N. (2019). Innovation in emerging economy organizations. *Cadernos EBAPE.BR*, 17(4), 886–894, doi: <https://doi.org/10.1590/1679-395120190184>.
- Berndt, A. C., Gomes, G., & Borini, F. M. (2023). Exploring the antecedents of frugal innovation and operational performance: the role of organizational learning capability and entrepreneurial orientation. *European Journal of Innovation Management*, doi: <https://doi.org/10.1108/EJIM-06-2022-0320>.
- Bhatti, Y. A. (2012). What is frugal, what is innovation? Towards a theory of frugal innovation. SSRN - Social Science Research Network. <https://doi.org/10.2139/ssrn.2005910>
- Calantone, R. J., Cavusgil, S. T., & Zhao, Y. (2002). Learning orientation, firm innovation capability, and firm performance. *Industrial Marketing Management*, 31(6), 515–524, doi: [https://doi.org/10.1016/S0019-8501\(01\)00203-6](https://doi.org/10.1016/S0019-8501(01)00203-6).
- Chin, W. W. (1998). The partial least squares approach to structural equation modeling. *Modern Methods for Business Research*, 295(2), 295–336.
- Chiva, R., Alegre, J., & Lapidiera, R. (2007). Measuring organisational learning capability among the workforce. *International Journal of Manpower*, 28(3/4), 224–242, doi: <https://doi.org/10.1108/01437720710755227>.
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed., Hillsdale, NJ: Erlbaum.
- Ferreira, J., Cardim, S., & Coelho, A. (2021). Dynamic capabilities and mediating effects of innovation on the competitive advantage and firm's performance: the moderating role of organizational learning capability. *Journal of the Knowledge Economy*, 12(2), 1–25, doi: <https://doi.org/10.1007/s13132-020-00655-z>.
- Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics, doi: <https://doi.org/10.2307/3151312>.
- Gomes, G., & Wojahn, R. M. (2017). Organizational learning capability, innovation and performance: Study in small and medium-sized enterprises (SMEs). *Revista de Administração (São Paulo)*, 52(2), 163–175, doi: <https://doi.org/10.1016/j.rausp.2016.12.003>.
- Gomes, G., Seman, L. O., & Carmona, L. J. D. M. (2022). Industry does matter: Analysing innovation, firm performance and organisational learning heterogeneities on Brazilian manufacturing sectors. *Structural Change and Economic Dynamics*, 63(4), doi: <https://doi.org/10.1016/j.strueco.2022.08.001>.
- Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, 31(1), 2–24, doi: <https://doi.org/10.1108/EBR-11-2018-0203>.
- 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, doi: <https://doi.org/10.1007/s11747-017-0517-x>.

- Hossain, M. (2018). Frugal innovation: A review and research agenda. *Journal of Cleaner Production*, 182(1), 926–936, doi: <https://doi.org/10.1016/j.jclepro.2018.02.091>.
- Hyypiä, M., & Khan, R. (2018). Overcoming barriers to frugal innovation: Emerging opportunities for Finnish SMEs in Brazilian markets. *Technology Innovation Management Review*, 8(4), 38–48, doi: <https://doi.org/10.22215/timreview/1151>.
- Isacsson, A., & Melkas, H. (2018). *Mobile Learning and Frugal Innovation for Emerging Markets*, Helsinki: Haaga-Helia University of Applied Sciences.
- Jerez-Gomez, P., Cespedes-Lorente, J., & Valle-Cabrera, R. (2005). Organizational learning capability: A proposal of measurement. *Journal of Business Research*, 58(6), 715–725, doi: <https://doi.org/10.1016/j.jbusres.2003.11.002>.
- Jiménez-Jiménez, D., & Sanz-Valle, R. (2011). Innovation, organizational learning, and performance. *Journal of Business Research*, 64(4), 408–417, doi: <https://doi.org/10.1016/j.jbusres.2010.09.010>.
- Knorringa, P., Peša, I., Leliveld, A., & Van Beers, C. (2016). Frugal innovation and development: Aides or adversaries? *The European Journal of Development Research*, 28(2), 143–153, doi: <https://doi.org/10.1057/ejdr.2016.3>.
- Kotabe, M., Martin, X., & Domoto, H. (2003). Gaining from vertical partnerships: Knowledge transfer, relationship duration, and supplier performance improvement in the US and Japanese Automotive Industries. *Strategic Management Journal*, 24(4), 293–316. doi: <https://doi.org/10.1002/smj.297>.
- Luu, T. T. (2017). Ambidextrous leadership, entrepreneurial orientation, and operational performance. *Leadership & Organization Development Journal*, 38(2), 229–253, doi: <https://doi.org/10.1108/LODJ-09-2015-0191>.
- McKinsey & Company. (2019). The state of the fashion. Retrieved from www.mckinsey.com/~/media/mckinsey/industries/retail/our%20insights/the%20state%20of%20fashion%202019%20a%20year%20of%20awakening/the-state-of-fashion-2019-final.ashx
- McMurray, A., de Waal, G. A., & Etse, D. (2019). Frugal innovation: Organisational climate and culture. *Frugal Innovation*. Routledge, (pp. 215–227).
- Macfie, H. J., Bratchell, N., Greenhoff, K., & Vallis, L. V. (1989). Designs to balance the effect of order of presentation and first-order carry-over effects in hall tests. *Journal of Sensory Studies*, 4(2), 129–148. doi: <https://doi.org/10.1111/j.1745-459X.1989.tb00463.x>.
- MacKenzie, S. B., & Podsakoff, P. M. (2012). Common method bias in marketing: Causes, mechanisms, and procedural remedies. *Journal of Retailing*, 88(4), 542–555, doi: <https://doi.org/10.1016/j.jretai.2012.08.001>.
- Memon, M. A., Ting, H., Cheah, J. H., Thurasamy, R., Chuah, F., & Cham, T. H. (2020). Sample size for survey research: review and recommendations. *Journal of Applied Structural Equation Modeling*, 4(2), 1–20, doi: [https://doi.org/10.47263/JASEM.4\(2\)01](https://doi.org/10.47263/JASEM.4(2)01).
- Migdadi, M. M. (2021). Organizational learning capability, innovation and organizational performance. *European Journal of Innovation Management*, 24(1), 151–172, doi: <https://doi.org/10.1108/EJIM-11-2018-0246>.
- Ning, L., & Li, J. (2016). Joint problem solving and organizational learning capacity in new product innovation. *R&D Management*, 48(5), 519–533, doi: <https://doi.org/10.1111/radm.12245>.
- Oh, S. Y., & Han, H. S. (2020). Facilitating organizational learning activities: Types of organizational culture and their influence on organizational learning and performance. *Knowledge Management Research & Practice*, 18(1), 1–15, doi: <https://doi.org/10.1080/14778238.2018.1538668>.
- Pisoni, A., Michelini, L., & Martignoni, G. (2018). Frugal approach to innovation: State of the art and future perspectives. *Journal of Cleaner Production*, 171, 107–126, doi: <https://doi.org/10.1016/j.jclepro.2017.09.248>.
- Pitelli, M. T. (2011). *Innovating for the Next Three Billion: The Rise of the Global Middle Class - and How to Capitalize on It, Growing Beyond*, p. 40. London: Ernest & Young.

- Prabhu, J. (2017). Frugal innovation: Doing more with less for more. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 375(2095), 20160372, doi: <https://doi.org/10.1098/rsta.2016.0372>.
- Pudjiarti, E. S., & Priagung Hutomo, P. T. (2020). The critical role of effective organizational learning to improve firm's innovation and performance in a market turbulence condition. *International Journal of Innovation Science*, 12(3), 237–254, doi: <https://doi.org/10.1108/IJIS-08-2019-0079>.
- Qurnain, N., & Hidayati, N. (2020). The effect of organization learning capability and organizational innovation on competitive advantage and business performance. *Russian Journal of Agricultural and Socio-Economic Sciences*, 99(3), doi: <https://doi.org/10.18551/rjoas.2020-03.02>.
- Reinartz, W., Haenlein, M., & Henseler, J. (2009). An empirical comparison of the efficacy of covariance-based and variance-based SEM. *International Journal of Research in Marketing*, 26(4), doi: <https://doi.org/10.1016/j.ijresmar.2009.08.001>.
- Rossetto, D. E., Borini, F. M., Bernardes, R. C., & Frankwick, G. L. (2023). Measuring frugal innovation capabilities: an initial scale proposition. *Technovation*, 121, 102674, doi: <https://doi.org/10.1016/j.technovation.2022.102674>.
- Salvador, F., Forza, C., Rungtusanatham, M., & Choi, T. Y. (2001). Supply chain interactions and time-related performances: An operations management perspective. *International Journal of Operations & Production Management*, 21(4), 461–475, doi: <https://doi.org/10.1108/01443570110381372>.
- Santos, L. L., Borini, F. M., & Oliveira, M. (2020). In search of the frugal innovation strategy. *Review of International Business and Strategy*, 30(2), 245–263, doi: <https://doi.org/10.1108/RIBS-10-2019-0142>.
- SEBRAE. (2020). Critérios de classificação de empresas: ME-MEI-EPP 2016. Retrieved from www.sebrae-sc.com.br/leis/default.asp?vcdtexto=4154
- Shah, R., & Ward, P. T. (2003). Lean manufacturing: Context, practice bundles, and performance. *Journal of Operations Management*, 21(2), 129–149, doi: [https://doi.org/10.1016/S0272-6963\(02\)00108-0](https://doi.org/10.1016/S0272-6963(02)00108-0).
- Shan, P., Song, M., & Ju, X. (2016). Entrepreneurial orientation and performance: Is innovation speed a missing link? *Journal of Business Research*, 69(2), 683–690, doi: <https://doi.org/10.1016/j.jbusres.2015.08.032>.
- Sutanto, E. M. (2017). The influence of organizational learning capability and organizational creativity on organizational innovation of universities in east java, Indonesia. *Asia Pacific Management Review*, 22(3), 128–135, doi: <https://doi.org/10.1016/j.apmr.2016.11.002>.
- Tambosi, S. S. V., Gomes, G., & Amal, M. (2020). Organisational learning capability and innovation: Study on companies located in regional cluster. *International Journal of Innovation Management*, 24(6), 2050057, doi: <https://doi.org/10.1142/S1363919620500577>.
- Turkulainen, V., & Ketokivi, M. (2013). The contingent value of organizational integration. *Journal of Organization Design*, 2(2), 31–43, available at SSRN: <https://ssrn.com/abstract=2319927>
- Wang, Z., & Wang, N. (2012). Knowledge sharing, innovation and firm performance. *Expert Systems with Applications*, 39(10), 8899–8908, doi: <https://doi.org/10.1016/j.eswa.2012.02.017>.
- Weyrauch, T., & Herstatt, C. (2016). What is frugal innovation? Three defining criteria. *Journal of Frugal Innovation*, 2(1), doi: <https://doi.org/10.1186/s40669-016-0005-y>.
- Zeschky, M. B., Winterhalter, S., & Gassmann, O. (2014). From cost to frugal and reverse innovation: Mapping the field and implications for global competitiveness. *Research-Technology Management*, 57(4), 20–27, doi: <https://doi.org/10.5437/08956308X5704235>.
- Zhang, F., & Zhu, L. (2019). Enhancing corporate sustainable development: Stakeholder pressures, organizational learning, and green innovation. *Business Strategy and the Environment*, 28(6), 1012–1026, doi: <https://doi.org/10.1002/bse.2298>.
- Zhu, C., Liu, A., & Chen, G. (2018). High performance work systems and corporate performance: The influence of entrepreneurial orientation and organizational learning. *Frontiers of Business Research in China*, 12(1), doi: <https://doi.org/10.1186/s11782-018-0025-y>.

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Data availability statement

Research data are not shared.