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Understanding the challenges of entrepreneurship in emerging economies: a grey systems-based study with entrepreneurs in Brazil

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Abstract

Purpose – This research aims to understand the primary challenges encountered by entrepreneurs operating in emerging economies, where entrepreneurship plays a vital role. The study places a particular emphasis on entrepreneurs in Brazil.

Design/methodology/approach – The research methodology involved the analysis of data obtained from interviews, using both content analysis and Grey Relational Analysis techniques.

Findings – The analysis revealed several prominent difficulties that entrepreneurs face in these domains. These challenges encompassed issues such as grappling with intricate taxation systems and the associated tax

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burden, navigating government bureaucracy, securing access to essential financing and initial investments, contending with the absence of supportive government programs and addressing the dynamic nature of market conditions. The findings on the most critical barriers reveal potential pathways for entrepreneurs, policymakers and universities to act in developing the entrepreneurial ecosystem in emerging economies.

Originality/value – The insights garnered from this research have the potential to inform the formulation of robust public policies aimed at fostering entrepreneurship and innovation in emerging countries. Furthermore, these findings can serve as a valuable resource for planning initiatives designed to train engineers to become successful entrepreneurs.

Keywords Entrepreneurship, Entrepreneurial ecosystem, Emerging economy, Grey systems

Paper type Research paper

1. Introduction

The pivotal role of entrepreneurship in the development of nations is recognized by companies, governments and the academic community (Zahra and Wright, 2016). Particularly in emerging countries, entrepreneurship plays a paramount role, serving as a catalyst for economic growth, job creation and innovation (Ajjan *et al.*, 2014; Crittenden and Crittenden, 2010). In these nations, where traditional employment opportunities may be limited, entrepreneurship provides a vital avenue for individuals to channel their creativity and resourcefulness into viable business ventures (Pounder and Gopal, 2021). Moreover, it stimulates local economies by fostering the development of small and medium-sized enterprises, which often serve as the backbone of these nations' economic landscapes (López-Morales *et al.*, 2020). By encouraging entrepreneurship, emerging countries can unlock new sources of wealth, reduce unemployment rates and promote sustainable development, ultimately contributing to their broader socioeconomic advancement (M. C. da Silva *et al.*, 2018).

Guerrero *et al.* (2014) argued for the necessity of entrepreneurs possessing a strong knowledge foundation to effectively manage their businesses sustainably over time. Kara *et al.* (2022) underscore the pivotal role of external support in shaping entrepreneurial intentions. Within this discourse, professionals with a solid higher education background tend to establish businesses that wield a more profound impact on society and the economy (Guerrero *et al.*, 2014). These professionals leave discernible imprints on technological advancement, mobility, education, culture, productivity and an improved quality of life, thereby fostering a virtuous ecosystem for development. In the quest for this virtuous development ecosystem, universities emerge as crucial players. It is a common observation that within most top-tier universities, the commitment to professional education is oriented toward equipping individuals with the ability to conduct critical analyses of prevailing models, innovate and embark on entrepreneurial ventures (Guerrero *et al.*, 2014; Gianiodis *et al.*, 2019) echo this sentiment, highlighting the pivotal role of universities in augmenting regional innovation systems.

In the realm of education, particularly concerning entrepreneurship, there have been observable advancements in recent years, yet the need for further improvement persists. Entrepreneurial education predominantly centers around instructing students on creating business plans, a teaching model that proves highly effective for those inclined toward entrepreneurship. However, when applied universally, it can yield adverse effects on students lacking such inclinations. For individuals who do not inherently possess entrepreneurial interests, a more constructive approach involves engaging in awareness-raising activities, which have the potential to foster entrepreneurial intention (Lopes and Lima, 2019). These activities are designed to cultivate vital entrepreneurial traits, including creativity, innovation, leadership, decision-making, risk tolerance and problem-solving abilities (Da Silva and Silva, 2019). These attributes assume particular significance in the context of our increasingly complex business environment (Haarhaus *et al.*, 2020).

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In addition to offering entrepreneurial training, universities play a pivotal role in nurturing entrepreneurship by establishing secure environments where students can experiment with ideas and cultivate their entrepreneurial skills (Alves *et al.*, 2019). These safe environments encompass various initiatives such as business incubators, technological development parks, dedicated entrepreneurship courses, extracurricular activities and business model competitions. These components are progressively becoming integral aspects of daily university education, providing students with hands-on opportunities to explore and refine their entrepreneurial prowess (Da Silva and Silva, 2019).

Fairlie and Fossen (2019) highlighted that university entrepreneurs who embark on business ventures driven by identified opportunities tend to be individuals with a high level of education. This observation underscores the significant potential of universities to generate a substantial impact on their local communities and the broader nation through effective training and support mechanisms provided to their students and researchers.

It is important to clarify that the type of entrepreneur previously described represents only a small segment of the existing entrepreneurial landscape in emerging economies. Regrettably, the vast majority of the population lacks access to such educational opportunities. Surveys, like the one conducted by the Global Entrepreneurship Monitor (GEM), which reports the entrepreneurial activity rate, often reveal that many people become entrepreneurs informally out of necessity rather than seizing opportunities (GEM, 2020a). A significant portion of these entrepreneurs cites a lack of employment opportunities as one of their primary motivations for starting a business (GEM, 2020b). Among all entrepreneurs, regardless of their educational background, 26.2% initiated their businesses solely with the goal of creating a source of income due to limited opportunities. If given the choice to select multiple motivation options for starting a business, a staggering 88.4% would choose the option of "creating a source of income because opportunities were scarce" as part of their initial motivation (GEM, 2020c).

In this context, understanding the challenges faced by entrepreneurs is crucial because entrepreneurship plays a pivotal role in driving economic growth, innovation and job creation, especially in emerging economies. By identifying and addressing these challenges, policymakers, educational institutions and support organizations can develop targeted strategies to foster a more conducive environment for entrepreneurship. The literature highlights several key challenges, including limited access to funding (Fathonih *et al.*, 2019; Rexhepi and Ramadani, 2015), inadequate infrastructure (Khoo *et al.*, 2024; Qin, 2024), regulatory hurdles (Golob *et al.*, 2020; Madzikanda *et al.*, 2022) and a lack of skilled human capital (Haneberg *et al.*, 2022; Lindvert, 2023). In addition, many entrepreneurs in emerging economies struggle with market instability (Al-Qahtani *et al.*, 2022; Aravamudhan *et al.*, 2024), insufficient mentoring and networking opportunities (Amir *et al.*, 2023) and limited access to advanced technology and business knowledge (Alawamleh *et al.*, 2023). Understanding these challenges in specific contexts is essential for crafting effective, tailored interventions that can enhance the capabilities and success rates of entrepreneurs in these regions.

As the largest economy in Latin America and eighth in the world (International Monetary Fund, 2024), Brazil's diverse and dynamic market environment, coupled with its complex regulatory framework, poses unique challenges for entrepreneurs that may not be as prevalent in other regions. Furthermore, Brazil's vast geographic size and regional disparities exacerbate issues such as access to funding and infrastructure, making it a critical case for examining the nuanced barriers faced by entrepreneurs (Fischer *et al.*, 2018). Understanding these specific challenges is essential, as Brazil's experiences can provide valuable insights into the broader landscape of entrepreneurship in developing economies, shedding light on how tailored interventions and policies can be designed to address similar issues in other contexts. In addition, Brazil's significant strides in fostering innovation and entrepreneurship through various

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government programs and university initiatives make it an important case for exploring the effectiveness of such support systems in overcoming entrepreneurial barriers.

Given the context presented, this paper aims to understand the primary challenges encountered by entrepreneurs operating in emerging economies. The study places a particular emphasis on entrepreneurs in Brazil and investigates entrepreneurship in the engineering field. This study also emphasizes the university's role in shaping entrepreneurial journeys and its broader impact on the Brazilian entrepreneurial ecosystem, among other relevant aspects.

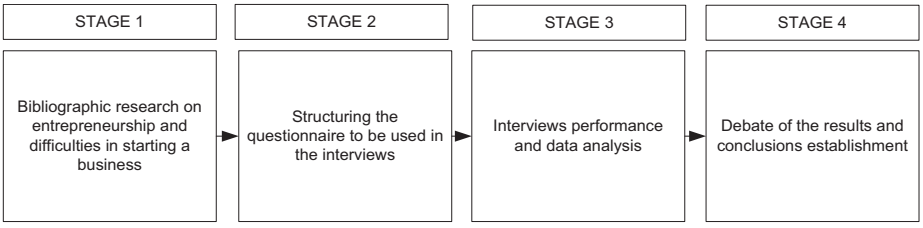
2. Methodological procedures

The progression of this research unfolded through four distinct and well-defined stages, as illustrated in Figure 1. It is important to highlight that all the procedures used in this research received approval from a Research Ethics Committee (certificate of approval number 40703120.4.0000.5404) of the university where this study was conducted, and that informed consent was presented in a written form and obtained from all participants.

The research commenced with an extensive review of the relevant literature, which served as the bedrock for building the theoretical foundation of this study. This involved a meticulous exploration of articles on various scientific platforms such as Elsevier, Scopus and Emerald, among others. The search was conducted using a diverse set of keywords and phrases, including “difficulties faced by entrepreneurs,” “entrepreneurship,” “entrepreneurship and university,” “policies for entrepreneurship,” “entrepreneurship ranking” and various combinations with terms like “difficulty,” “entrepreneurship,” “university,” “government,” “public policies,” “economics” and “ranking.” This comprehensive literature review spanned a period of six months, culminating in the compilation of a comprehensive list of challenges encountered by entrepreneurs when initiating their ventures, as documented in the works of various authors and institutions. The synthesized list is presented in Table 1.

The research protocol for the interviews was developed based on the information gleaned from the literature. This protocol comprised seven questions, with six of them being open-ended and one involving a rating scale for assessing the difficulties outlined in Table 1. The open-ended questions were designated as 1, 2, 3, 4, 5 and 7, whereas question 6 involved indicating scores. The content of Table 2 outlines the open-ended questions, whereas Table 3 provides details about the scale used for evaluating each of the 17 difficulties presented to the interviewees.

For participant selection in this phase of the research, professionals with backgrounds in mechanical engineering or control and automation were identified. In addition, these individuals possessed valuable insights into the role of universities in the entrepreneurial process. The search for potential participants who were willing to contribute to the study was conducted within the database of companies affiliated with the second largest university in



Source: Elaborated by the authors

Figure 1. Stages performed to develop this research

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Table 1. Difficulties faced by entrepreneurs according to the literature

ID	Difficulties	Context	Method	References
D1	Difficulty securing financing or initial investment	Jordan Islamic countries	Interviews Content analysis	(Fathonih *et al.*, 2019) (Rexhepi and Ramadani, 2015)
D2	Difficulty related to the lack of training in the field	Europe and North America Global South	Case studies Longitudinal interviews	(Haneberg *et al.*, 2022) (Lindvert, 2023)
D3	Difficulty related to the lack of entrepreneurial training at the university level	China Spain	Document analysis and focus group Survey	(He and Yu, 2023) (Peña Hita *et al.*, 2023)
D4	Difficulty related to the limited access to post-university management and entrepreneurship courses	Italy Pakistan	Econometric regression analyses Survey	(Colombelli *et al.*, 2021) (Soomro *et al.*, 2024)
D5	Difficulty related to government bureaucracy for business formalization/ transitions	USA Romania	Logistic and multiple regression Content analysis	(Kwapisz, 2019) (Lucian and Şaită, 2023)
D6	Difficulty comprehending taxation and managing tax burdens	USA Southern Africa	Analysis of variance Multivariate analysis	(Strow and Strow, 2018) (Madzikanda *et al.*, 2022)
D7	Difficulty understanding relevant field-specific legislation	Central Europe United Arab Emirates	Interviews and focus groups Interviews	(Golob *et al.*, 2020) (Yasin *et al.*, 2021)
D8	Difficulty navigating complex market conditions during business establishment	Rajasthan Qatar	Structural modeling and MICMAC analysis Survey	(Aravamudhan *et al.*, 2024) (Al-Qahtani *et al.*, 2022)
D9	Difficulty related to the lack of government programs promoting entrepreneurship in the field	India Malaysia	Structural modeling and MICMAC analysis Factor analysis and regression analysis	(Aravamudhan *et al.*, 2024) (Amir *et al.*, 2023)
D10	Difficulty related to the requirement for intensive innovation, including R&D	China India	Multivariate analysis Grey DEMATEL and grey-causal modeling	(Qin, 2024) (Agrawal *et al.*, 2024)
D11	Difficulty associated with intellectual property management (creation and use)	Russia Emerging countries	Case study Survey	(Thurner and Proskuryakova, 2016) (Pathak *et al.*, 2014)

(*continued*)

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Table 1. Continued

ID	Difficulties	Context	Method	References
D12	Difficulty accessing professional services (e.g., lawyers, accountants)	UK and the Netherlands	Interview and critical incident analysis	(Soetanto, 2017)
		UK	Structural modeling	(Shahid, 2023)
D13	Difficulty related to the limited access to physical infrastructure	China	Multivariate analysis	(Qin, 2024)
		Latin America	Interviews	(Khoo *et al.*, 2024)
D14	Difficulty related to establishing an active professional network	UK	Interviews	(Johnston and Blenkinsopp, 2017)
		Malaysia	Factor analysis and regression analysis	(Amir *et al.*, 2023)
D15	Difficulty related to the lack of an entrepreneurial culture	United Arab Emirates	Case studies	(Bhayani, 2015)
		Algeria	Survey	(Abadli *et al.*, 2020)
D16	Difficulty associated with psychological preparedness (e.g. frustration, fear of failure, uncertainty)	Vietnam	Survey and structural modeling	(To and Le, 2021)
		Turkey	Survey and regression analysis	(Akkaya *et al.*, 2024)
D17	Difficulty associated with the shortage of managerial and organizational knowledge	Jordan	Interviews	(Alawamleh *et al.*, 2023)
		USA	Action research	(DeWaters and Kotla, 2023)

Notes: MICMAC = Matrice d'Impacts Croisés Multiplication Appliqués à un Classement, R&D = Research and development; DEMATEL = decision making trial and evaluation laboratory
Source: Authors' own creation

Table 2. Open-ended questions used in the interviews

#	Question
1	Can you share a bit about your personal journey as an entrepreneur?
2	How would you assess the Brazilian entrepreneurial ecosystem, both when you initially started your business and in the present day?
3	From your perspective, what opportunities do you see for new ventures in the fields of mechanical engineering and/or control and automation engineering in Brazil?
4	Reflecting on your academic background, could you highlight the strengths that have contributed to your entrepreneurial endeavors?
5	Conversely, what aspects of your academic training do you think could have been further developed to better support your entrepreneurial initiatives?
7	Is there anything additional you would like to share or any particular difficulty that you have encountered in your entrepreneurial journey that has not been mentioned previously but had a significant impact on your experience?

Source: Authors' own creation

Table 3. Scores to be assigned by the entrepreneur for each difficulty

Score	Difficulty level
1	Difficulty is slightly observed in the entrepreneurial initiative
2	Difficulty is little observed in the entrepreneurial initiative
3	Difficulty is averagely observed in the entrepreneurial initiative
4	Difficulty is intensely observed in the entrepreneurial initiative
5	Difficulty is very intensely observed in the entrepreneurial initiative

Source: Authors' own creation

Brazil. Subsequently, four entrepreneurs expressed their willingness to participate in the research, and their individual trajectories and insights will be elaborated upon in later sections of the study.

Entrepreneur 1 operates a company specializing in control and automation engineering, focusing on process optimization through artificial intelligence. The company was established in 2009, founded alongside two other partners. Presently, the enterprise boasts a workforce exceeding 100 employees and has successfully served over 50 clients.

Entrepreneur 2 is active in the realm of control and automation engineering, specializing in home automation. He obtained his degree in control and automation engineering in 2006 and established his company in 2011. Interestingly, he formed partnerships during his university years.

Entrepreneur 3 is engaged in mechanical engineering and manages a company specializing in industrial automation and pneumatics. His journey as an entrepreneur commenced during his undergraduate studies, and he currently plays a pivotal role in the recovery of his family's company from a financial crisis.

Entrepreneur 4 operates in the field of mechanical engineering, running a company that specializes in occupational safety. He obtained a bachelor's degree in mechanical engineering in 2009 and collaborated with five other partners he met during his time at the university in establishing the company.

Regarding data analysis, qualitative aspects were examined using the content analysis technique, following the guidelines outlined by Elo and Kyngäs (2008). This particular

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approach to analysis can be executed through either a deductive or inductive method. The primary distinction between these approaches lies in whether the researcher uses a structured framework or matrix to guide the categorization of the collected data. In our study, given the utilization of a research protocol with predefined questions aligning with themes derived from the literature, the approach can be classified as deductive (Elo and Kyngäs, 2008).

The content analysis process encompassed three fundamental phases. The first phase involved preparation, during which researchers gained a deeper familiarity with the collected data and defined the unit of analysis. Following this, the organization phase ensued, wherein categorizations, groupings and the documentation of the analytical process were performed. Finally, the analysis culminated in the formulation of a model, conceptual map, or final conclusions drawn from the study (Elo and Kyngäs, 2008).

For the analysis of question six, in which respondents assessed the difficulties based on their entrepreneurial experiences, the Grey Relational Analysis (GRA) technique was used. Grey methods are more appropriate for studying problems involving uncertainty because they are specifically designed to manage situations where information is ambiguous, incomplete or only partially accessible (Liu and Lin, 2010). Unlike traditional statistical or probabilistic methods, which require large data sets, well-defined distributions and robust sample sizes to yield accurate results, grey methods thrive in conditions of limited and poor information (Liu *et al.*, 2022). They offer a structured framework for decision-making and analysis in uncertain environments, making them particularly valuable for problems where conventional approaches fall short (Liu *et al.*, 2016).

In this sense, grey methods are particularly suitable for investigating uncertain contexts, such as the dynamic challenges faced in entrepreneurship, due to their robustness in handling ambiguous or incomplete information. Entrepreneurship often involves unpredictable variables and rapidly changing conditions, where making informed decisions with limited information is crucial. Grey methods enable entrepreneurs to model and analyze these uncertainties effectively, providing a structured approach to decision-making in the face of unknowns and allowing for adaptive strategies that can better navigate the complexities of entrepreneurial ventures. For these reasons, grey methods have been applied to entrepreneurship research to investigate competitiveness (Gabor *et al.*, 2024), education courses (Xu and Li, 2018), innovation ability (Ning, 2023) and critical success factors (Muhammad Muneeb *et al.*, 2020).

Particularly regarding the GRA, the same rationale applies when comparing GRA to traditional ranking methods such as technique for order of preference by similarity to ideal solution or analytic hierarchy process (Kemechian *et al.*, 2023; Pio *et al.*, 2023). The GRA method operates by combining a range of values assigned to the attributes under evaluation, resulting in a single value that condenses multiple response options into a single, easily comparable metric across the attributes, as elucidated by Kuo *et al.* (Kuo *et al.*, 2008). It is worth noting that discussions surrounding GRA have evolved over the years (Liu *et al.*, 2016). Within the literature, GRA has found diverse applications (Hu and Liu, 2022; Yin, 2013), encompassing various fields, including studies related to entrepreneurship, as exemplified by Mierzwiak and Więcek-Janka (Mierzwiak and Więcek-Janka, 2015).

The initial step in computing the GRA index involves constructing a matrix in which the rows correspond to the analyzed difficulties, and the columns correspond to the entrepreneurs who provided ratings for each of the mentioned challenges. In this research, the attributes are represented by the "entrepreneurs," and there is no inherent concept of "bigger is better," "smaller is better" or "closer to the reference is better," as discussed by Kuo *et al.* (Kuo *et al.*, 2008) in their study on normalization techniques. According to these authors, the researcher must make a deliberate choice regarding the normalization method to

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be used and comprehend the implications of this choice on the resulting ranking. In this research, normalization will be executed using the equation described below [equation (1)]. When applied, this normalization method yields a comparative list of difficulties for entrepreneurial initiatives in the engineering sectors under examination, with the most intense difficulty occupying the top position:

$$x_{ij} = \frac{y_{ij} - min\{y_{ij},\, i = 1,\, 2,\, \ldots,\, m\}}{max\{y_{ij},\, i = 1,\, 2,\, \ldots,\, m\} - min\{y_{ij},\, i = 1,\, 2,\, \ldots,\, m\}} \text{ for } i = 1,\, 2,\, \ldots,\, m \text{ and } j = 1,\, 2,\, \ldots,\, n \tag{1}$$

Once the matrix is normalized, with values ranging between 0 and 1, the next step involves establishing a reference vector, denoted as $X_o = (x_{01}, x_{02}, \ldots, x_{ij}, \ldots, x_{0n}) = (1, 1 \ldots, 1, \ldots, 1)$. Subsequently, the distance between each element in the normalized matrix and this reference vector should be computed, yielding the matrix of values Δ_{ij}. With the values of Δ_{ij} in hand, it becomes possible to calculate the grey relational coefficient (γ), as outlined in equation (2):

$$\gamma(x_{0j},\, x_{ij}) = \frac{\Delta_{min} + \xi\Delta_{max}}{\Delta_{ij} + \xi\Delta_{max}} for\ i = 1,\, 2 \ldots,\, m\ \ and\ \ j = 1,\, 2,\, \ldots,\, n \tag{2}$$

In which $\gamma(x_{0j}, x_{ij})$ is the grey relational coefficient between x_{ij} and x_{0j}:

$$\Delta_{ij} = |x_{0j} - x_{ij}| \tag{3}$$

$$\Delta_{min} = Min\{\Delta_{ij},\, i = 1,\, 2,\, \ldots,\, m;\, j = 1,\, 2,\, \ldots,\, n\} \tag{4}$$

$$\Delta_{max} = Max\{\Delta_{ij},\, i = 1,\, 2,\, \ldots,\, m;\, j = 1,\, 2,\, \ldots,\, n\} \tag{5}$$

$$\xi \text{ is the distinguishing coefficient, } \xi \in |0,\, 1| \text{and in this study } \xi = 1.0 \tag{6}$$

Subsequently, the grey relational coefficients for each attribute are computed using equation (7). In this equation, the factor w_j represents a weight that can be assigned to attribute j based on the judgment of the decision-maker or in alignment with the problem's structure. It is essential to note that the summation of these weights should equal 1 to ensure a proper weighting distribution. In the context of this research, the weight was evenly divided among the participants, demonstrating fairness and equal consideration of their viewpoints:

$$\Gamma(X_0,\, X_i) = \sum_{j=1}^{n} w_j \gamma(x_{0j},\, x_{ij})\ for\ i = 1,\, 2 \ldots,\, m \tag{7}$$

The values of Γ are instrumental in the process of ranking the studied difficulties. It is essential to bear in mind that the choice of the normalization method can influence the positioning of difficulties within the ranking. Typically, with the chosen normalization method, difficulties occupying the top positions in the ranking indicate those experienced most intensely by entrepreneurs in a comparative sense. Thus, this research combines both qualitative and quantitative analyses of the collected data. These findings are subsequently discussed, leading to the formulation of conclusive insights and outcomes based on the research outcomes and observations.

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3. Results

3.1 Qualitative data analysis

As previously indicated, the qualitative analysis of the data was conducted using the content analysis technique. Each interview was subjected to individual analysis, and subsequently, the comparative table depicted below (Table 4) was constructed. This table outlines five overarching themes for the analysis of aggregated information: the entrepreneur's journey, the Brazilian entrepreneurial ecosystem, prospects for new ventures, strengths stemming from academic training and areas of deficiency in academic preparation.

These themes serve as a framework for the structured examination and comparison of insights derived from the interviews, allowing for a comprehensive understanding of the qualitative data.

The qualitative analysis of data from entrepreneurs in Brazil reveals key insights into entrepreneurship in emerging economies. Entrepreneurs often initiate their ventures during or immediately after college, showcasing a strong link between higher education and entrepreneurship. However, challenges in securing financing, especially for initial activities, remain a hurdle.

The Brazilian entrepreneurial ecosystem has shown improvement over the last decade, but bureaucratic hurdles, labor laws and taxation complexities continue to hinder business operations. Despite these challenges, opportunities for value-added ventures in technology, information and Industry 4.0 are abundant, giving local businesses a competitive edge.

Academic training provides strengths in problem-solving skills, diverse networks and exposure to impactful research and extracurricular activities, inspiring entrepreneurial pursuits. However, soft skills development, such as leadership and emotional intelligence, is lacking in undergraduate programs. In addition, a curriculum gap in accounting and entrepreneurship-related topics underscores room for improvement in preparing students for entrepreneurship.

The analyses presented reveal insights into the dynamics of entrepreneurship in Brazil's emerging economy. While there are positive indicators and connections between education and entrepreneurship, addressing bureaucratic obstacles and enhancing educational offerings can further foster entrepreneurship and innovation in the country.

3.2 Quantitative analysis of difficulties via grey relational analysis

In the quantitative phase of the study, the four entrepreneurs assessed the 17 difficulties outlined in Table 1 based on their experiences in launching businesses within the mechanical engineering and control and automation sector, using the scale detailed in Table 2. The gathered data underwent analysis via the GRA method, which allowed for a comparative evaluation of the difficulties. The grades assigned and the normalization results are summarized in Table 5.

Following this, the relational coefficients γ were computed with the values of Δ_{ij} considered concerning the chosen reference $(x_{01}, x_{02}, x_{03}, \ldots, x_{07}) = (1, 1, 1, \ldots, 1)$ and with $\xi = 1.0$ as the parameter. Table 6 provides an overview of the values obtained for Δ_{ij} as well as the resulting relational coefficients γ.

With equal weights assigned to each interviewee ($w_j = 0.25$), the grey relational coefficients were calculated, allowing for a comparative ranking of difficulties based on the extent of observation according to the interviewees' perspectives. Table 7 presents the difficulties ranked in accordance with these coefficients, in which higher positions mean the most critical difficulty in comparative terms.

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Table 4. Qualitative analysis of open questions

Themes	Consolidated information
Entrepreneur's trajectory	• Three of the four interviewees graduated at University of Campinas between 2000 and 2010 and started their business between 2006 and 2010. Of the three entrepreneurs who started the company with partners, the business partners were known during college. The other entrepreneur continued a family business • 75% of the interviewees carried out entrepreneurial activities while they were still in college, such as applying research to local problems, student organizations, among others • Among the interviewees, three had difficulties in accessing financing for the development of initial activities and still find it difficult to access credit programs • Two respondents founded the company shortly after graduation or during graduation, whereas the other half had experience in consulting firms before
Entrepreneurial ecosystem	• Three of the participants consider that the Brazilian ecosystem in general has improved in the past 15 years; only one participant did not notice improvement in the past 10 years • All the participants evaluate that there is greater openness to investments when compared to 15 years ago, but there are still difficulties in attracting investments for businesses in very technical areas such as in the control and automation segment and mechanical engineering • Despite the improvements, especially in the time it takes to open a new company, Brazilian bureaucracy is a major complicating factor for anyone who wants to start a business in the country, according to the opinion of all the participants • Labor laws and taxation were topics mentioned by all, a very complicated aspect to understand, making it difficult to act
Existing opportunities	• All the participants highlighted that the Brazilian market is very broad and that there is a lot of opportunities for new local entrants. Thus, they pointed out that taxes and internal bureaucracy are a major barrier to external competitors • The four participants stated that the greatest business opportunities are for companies that generate a lot of added value, mainly related to technology, information and Industry 4.0 • Three of the participants argue that companies that do not work with value creation, especially with information processing, suffer from the commoditization of products and are not considered as good business
Strengths of academic training	• All the participants understand that training at a college recognized for its quality helps in the following topics: ability to solve complex problems; diverse contact network, due to the wide range of courses offered and the different locations in the country and/or in the world that the professors and students came from • Three of the participants evaluate as positive the possibility of participating in impactful research or extracurricular activities; one of the participants pointed out that the contact with entrepreneurs during their academic training encouraged them to move on to entrepreneurship • Three participants evaluate as positive the possibility of participating in impactful research or extracurricular activities; one of the participants pointed out that the contact with entrepreneurs during their academic training encouraged him to move on to entrepreneurship • For those who work with programming, the technical training was very good.
Weaknesses of academic training	• Three participants mentioned that training in soft skills was low in their undergraduate programs (characteristics such as: leadership, proactivity and emotional intelligence) • Two participants mentioned that there should be materials that teach about notions of accounting and entrepreneurship (business modeling, lean start-up, product and marketing) • One of the participants mentioned the possibility of a greater focus on application and project during their graduation

Source: Elaborated by the authors

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Table 5. Scores assigned by the participants in evaluating the difficulties

	Scores				Normalized data			
#	E1	E2	E3	E4	E1	E2	E3	E4
D1	3	5	4	5	0.50	1.00	0.75	1.00
D2	1	1	5	3	0.00	0.00	1.00	0.50
D3	5	5	2	3	1.00	1.00	0.25	0.50
D4	4	2	1	1	0.75	0.25	0.00	0.00
D5	3	5	5	5	0.50	1.00	1.00	1.00
D6	5	5	5	5	1.00	1.00	1.00	1.00
D7	3	3	5	4	0.50	0.50	1.00	0.75
D8	5	4	1	5	1.00	0.75	0.00	1.00
D9	2	4	5	5	0.25	0.75	1.00	1.00
D10	2	2	3	5	0.25	0.25	0.50	1.00
D11	4	3	5	3	0.75	0.50	1.00	0.50
D12	1	3	2	2	0.00	0.50	0.25	0.25
D13	2	1	4	1	0.25	0.00	0.75	0.00
D14	5	4	2	3	1.00	0.75	0.25	0.50
D15	3	4	5	4	0.50	0.75	1.00	0.75
D16	3	4	3	1	0.50	0.75	0.50	0.00
D17	5	4	3	4	1.00	0.75	0.50	0.75

Source: Elaborated by the authors

Table 6. Values calculated for Δ_{ij} and for γ, considering each participant and each difficulty

	Values for Δ_{ij}				Values for individual γ			
#	E1	E2	E3	E4	E1	E2	E3	E4
D1	0.50	0.00	0.25	0.00	0.67	1.00	0.80	1.00
D2	1.00	1.00	0.00	0.50	0.50	0.50	1.00	0.67
D3	0.00	0.00	0.75	0.50	1.00	1.00	0.57	0.67
D4	0.25	0.75	1.00	1.00	0.80	0.57	0.50	0.50
D5	0.50	0.00	0.00	0.00	0.67	1.00	1.00	1.00
D6	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
D7	0.50	0.50	0.00	0.25	0.67	0.67	1.00	0.80
D8	0.00	0.25	1.00	0.00	1.00	0.80	0.50	1.00
D9	0.75	0.25	0.00	0.00	0.57	0.80	1.00	1.00
D10	0.75	0.75	0.50	0.00	0.57	0.57	0.67	1.00
D11	0.25	0.50	0.00	0.50	0.80	0.67	1.00	0.67
D12	1.00	0.50	0.75	0.75	0.50	0.67	0.57	0.57
D13	0.75	1.00	0.25	1.00	0.57	0.50	0.80	0.50
D14	0.00	0.25	0.75	0.50	1.00	0.80	0.57	0.67
D15	0.50	0.25	0.00	0.25	0.67	0.80	1.00	0.80
D16	0.50	0.25	0.50	1.00	0.67	0.80	0.67	0.50
D17	0.00	0.25	0.50	0.25	1.00	0.80	0.67	0.80

Source: Elaborated by the authors

4. Discussion

While there is a consensus among most interviewees that the overall Brazilian entrepreneurial ecosystem has shown improvement in recent years, certain challenges persist, especially for investments in highly technical fields such as control and automation

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Table 7. Ranking of difficulties according to grey relational coefficients

ID	Difficulty	Γ	Ranking
D6	Difficulty comprehending taxation and managing tax burdens	1.000	1st
D5	Difficulty related to government bureaucracy for business formalization/transitions	0.917	2nd
D1	Difficulty securing financing or initial investment	0.867	3rd
D9	Difficulty related to the lack of government programs promoting entrepreneurship	0.843	4th
D8	Difficulty navigating complex market conditions during business establishment	0.825	5th
D15	Difficulty related to the lack of an entrepreneurial culture	0.817	6th
D17	Difficulty associated with the shortage of managerial and organizational knowledge	0.817	6th
D3	Difficulty related to the lack of entrepreneurial training at the university level	0.810	7th
D11	Difficulty associated with intellectual property management (creation and use)	0.783	8th
D7	Difficulty understanding relevant field-specific legislation	0.783	8th
D14	Difficulty related to establishing an active professional network	0.760	9th
D10	Difficulty related to the requirement for intensive innovation, including R&D	0.702	10th
D2	Difficulty related to the lack of training in the field	0.667	11th
D16	Difficulty associated with psychological preparedness (e.g. frustration, fear of failure)	0.658	12th
D4	Difficulty related to the limited access to post-university management and entrepreneurship courses	0.593	13th
D13	Difficulty related to the limited access to physical infrastructure	0.593	13th
D12	Difficulty accessing professional services (e.g. lawyers, accountants)	0.577	14th

Source: Elaborated by the authors

engineering and mechanical engineering. Notably, the interviews highlighted five difficulties that were particularly prominent: understanding tax-related matters (D6), grappling with governmental bureaucracy (D5), securing initial funding (D1), dealing with the absence of governmental programs to promote entrepreneurship (D9) and navigating market conditions for business establishment (D8), which are often unstable in emerging economies. It is worth noting that these challenges align with reports from reputable international organizations, such as the GEM, underlining their significance in the entrepreneurial landscape.

The challenges highlighted in the interviews, particularly the complexities of Brazilian bureaucracy and the tax burden, align with findings from prominent international analyses. GEM's assessment (GEM, 2020c, 2023) underscores the significance of these barriers for entrepreneurs in Brazil. Furthermore, according to the World Economic Forum (WEF, 2018), the Brazilian business landscape poses obstacles to direct foreign investments in the country. The World Bank's report (The World Bank, 2020) sheds light on the extensive time and financial resources that Brazilian companies dedicate to tax-related matters. For instance, companies in Brazil spend nine times more time on tax issues compared to the global average. In São Paulo, a significant 64.7% of companies' profits go toward taxes, a stark contrast to the Organization for Economic Co-operation and Development average of 39.9%, indicating that Brazilian entrepreneurs shoulder a 60% higher tax burden. These challenges are further reflected in Brazil's low ranking in the “Ease of Doing Business” index, where the country occupies the 124th position (The World Bank, 2020).

On the contrary, the interviewees highlight the presence of business opportunities in Brazil, especially in the areas of digitalization and industry 4.0. For instance, leveraging big data from Internet of Things devices in start-ups offers great potential for entrepreneurs (Sestino *et al.*, 2020). This is supported by Siltori *et al.* (2021), who argue that the industry 4.0 environment offers a promising foundation for innovative business ventures.

The interviewees also stress the importance of skills such as complex problem-solving, leadership, proactivity and emotional intelligence for starting and managing a business. They

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believe that universities can play a pivotal role in instilling these skills in their students. While improvements have been observed since their graduation, there is still room for enhancement. The literature corroborates the significance of universities in nurturing entrepreneurial skills among their students, as demonstrated by the work of Pardo-Garcia and Barac (2020). This allows us to connect the findings with recent discussions about new educational paradigms (Morin, 2015). The literature on entrepreneurship education is not yet connected like that of other areas such as engineering (Sigahi and Sznelwar, 2023). Along these lines, the study's findings shed light on the need to develop systemic thinking, capable of dealing with issues of a diverse nature, to understand entrepreneurship as a complex system (Sigahi *et al.*, 2023).

The ranking of difficulties in Table 7, as determined by GRA, offers valuable insights into the critical hurdles experienced by entrepreneurs in Brazil. At the top of the list, it is found the challenge of understanding taxation and managing tax burdens (D6), highlighting the intricate nature of tax-related issues, a common concern among entrepreneurs in emerging economies. Following closely is the difficulty related to government bureaucracy for business formalization and transitions (D5), emphasizing the enduring obstacles posed by bureaucratic processes, which hinder the ease of conducting business.

Moreover, securing financing or initial investment (D1) ranks third, underscoring the significance of financial constraints in the entrepreneurial journey. Government support through programs promoting entrepreneurship (D9) is another crucial factor, as reflected in the fourth-ranked difficulty, highlighting the importance of policy interventions to foster a supportive environment for start-ups. In addition, navigating complex market conditions during business establishment (D8) and fostering an entrepreneurial culture (D15) are identified as key challenges, showing the difficulties entrepreneurs face in adapting to market dynamics and promoting innovation within the entrepreneurial ecosystem.

On the contrary, challenges related to accessing professional services (D12), limited access to physical infrastructure (D13) and postuniversity management and entrepreneurship courses (D4) rank lower in the list. While these challenges are not insignificant, they appear to be comparatively less intense in the Brazilian context, particularly in high technical fields such as mechanical engineering and control and automation engineering sectors.

Entrepreneurs can leverage the findings of this research to better navigate the complex landscape of starting and growing a business in Brazil and other emerging economics with similar socioeconomic characteristics. By understanding the critical difficulties identified, entrepreneurs can proactively seek out resources, training and strategies to mitigate these challenges. For instance, entrepreneurs might prioritize gaining a deeper understanding of tax regulations and compliance to manage the substantial tax burden more effectively. In addition, entrepreneurs can benefit from the insights regarding the importance of developing soft skills like leadership, proactivity and emotional intelligence, which are crucial for business success but often underemphasized in academic training. New educational paradigms, such as complex systems, also need to be more connected to the entrepreneurship environment and not confined just to more technical fields such as engineering (Sigahi *et al.*, 2023). Recognizing the value of building a robust network and participating in impactful research or extracurricular activities during their university years can also help entrepreneurs build a strong foundation and gain valuable experiences and contacts that support their entrepreneurial endeavors, considering this complexity thinking paradigm (Sigahi and Sznelwar, 2023).

Policymakers and universities can take several actions based on the findings of this research to create a more supportive environment for entrepreneurs in Brazil. Policymakers should focus on simplifying the tax system and reducing bureaucratic barriers to ease the

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process of business formalization and transitions. Introducing more government programs specifically aimed at promoting entrepreneurship and providing easier access to financing and initial investments would address some of the most critical challenges identified by the study. Additionally, policies that foster a more robust entrepreneurial culture and provide targeted support for navigating market conditions can significantly enhance the entrepreneurial ecosystem.

Universities, on the contrary, should aim to enhance their academic programs by integrating more comprehensive training in soft skills such as leadership, proactivity and emotional intelligence. They can also incorporate practical courses on accounting, business modeling, lean start-up methodologies and marketing into their curricula to better prepare students for the realities of entrepreneurship. Encouraging participation in research, extracurricular activities and interactions with successful entrepreneurs can provide students with valuable insights and inspiration. By focusing on these areas, universities can play a pivotal role in equipping future entrepreneurs with the knowledge, skills and networks necessary to succeed in the challenging business environment of Brazil.

5. Conclusion

The primary aim of this study was to gain insights into the key challenges faced by entrepreneurs in emerging economics, focusing on the experience of entrepreneurs operating in the fields of mechanical engineering and control and automation engineering in Brazil. This research contributed to deepen understanding of entrepreneurship, explored relevant indicators in the Brazilian context, assessed the role of universities in fostering entrepreneurship and comprehensively examined the common obstacles encountered by individuals venturing into or transitioning within economic activities.

The interviews conducted with entrepreneurs highlighted five major challenges: difficulty comprehending taxation and managing tax burdens (D6); government bureaucracy for business formalization/transitions (D5); difficulty securing financing or initial investment (D1); lack of government programs promoting entrepreneurship (D9); and difficulty navigating complex market conditions during business establishment (D8). Notably, these challenges align with prior research findings and mirror the difficulties confronted by entrepreneurs across various domains, but they also shed light on underexplored topics in entrepreneurship research, such as industry 4.0 and new educational paradigms.

The findings of this research can benefit both entrepreneurs, policymakers and universities in Brazil and similar emerging economies. Entrepreneurs can leverage the findings of this research to better navigate the complexities of starting and growing a business by proactively addressing critical challenges such as tax compliance and the development of soft skills like leadership and emotional intelligence. Understanding these difficulties allows entrepreneurs to seek appropriate resources, training and strategies while also recognizing the importance of building robust networks and participating in impactful activities during their university years. Policymakers can simplify the tax system, reduce bureaucratic barriers and introduce more government programs to promote entrepreneurship and provide easier access to financing. Meanwhile, universities can enhance academic programs by integrating comprehensive soft skills training and practical courses on business fundamentals and by encouraging student participation in research and extracurricular activities to equip future entrepreneurs with the necessary knowledge, skills and networks to thrive.

Although this research provides valuable insights into the challenges faced by entrepreneurs in Brazil, it is essential to acknowledge the limitation posed by the relatively small number of participants, with only four entrepreneurs interviewed. To address this

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limitation and further enrich our understanding of the subject, future research could consider conducting interviews with a more diverse and extensive group of entrepreneurs to gain deeper insights into their experiences. Another research avenue would be exploring entrepreneurs' journeys over an extended period to understand how challenges evolve and how they adapt. Finally, future studies can compare the experiences of entrepreneurs from different industries to identify industry-specific challenges and general trends.

Understanding the challenges faced by entrepreneurs serves multiple crucial purposes. First, it aids in the formulation of effective public policies aimed at fostering entrepreneurship and innovation. Second, it provides valuable insights for designing educational initiatives that equip engineers with the skills required to navigate the complexities of starting and sustaining a business. Finally, when universities produce a larger pool of well-prepared entrepreneurs who can thrive in a supportive business environment, society as a whole benefits. This translates into increased employment opportunities, a boost in innovation and heightened competition. These factors, in turn, have the potential to propel the country toward economic growth, elevate the average income of the population and enhance the overall quality of life for Brazilian citizens.

This study offers valuable insights that can prove beneficial for other emerging countries facing similar challenges in promoting entrepreneurship and fostering innovation. By examining the difficulties encountered by entrepreneurs in Brazil, this research provides a blueprint for understanding the intricacies of entrepreneurship ecosystems in emerging economies. The identified challenges, such as navigating tax complexities, bureaucratic hurdles and access to financing, are often common barriers encountered by entrepreneurs worldwide. Therefore, the strategies, policies and educational initiatives suggested based on this study's findings can serve as a valuable reference for policymakers, educators and entrepreneurs in other emerging nations. By adapting and implementing the lessons learned from Brazil's experiences, these countries can potentially create more conducive environments for entrepreneurship, leading to economic growth, job creation and enhanced innovation, ultimately contributing to the betterment of their societies.

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