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# AN ENTREPRENEURIAL MATURITY LEVEL ASSESSMENT METHODOLOGY: A CASE STUDY IN THE BUSINESS INCUBATOR OF MACKENZIE PRESBYTERIAN UNIVERSITY

## *UMA METODOLOGIA DE AVALIAÇÃO DO NÍVEL DE MATURIDADE EMPREENDEDORA: UM ESTUDO DE CASO NA INCUBADORA DA UNIVERSIDADE PRESBITERIANA MACKENZIE*

## *UNA METODOLOGÍA DE EVALUACIÓN DEL NIVEL DE MADUREZ EMPRESARIAL: UN ESTUDIO DE CASO EN LA INCUBADORA DE LA UNIVERSIDAD PRESBITERIANA MACKENZIE*

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## Abstract

**Objective of the study:** To propose and evaluate the DIMEP methodology for diagnosing and monitoring the maturity of startups in academic institutions, based on dimensions, subdimensions and maturity levels for evaluating startups at different entrepreneurial journey stages.

**Methodology:** Exploratory, with the proposal of DIMEP, based on the concepts of entrepreneurial journey in academic environments and critical success factors for startups; and its application in a case study to evaluate the entrepreneurial journey promoted in the innovation ecosystem of a Brazilian university.

**Originality / Relevance:** Stimulating student entrepreneurship requires a monitoring methodology throughout the entrepreneurial journey. The literature still lacks well-structured proposals in this regard. DIMEP emerges as an evaluation methodology with demonstrated applicability in this context.

**Main Results:** DIMEP was evaluated during a pre-acceleration program of the university under study, proving to help monitor the projects, allowing an objective assessment of their progress and difficulties, diagnosing particular aspects of each project and the most challenging dimensions for all the program's startups.

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**Theoretical / Methodological Contributions:** A generic methodology for diagnosing the maturity of innovative ventures. Its positive aspects include generality, structuring around a well-defined entrepreneurial journey, the possibility of carrying out qualitative and quantitative analyzes and flexibility to customize different universities' entrepreneurship journeys.
**Social / Managerial Contributions:** DIMEP has applicability potential in evaluating startups in other institutions, contributing to the development of their innovation and entrepreneurship ecosystems, concerning monitoring the entrepreneurial journey.

**Keywords:** Entrepreneurial maturity. DIMEP. Entrepreneurial journey. Methodology.

**Resumo**
**Objetivo do estudo:** Propor e avaliar a metodologia DIMEP para diagnóstico e acompanhamento da maturidade de empreendimentos em instituições acadêmicas, fundamentada em dimensões, subdimensões e níveis de maturidade para avaliação de empreendimentos em diferentes estágios da jornada empreendedora.
**Metodologia:** Metodologia exploratória, com a proposição da DIMEP fundamentada em literatura sobre jornada empreendedora em ambiente acadêmico e fatores críticos de sucesso de startups; e sua aplicação em um estudo de caso de avaliação da jornada empreendedora promovida no ecossistema de inovação de uma universidade brasileira.
**Originalidade/Relevância:** O estímulo ao empreendedorismo estudantil requer uma metodologia de acompanhamento ao longo da jornada empreendedora. A literatura ainda carece de propostas bem estruturadas neste sentido. A DIMEP surge como uma metodologia de avaliação com aplicabilidade demonstrada neste contexto.
**Resultados Principais:** A DIMEP foi avaliada durante um programa de pré-aceleração da universidade em estudo, mostrando ser útil para o acompanhamento dos empreendimentos, permitindo avaliação objetiva dos avanços e dificuldades, diagnóstico dos aspectos particulares de cada empreendimento e as dimensões mais desafiadoras para todos os empreendimentos do programa.
**Contribuições Teóricas/Metodológicas:** A contribuição principal é uma metodologia genérica de diagnóstico da maturidade de empreendimentos inovadores. Seus pontos positivos incluem generalidade, estruturação em torno de uma jornada empreendedora bem definida, possibilidade de realizar análises qualitativas e quantitativas e flexibilidade para customização à jornada de cada instituição.
**Contribuições Sociais/Gerenciais:** A DIMEP apresenta potencial de aplicabilidade na avaliação de empreendimentos em outras instituições, contribuindo para o desenvolvimento dos ecossistemas de inovação e empreendedorismo, no que se refere ao acompanhamento da jornada empreendedora.

**Palavras-chave:** Maturidade empreendedora. DIMEP. Jornada empreendedora. Metodologia.

**Resumen**
**Objetivo del estudio:** Proponer y evaluar la metodología DIMEP para el diagnóstico y seguimiento de la madurez de empresas en instituciones académicas, con base en dimensiones, subdimensiones y niveles de madurez para evaluar empresas en diferentes etapas del camino emprendedor.
**Metodología:** Metodología exploratoria, con la propuesta de DIMEP, basada en literatura sobre viaje emprendedor en un entorno académico y factores críticos de éxito para startups; y su aplicación en un estudio de caso para evaluar el camino emprendedor promovido en el ecosistema de innovación de una universidad brasileña.
**Originalidad / Relevancia:** Estimular el espíritu empresarial de los estudiantes requiere una metodología de seguimiento durante todo el recorrido empresarial. La literatura aún carece de propuestas bien estructuradas al respecto. DIMEP surge como una metodología de evaluación con demostrada aplicabilidad en este contexto.
**Resultados principales:** DIMEP fue evaluada durante un programa de pre-aceleración de la universidad en estudio, resultando útil para el seguimiento de los proyectos, permitiendo una valoración objetiva de los avances y dificultades, diagnosticando los aspectos particulares de cada proyecto y las dimensiones más desafiantes para todos. los compromisos del programa.

**Contribuciones teóricas / metodológicas:** La principal contribución es una metodología genérica para diagnosticar la madurez de emprendimientos innovadores. Sus puntos positivos incluyen la generalidad, la estructuración en torno a un recorrido emprendedor bien definido, la posibilidad de realizar análisis cualitativos y cuantitativos y la flexibilidad para personalizar el recorrido de cada institución.
**Contribuciones sociales / gerenciales:** DIMEP tiene potencial de aplicabilidad en la evaluación de empresas en otras instituciones, contribuyendo al desarrollo de ecosistemas de innovación y emprendimiento, en lo que respecta al seguimiento del camino emprendedor.

**Palabras clave:** Madurez emprendedora. DIMEP. Viaje de emprendimiento. Metodología.

## 1 Introduction

Over the past years, there has been an increase in demands on the role of higher education institutions beyond education, research and articulation with society, known as extension. In Audy's (2017) view, in the knowledge society in which we live, universities play a key role in scientific and technological development, as "a place (not only) of scholarship, but of interdisciplinary effort in solving problems", and advances to become a relevant agent in the new learning society, where the ability to learn continuously is fundamental for society to be able to overcome complex and unknown problems.

In this context, the concept of *entrepreneurial university* arises. In Clark's (1998) conception, an entrepreneurial university is one that actively seeks to innovate in the way it conducts its activities, promoting changes in its organizational structure and aiming to differentiate itself. Etzkowitz (2004) proposes that entrepreneurial universities result from a second academic revolution that integrates the mission for economic and social development with a transformation in their traditional teaching, research, and development role.

Although the very concept of the entrepreneurial university can be proposed in a specific way for each institution (Coyle et al., 2013), there is a certain consensus that entrepreneurial universities need to be connected with the productive sectors of the economy, emphasize the development of entrepreneurial skills and enable an ecosystem of innovation and entrepreneurship (Marco Legal, 2018), allowing the transformation of knowledge into the addition of economic and social value (Audy, 2017). This posture aims to establish a stimulating and sustainable environment both for the efforts to transform the knowledge generated internally into technologies and enterprises, as well as to encourage the protagonism and learning of students in the process of solving problems (Coelho, 2017; Alves et al., 2019).

Student entrepreneurship has been, in general, stimulated in the *ecosystems of innovation and entrepreneurship* in universities through the development of an entrepreneurial mindset, training in the process of innovation and entrepreneurship, encouraging the

development of projects, and supporting the development of startups. Although there are known structures for evaluating innovation in different dimensions (Araujo & Paula, 2017), the process of monitoring and evaluating student entrepreneurship journeys within universities is still a challenge (Alves, 2019).

One of the main objectives of innovation ecosystems is to promote the development of startups and spinoffs. To this end, university business incubators provide shared physical infrastructure, connections, consultancies, and training programs for entrepreneurs. To make sure that entrepreneurs and startups are making progress on the entrepreneurial journey, it is necessary to adopt a diagnostic methodology capable of assessing the maturity level of the startups over time. This methodology must contain, at least, the following elements: a set of *evaluation measures* (variables, critical factors, or dimensions); the definition of the stages or *phases of the entrepreneurial journey*; *maturity levels*; and the *progression criteria*.

This paper proposes a methodology for assessing the maturity level of innovative ventures (startups) in higher education institutions, called DIMEP. To meet this objective, DIMEP is structured into five fundamental dimensions that make up an entrepreneurial project and classify these dimensions into maturity levels. Following a qualitative and exploratory approach, the paper examines a case study (Yin, 2011) of the application of DIMEP in the context of a pre-acceleration program implemented at the Mackenzie Presbyterian University, in the state of São Paulo, Brazil, in the second semester of 2019, analyzing its application results, limitations and proposals for improvement.

The paper is organized as follows. Section 2 briefly reviews the two structuring topics of the research: the entrepreneurial journey in academic environments and critical success factors for startups. Section 3 deals with the DIMEP proposal starting with a presentation of the entrepreneurial journey within the Mackenzie Presbyterian University, the five dimensions of DIMEP, its subdimensions and descriptions, the maturity levels, the proposal of criteria for progression along the entrepreneurial journey and concludes with a review of related works. In Section 4, we present a case study of the application of DIMEP in a pre-acceleration program at Mackenzie Presbyterian University carried out in the second semester of 2019. The work is concluded in Section 5 with a general discussion on the proposal, the results obtained and the prospects for future work.

## 2 Conceptual background

This paper is rooted in two main pillars: the entrepreneurial journey in academic environments and critical success factors for startups. Based on them, the DIMEP methodology will be built. This section provides an overview of the concepts of these two pillars.

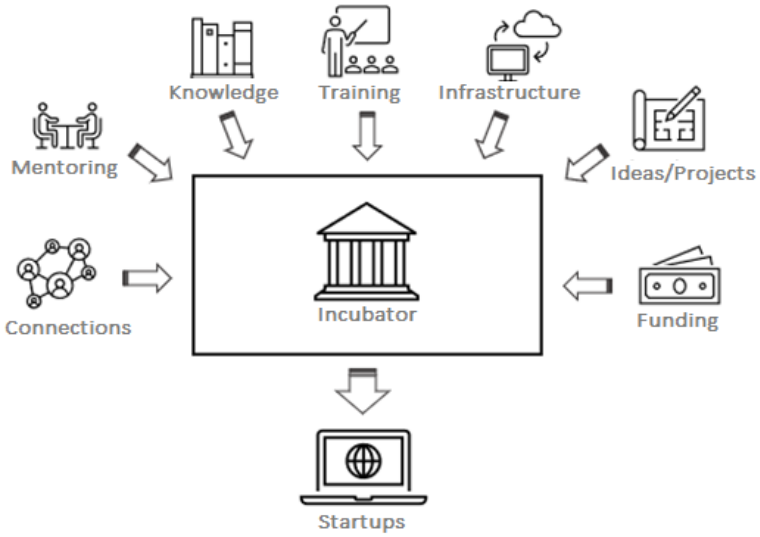
### *2.1 Entrepreneurial journey in universities*

Universities, when asked to act in an entrepreneurial way, have sought to review their cultural, governance and teaching practices to create environments that allow the development of entrepreneurial education, mainly by their students, but also by the faculty and administrative staff (Coyle et al., 2013; Santos, 2017). In this way, we have seen the adaptation of undergraduate and graduate curricula to include the teaching of entrepreneurship to develop entrepreneurial skills – proactivity, creativity, leadership, public speaking, innovation, etc. – and to disseminate the entrepreneurship culture and mindset, considered essential for the insertion of its students in the labor market, as well as their formation as citizens in a competitive and constantly changing society.

However, entrepreneurial mindsets and skills development result from a process that needs to go beyond the classroom, comprising real actions to perceive opportunities and create new businesses (Santos, 2017). In this sense, business incubators have been a common way of oxygenating, stimulating, and supporting the emergence of startups within universities, as illustrated in Figure 1 (Saveliev & Lytynov, 2016).

**Figure 1**

*Support offered by business incubators and academic environments for the development of startups*




**Source**: The authors.

According to the Brazilian Ministry of Science, Technology and Innovation (MCTI), a Business Incubator can be defined as a mechanism that generates the stimulus and provides the logistical, managerial and technological support necessary for entrepreneurship development. Business incubators can also be understood as environments where the development of innovative business occurs. In parallel, the overall development of the entrepreneur takes place, both in technical, management, and personal aspects (Fragoso, 2016).

McMullen & Dimov (2013) stated that the entrepreneurial journey comprises a process, a sequence of steps, interactions, and the organization of information to create a product or service over time. This process requires that certain conditions are met – purpose, means, opportunities and objectives – and that a series of events occur, not necessarily in entirely chronological order. Thus, entrepreneurship becomes a process and not an act, which must be studied as a journey (McMullen & Dimov, 2013).

This entrepreneurial journey perspective allows analysis and evaluates the entrepreneurial process as a function of variables and/or events over time (Cha & Bae, 2010; McMullen & Dimov, 2013; Selden & Fletcher, 2014). It includes the stages that new business creation projects go through, from the empowerment of new entrepreneurs, through the creation and development of their ventures, to the growth of the business as small and medium-sized companies.

Cha & Bae (2010) propose that successful entrepreneurial journeys have three effects: channeling (motivation), concentration (direction) and continuity (duration). The union of these three effects allows the creation, attraction, and combination of resources necessary to generate market opportunity value. Encouraging, conducting, monitoring, and sustaining these projects in all their stages become key activities for the university in its mission as an agent to encourage and promote entrepreneurship.

### *2.2 Critical success factors for startups*

One way to build entrepreneurial maturity assessment criteria is to identify which startup characteristics typically lead to its success. With this objective, several works in the literature propose different sets of *Critical Success Factors* (CSF) for startups (Song et al., 2008; de Carvalho et al., 2015; Seol-Bin, 2017; Tur-Porcar et al., 2018; Kim et al., 2018). Most of these works identify the CSFs based on research carried out with experts and entrepreneurs (Kim et al., 2018; Tur-Porcar et al., 2018) or studies based on an analysis made from related works (Song et al., 2008).

As the literature on the subject is relatively vast, our goal here is not to exhaust the discussion about the critical success factors of startups but to reference some works so that we can understand the construction process of the DIMEP methodology proposed in this paper. Our analysis will consider two recent papers that deal with startup CSF and one that consolidates empirical results from the literature.

The first paper emphasizes design and technology startups, proposing four success factors with five attributes each, based on a survey conducted with 12 design startup entrepreneurs and 12 other technology startup entrepreneurs (Kim et al., 2018). The second work addresses the CSF from a company sustainability perspective (Tor-Porcar et al., 2008). The authors divided a set of fourteen factors into four areas and surveyed them to assess the importance of each factor for the sustainability of companies. Finally, in a work by Song et al. (2008), the authors proposed a meta-analysis of the CSF. They analyzed the academic literature searching for empirical work on the critical success factors of new technology companies. They found eight CSF considered homogeneous in the research, divided into three broad categories (Song et al., 2008). The summary of the perspective brought by each of these authors is shown in Table 1.

**Table 1**

*Startups' critical success factors (CSF) based on some works from the literature*

| AUTHORS | CSF | ATTRIBUTES |
|---|---|---|
| Kim et al., 2018 | Entrepreneurship | • Competence<br>• Tendency to adventures<br>• Desire for achievement<br>• Goal orientation<br>• Risk sensitivity |
| | Innovation | • Entrepreneurial motivation<br>• Progressive thinking<br>• Self-development<br>• Marketing the idea<br>• Market-oriented work |
| | Technology | • Creativity<br>• Knowledge<br>• Retention of intellectual property<br>• Market orientation<br>• Technological globalization |
| | Economy | • Continuous investment<br>• Use of venture capital<br>• Raising venture capital<br>• Resource retention capacity |
| Tur-Porcar et al., 2018 | **AREAS** | **CSF** |
| | Environment | • Sustainability<br>• Social conscience<br>• Policies<br>• Regulations |
| | Business Factors | • Profit<br>• Job satisfaction<br>• Management<br>• Access to resources |
| | Behavior | • Motivation<br>• Lifestyle<br>• Metacognition (self-regulation, self-efficacy, competitive intelligence) |
| | Human Relations | • Reputation<br>• Congruence<br>• Leadership |
| Song et al., 2008 | **CATEGORIES** | **CSF** |
| | Market and Opportunity | • Market scope |
| | Team | • Marketing experience<br>• Market experience |
| | Resources | • Integration with the supply chain<br>• Size of the founding team<br>• Financial<br>• Company age<br>• Intellectual property protection |

**Source:** The authors.

Based on the meta-analysis results, Song et al. (2008) proposed a theoretical framework for evaluating the performance of startups. This structure is based on five categories: entrepreneurial opportunities, entrepreneurial team, resources, strategic and organizational fit,

and performance. Performance is seen as a consequence of the other four categories rather than an independent category and, therefore, will be treated here due to the others. Each of these categories has a set of critical success factors, totaling 15 CSF. Table 2 summarizes the theoretical structure of Song et al. (2008).

**Table 2**

*Performance evaluation of innovative ventures - theoretical framework*

| | Categories | Factors |
|---|---|---|
| Song et al., 2008 | Resources | • Financials and investments<br>• Intellectual property<br>• Partnerships and contact networks<br>• Institutional features |
| | Team | • Team Characteristics<br>• Experience, knowledge and skills<br>• Values and beliefs<br>• Behaviors and leadership styles |
| | Strategic and Organizational Fit | • Competitive strategy<br>• Structure<br>• Processes<br>• Systems |
| | Opportunity | • Dimensions of opportunity<br>• Environment characteristics<br>• Market characteristics |

**Source:** Song et al. 2008.

## 3 INOVAMACK: ecosystem of innovation and entrepreneurship of the mackenzie presbyterian university

The Business Incubator of the Mackenzie Presbyterian University was founded in 2008, together with the Nucleus of Technological Innovation (NIT). In 2009, the Incubator's First Batch and Entrepreneurship Contest was launched, with the primary objective of attracting projects for the incubator, both in the pre-incubation and incubation stages. Six projects were selected, finishing their graduation in 2012. Also, in 2012, the managers of the Mackenzie Incubator participated, for the first time, in the CERNE Training Course (https://anprotec.org.br/cerne/); then, the Business Incubator of the Campinas Unit at the Mackenzie Presbyterian University was created. In 2015, after graduating 18 startups and losing other 7, the incubator began offering consultancy to entrepreneurs.

The first ten years of Mackenzie's incubators and NIT operations composed the first phase in the development of Mackenzie's ecosystem of innovation and entrepreneurship. In 2017, a second planning cycle began for the new Ecosystem of Innovation and Entrepreneurship at Mackenzie Presbyterian University, INOVAMACK, based on the tripod of Intellectual

Property Protection and Technology Transfer, development of Innovative Enterprises (startups and spinoffs), and execution of Partnership Projects with the Productive Sectors. Within this new context and concept, the activities began with the construction of institutional normative devices that would allow a fluid and procedural action of the three pillars of INOVAMACK, culminating with the publication of the Innovation Policy of the Mackenzie Presbyterian University in 2021.

A central component of INOVAMACK, as an academic ecosystem of innovation and entrepreneurship, is its ability to support the development of startups. Given the non-public, philanthropic, community and confessional characteristics of Mackenzie Presbyterian University, INOVAMACK has always been concerned with supporting technological projects and impact projects, mainly social and environmental.

### *3.1 The entrepreneurial journey*

As part of the INOVAMACK construction process, the Mackenzie Presbyterian University implemented a Startup Development Support Program, consisting of a set of processes and environments that provide infrastructure and institutional arrangements for the development of university startups. It defined four evolutionary phases for the entrepreneurial journey:

1) **Ideation:** Initial phase of the entrepreneurial journey whose objective is to identify the main hypotheses associated with the development of a startup, including problem, product, market and growth hypotheses, in addition to carrying out the initial startup modeling. Typically, we have an entrepreneurial project in the ideation phase, but the company is not yet incorporated. In the context of the Mackenzie Presbyterian University business incubator, the ideation phase is within the pre-incubation process.
2) **Validation:** In this phase, the startup must carry out Proofs of Concept (PoCs), validation and demonstration of products in the laboratory, development of prototypes (for example, a Minimum Viable Product or MVP), discovery and market validation and startup incorporation. In the Mackenzie Presbyterian University incubator, once the company has been established - a PoC has been carried out or an MVP has been built - the project can migrate from pre-incubation to incubation.
3) **Acceleration:** In this phase, the startup must demonstrate its products and services in a real environment, deliver a complete and qualified solution, structure the Business Plan, launch the product or service, attract customers, and obtain sufficient maturity to survive in the market.

Once this step is completed, the startup is ready to graduate, that is, to complete its incubation stage in the academic ecosystem.

4) **Growth:** Phase in which the startup is already structured, increases its independence, focuses on solving specific challenges and reaches the growth stage; that is, it scales its sales with the same structure. Usually, the startup maintains the link with the academic ecosystem at this stage but is no longer resident in the incubator.

## 4 DIMEP: entrepreneurial maturity level assessment method

Given the objectives and characteristics of INOVAMACK, it became necessary and urgent to build a methodology that would allow the assessment and monitoring of the maturity of startups within the ecosystem. This methodology was called DIMEP, an acronym for Mastery of Technique (***D**omínio da Técnica*, in Portuguese), **I**nnovation in Product or Service, **M**arket, Team (***E**quipe*, in Portuguese) and **P**lanning, which makes up the five principal dimensions of the startup maturity assessment framework at Mackenzie.

DIMEP starts from a definition of the entrepreneurial journey within the university and a set of dimensions, which represent the critical success factors of startups. Based on these two pillars, maturity levels in each dimension and criteria for progression in the entrepreneurial journey for each dimension are proposed. This section details DIMEP and presents the result of applying this methodology in a pre-acceleration program run at the university in the second semester of 2019.

### *4.1 DIMEP assessment dimensions*

DIMEP's main focus is the continuous assessment of the maturity of startups along their journey. To meet this objective, DIMEP is structured on: i) primary **dimensions** of assessment; ii) **subdimensions**, which specify the dimensions; and iii) the respective **descriptions**. The dimensions are the critical success factors of the startup and the degree of development in each one of them, showing the maturity of the enterprise through the subdimensions.

#### 4.1.1 Mastering the technique

*Mastering the technique* is related to the application of technology in the startup. In this dimension, it is necessary to assess whether the technology necessary for the startup to deliver its value proposition exists and whether the team masters it. The entrepreneur and his team must know the technologies necessary for the development of the business, must be able to apply

them in a growing view of business maturity and to master the fundamental technology for the business development, validate it enabling its commercialization and, finally, scale it. The latter is the highest degree of maturity expected within this dimension. Table 3 summarizes the domain dimension of the DIMEP technique.

**Table 3**

*DIMEP structure. Dimension: mastering the technique*

| Dimension | Subdimension | Description |
|---|---|---|
| **Mastering the Technique** | Knowledge | Does the startup know what technologies are needed for business development? |
| | Application | Does the startup know how to apply the necessary technologies for business development? |
| | Mastery | Does the startup master the fundamental technology for business development? |
| | Validated | Has the startup been able to validate the technology in practice, demonstrating its viability? |
| | Scaled | Has the startup managed to scale the technology by demonstrating that it is scalable. |

**Source:** The authors.

### 4.1.2 Products or Services Innovation

This dimension is related to the startup's primary value delivery to the market, whether it is a product, process, or service. It is expected that the first step within an increasing scale of maturity is a clear *definition*, by the entrepreneur and his team, of the value offer. From this understanding, it needs to be *tested* and validated by the market. The following steps within this dimension are the development of a *prototype* or an MVP to *market* validation with evidence of product or service commercialization. Table 4 summarizes DIMEP's product or service innovation dimension.

**Table 4**

*DIMEP structure. Dimension: product or services innovation*

| Dimension | Subdimension | Description |
|---|---|---|
| **Product or Services Innovation** | Defined | Is the startup´s product or service correctly defined and does it have a clear value proposition? |
| | Tested | Has the startup´s product or service been tested in the field and has it validated its value and journey? |
| | Prototyped | Does the startup have a prototype tested and validated with opinion leaders? |
| | MVP | Does the startup have a validated MVP that delivers the value of the main product or service? |
| | Market | Has the startup brought the product or service to market and is it being commercialized? |

**Source:** The authors.

### 4.1.3 Market

The *market* can be understood as the agents and environment where the exchange of goods and services takes place. In the DIMEP structure, the market comprises the *segment*, *target audience*, *competitors*, *brand* and *competitive differentials*, and *positioning* subdimensions, as summarized in Table 5. As in the other subdimensions, the proposal is to progressively understand the startup maturity level, the entrepreneur, and its competition regarding the market. The segment subdimension seeks to investigate the degree of knowledge of the market segment for that startup. In target audiences, the aim is to see if the entrepreneur and his team know clearly and objectively who his target audience is so that this knowledge can help them focus on business development. In the competitors' subdimension, it is necessary to map the degree of knowledge and the intensity of direct and indirect competitors. In the brand and competitive differentials subdimension, the startup is expected to present a defined brand with a visual identity and an appropriate brand manifest or brand book. Finally, the positioning subdimension refers to positioning in the market clearly and strategically for business development.

**Table 5**

*DIMEP structure. Dimension: market*

| Dimension | Subdimension | Description |
|---|---|---|
| **Market** | Segmentation | Does the enterprise have reliable and relevant data that demonstrate that there is a real business opportunity in the proposed market segmentation? |
| | Target | Does the enterprise have a clear target audience and defined personas to assist in the business development focus? |
| | Competitors | Are direct and indirect competitors mapped? Is there an analysis of the startup´s market positioning in relation to the 4 Ps and brand position? |
| | Brand/Competitive Differentiation | Does the enterprise have a defined brand with graphic identity and a brand manifest or a suitable Brandbook? |
| | Position | Does the enterprise have a clear and strategic position in the market for business development? |

**Source:** The authors.

### 4.1.4 Team

In the *team* dimension, five subdimensions progressively assess the degree of maturity of the entrepreneur, shown here by *founder*, *co-founders*, *team*, *retention*, and *areas* (Table 6). These five subdimensions aim to understand how much the entrepreneur is aware of his tasks and skills to be developed, to the point of motivating and involving others in his startup. The points suggested as maturity levels in this dimension are: to have a vision regarding the need for complementarity of a team until its formation and a transparent model for positions, functions, and responsibilities.

**Table 6**

*DIMEP structure. Dimension: team*

| Dimension | Subdimension | Description |
|---|---|---|
| **Team** | Founder | Does the founder demonstrate clarity regarding the tasks to be carried out, resilience and empowerment? |
| | Co-Founders | Do the founders demonstrate mastering the startup´s objective and strategy, and being engaged and aware of the tasks to be carried out? |
| | Team | Does the startup have a defined hiring strategy, with descriptions of tasks and responsibilities aligned with the business plan? |
| | Retention | Does the enterprise have strategies for retaining and reversing staff, talents and acquired knowledge loss? |
| | Areas | Does the enterprise have a model for organizing people, roles and responsibilities? |

**Source:** The authors.

### 4.1.5 Planning

The last dimension was called *planning* and deal with understanding the structuring of the business model itself. Maturity levels should be explained here within the subdimensions based on a precise and innovative business model, followed by a clear and objective speech capable of communicating the business pillars and the market pain to be resolved, up to a complete and consistent financial, operational, and commercial planning.

**Table 7**

*DIMEP structure. Dimension: planning*

| Dimension | Subdimension | Description |
|---|---|---|
| **Planning** | Business Model | Does the startup have a clear, innovative and scalable business model? |
| | Presentation | Does the startup have a clear presentation with an objective and seductive speech? |
| | Financial Plan | Does the startup have a financial plan that contains the items necessary for business operation and scale? |
| | Operational Plan | Does the startup have a defined and validated operating plan, ready for implementation? |
| | Business Plan | Does the startup have a complete and consistent business plan? |

**Source:** The authors.

### *4.2 Maturity levels*

The subdimensions of DIMEP, defined by the proposed descriptions, make up the factors to be analyzed in each startup so that we can follow its development. In this sense, each subdimension of the entrepreneurial assessment may assume one of the following maturity levels, sequentially ordered:

- **Conception (1):** This is the first maturity level of any subdimension. It only indicates a general notion, a concept about that subdimension.
- **Planning (2):** It requires that the startup is already defining, at least, methods, processes and stages of development of that subdimension, that is, an action, development or work plan.
- **Deployment (3):** It implies that the startup has already done the subdimension planning and is working on deploying this planning.
- **Consolidation (4):** It means that the plan has already been implemented and has results to be evaluated.
- **Maturity (5)**: Maturity is the highest level of progress of the DIMEP subdimensions. To reach this level, the subdimension must present recurrence, adjustments, and evolutions.

### *4.3 Criteria to progress in the entrepreneurial journey*

At first, DIMEP can be used at any stage and for any conception of an entrepreneurial journey. However, it provides specific assessment milestones in the entry/exit stages that make up the journey. The definition of these criteria can be done to meet the realities of each institutional ecosystem and its entrepreneurial journey. As an example, in the Mackenzie Presbyterian University entrepreneurial journey, described in Section 3.1 (ideation, validation, acceleration and growth), minimum progression criteria following the maturity levels were proposed (Section 3.3), as shown in Table 8. It is suggested that this evaluation be carried out by an assessment committee composed of internal and external experts, at the institution's discretion, upon presentation of startups/projects and submission of documentation that allows the analysis of evidence regarding each dimension of the evaluation structure.

**Table 8**

*Grades (maturity level) within the DIMEP methodology for the Mackenzie Presbyterian University entrepreneurial journey. D: mastery of technique; I: product/services innovation; M: market; E: team; P: planning.*

| Dimensions | | D | I | M | E | P |
|---|---|---|---|---|---|---|
| **Phase** | **Product I/O** | **Maturity model** | | | | |
| **Ideation** | Input: - | • Interview involving the members of the evaluation board and the startups to fill in the evaluation matrix.<br>• To join the journey, the startup cannot have a "zero" in any dimension. | | | | |
| | Output: Prototype/Canvas | 1 | 2 | 2 | 1 | 1 |
| **Validation** | Input: Prototype/Canvas | 1 | 2 | 2 | 1 | 1 |
| | Output: MVP/Launch Plan | 1 | 3 | 2 | 2 | 2 |
| **Acceleration** | Input: MVP/Launch Plan | 1 | 3 | 2 | 2 | 2 |
| | Output: Structured Business + Customers (Traction) | 3 | 3 | 3-4 | 3-4 | 3-4 |
| **Growth** | Input: Structured Business + Customers (Traction) | 3 | 3 | 3-4 | 3-4 | 3-4 |
| | Outpur: Expansion (Scale-up) | 4-5 | 4-5 | 4-5 | 4-5 | 4-5 |

**Source:** The authors.

### *4.4 Related Works*

Evaluating student entrepreneurship results in higher education institutions is a challenge that has not yet been resolved. Works available in the literature report, based on questionnaires, that there is motivation and concerns of university entrepreneurs, who need to rely on adequate institutional support (Garcia et al., 2012; Frizzo et al., 2019; Carmo & Rangel, 2020). However, Alves et al. (2019) point out that the actions of student entrepreneurship in Brazil, in general, disregarding specific cases, have unexpected results, probably resulting from independent institutional actions and poorly aligned with each other. In this scenario, consistent methodologies for managing entrepreneurial journeys, such as DIMEP, are necessary. Some proposals in this regard can be found in the literature, as summarized below.

Moura Filho et al. (2019) propose an approach for diagnosing and planning innovation ecosystems in universities, considering the axes of strategy, modeling, services, demands and

driving elements. The work shows an example of applying the approach in a private university in Bahia, which does not have an innovation ecosystem yet, therefore, without evaluating projects.

Saveliev and Lytvynov (2016) present a conceptual model and an automated tool for evaluating startups generated in university ecosystems. The model is focused on startups in the IT business domain and is based mainly on the CMMI model, widely used in the market since the 1990s to assess the maturity of software providers worldwide.

Wrubel et al. (2016) describe a qualitative study on methodologies for evaluating the performance of incubators, with the primary context being FUNDETEC, in Paraná. Among the different levels of analysis used in the methodology is the performance evaluation of incubated projects, comprising the axes of personnel, management, market, technology, finance, ethics, and social and environmental responsibility. Assessments are carried out based on a questionnaire at different times during the projects' journeys (growth, maturation, and graduation), which may or may not justify the project's continuity in the context of the incubator.

DIMEP is also inspired by maturity models, such as the CMMI, but adds dimensions that can be used for undertakings in any business area (see Table 10). By including the definition of maturity levels for each assessment dimension, DIMEP allows the combination of objective (quantitative) analyses with the usual qualitative analyses in project monitoring processes, eventually facilitating discussion and convergence of assessments.

## 5 Case study: application in a pre-acceleration program at the Mackenzie Presbyterian University

This section presents and discusses a case study of the application of DIMEP in monitoring enterprises participating in a pre-acceleration program conducted at Mackenzie Presbyterian University in 2019. Yin (2015) defines a case study as a research method suitable for situations in which one wants to investigate a phenomenon within a practical or application context and environment. Also, according to Yin (2015), the case study conducted in this research is qualitative and exploratory in nature, comprising a single unit of analysis, in this case, the evaluation phase of university projects of the Mackenzie Presbyterian University pre-acceleration program.

We define the objective of this case study according to the GQM (Goal-Question-Metric) approach (Basili, 1992): to analyze the DIMEP methodology of assessing

entrepreneurial maturity to evaluate an entrepreneurial journey in an innovation ecosystem at a Brazilian university. It is, therefore, a pilot study of the application of DIMEP to observe its applicability.

As already mentioned, the context of the case study is the startup pre-acceleration program of the Mackenzie entrepreneurship and innovation ecosystem. The startups were, in their entirety, originating from academic initiatives and linked to the university, being resident and supported by the university's incubator. In the group of participating startups, there were pre-incubated and incubated projects. All projects had their main characteristic: their teams' high adhesion and commitment, adhering voluntarily to the pre-acceleration process through an internal call for participation. A more detailed description of the nature of the startups is omitted for ethical and confidentiality reasons. The body of participating evaluators was composed of the coordinator of the incubator and the business model consultant, who were solely responsible for conducting the evaluation process of the projects and the pre-acceleration program as a whole.

The description of the program, its main phases, and the results of applying DIMEP are described in the following sections.

### *5.1 The pre-acceleration program*

Intending to accelerate the development of startups residing at INOVAMACK, Mackenzie established a partnership with the Bluefields accelerator, which developed a specific Pre-Acceleration Program (PPA) for the university with three stages and a total duration of 8 weeks:

1) **Ideation**: Initial stage of the program focused on developing ideas through a set of methods and processes used to identify and solve problems. At the end of this phase, the startup is expected to have a first prototype and a first version of Canvas. For technology startups, a Technology Readiness Level (TRL) (Mankins, 1995; Mankins, 2009) equivalent to TRL 3 at the end of this stage is expected.
2) **Validation**: The validation stage is focused on the development of the business model, specifically on the validation of hypotheses focused on product-market-fit, target audience segmentation and MVP. At the end of this stage, it is expected that the startup already has an MVP and a launch plan for its product/service. For technology startups, a TRL 5 is expected at the end of this stage.

3) **Pre-Acceleration**: At this stage, the objectives involve managerial training focused on startups, access to the university's incubation program, participation in business pre-acceleration sprints and pitch day. The content includes an investment preparation checklist, inbound and outbound marketing strategies, finances and projections, operations, pricing, sales funnel, identity and performance management, competitor analysis and pitch day. For technology startups, a TRL 7 is expected at the end of this stage.

This pre-acceleration program covers the first two phases of the university entrepreneurial journey (Section 3.1) and partially the acceleration phase. Thus, we consider the grades and exit criteria for the pre-acceleration stage a little earlier than those for the acceleration proposed in Table 8, but in line with the developments of the executed program (Table 9).

**Table 9**

*Minimum dimension grades for the pre-acceleration program at Mackenzie Presbyterian University*

| Dimension | D | I | M | E | P |
|---|---|---|---|---|---|
| *Pré-acceleration* | | | | | |
| Input: MVP/Launch Plan | 1 | 3 | 2 | 2 | 2 |
| Output: Customer or Product or Structured Business | 2-3 | 3 | 2-3 | 2-3 | 3 |

**Source:** The authors.

## *5.2 Pre-acceleration batch*

The group of startups that went through the university's pre-acceleration program during the second semester of 2019 started with 11 projects. It ended up with six startups on Pitch Day, assessed by two internal university members and two angel investors invited. Table 10 summarizes the grades and areas of action (solutions) of each startup in each DIMEP dimension along the entrepreneurial journey directed by the pre-acceleration program. Undetached grades are within the progression threshold. Grades highlighted in darker gray are above the threshold for progression, while grades highlighted in lighter gray did not reach the expected thresholds.

**Table 10**

*Maturation of startups that completed the pre-acceleration program along the entrepreneurial journey. D: mastery of technique; I: product/services innovation; M: market; E: team; P: planning*

| | D | I | M | E | P |
|---|---|---|---|---|---|
| *STARTUP 1 – Cell phone rental service (Technology)* | | | | | |
| Ideation | 1 | 2 | 1 | 1 | 1 |
| Validation | 2 | 2 | 3 | 2 | 3 |
| Pre-acceleration | 2 | 2 | 3 | 2 | 2 |
| *STARTUP 2 - Emotional care for the elderly and people with special needs (Social Impact)* | | | | | |
| Ideation | 2 | 1 | 2 | 1 | 1 |
| Validation | 2 | 1 | 2 | 2 | 2 |
| Pre-acceleration | 2 | 2 | 3 | 2 | 2 |
| *STARTUP 3 – Platform for life project development for young people (Technology)* | | | | | |
| Ideation | 2 | 2 | 2 | 2 | 2 |
| Validation | 3 | 2 | 2 | 2 | 2 |
| Pre-acceleration | 3 | 2 | 2 | 3 | 2 |
| *STARTUP 4 - Encouragement and awareness of charitable activities (Social Impact)* | | | | | |
| Ideation | 1 | 2 | 2 | 2 | 2 |
| Validation | 2 | 1 | 2 | 2 | 2 |
| Pre-acceleration | 2 | 2 | 3 | 2 | 2 |
| *STARTUP 5 – Bakeries Marketplace (Technology)* | | | | | |
| Ideation | 1 | 1 | 1 | 1 | 1 |
| Validation | 2 | 2 | 2 | 2 | 2 |
| Pre-acceleration | 2 | 2 | 3 | 2 | 2 |
| *STARTUP 6 – Customization of travel itineraries (Technology)* | | | | | |
| Ideation | 2 | 2 | 2 | 1 | 2 |
| Validation | 2 | 1 | 3 | 2 | 2 |
| Pre-acceleration | 2 | 2 | 3 | 2 | 2 |

**Source:** The authors.

As can be seen from the results presented in Table 10, no startup that completed the pre-acceleration program reached the expected maturity level in dimensions I (innovation in product/service) and P (planning). In both cases, a maturity level 3 (deployment level) was expected for these dimensions, but startups were between levels 1 and 2.

In dimension I, a maturity level of 3 means that the startup's product or service has already been prototyped; that is, there is already a preliminary model of the solution tested and validated by opinion leaders. Level 2, on the other hand, indicates that the startup was only able to validate the solution concept through research. As all startups started the journey in the ideation phase within the program, we noticed that the teams had a lot of difficulty in establishing their service protocols (in the case of social impact startups) or prototyping their solutions (in the case of technology startups) within two months.

For dimension P, a maturity level equals three means that the startup has already completed the business modeling via Business Model Canvas (BMC) and has a preliminary version of its Business Plan ready to present to potential investors via a Pitch Deck. A level 2 maturity in this regard means that entrepreneurs have already developed the BMC and can prepare a Pitch Deck without the support of more structured planning considering a financial and operational plan.

The five startups that failed to complete the program or that participated without progression basically had the following difficulties: conflict between partners, inability to reconcile entrepreneurship with the dedication to academic activities, and low dedication (attendance) to the activities proposed by the PPA. Among these, three startups participated in the entire program but remained with maturity level 1 in all dimensions, failing to evolve appropriately in applying methods and technologies for business planning and development.

### *5.3 Assessment process*

The evaluation process of the program's undertakings was carried out through the presentation of the startups/projects and submission of documentation by the startups that allowed the analysis of pieces of evidence regarding each dimension of the evaluation structure. The participating evaluators composed a panel where the questions presented by DIMEP and the answers and analysis of the startups were debated to ensure that a convergent understanding of the evaluation was attributed. To support the evaluation, the assessment process at each stage was configured on a customized platform, allowing for the consolidation of assessments, analysis of dimensions via graphics, and the recording of the assessment history of the journey of each project.

### *5.4 Discussion*

DIMEP presents the main components necessary for the design of a generic methodology for diagnosis and monitoring of the maturity level of innovative projects: the critical success factors (dimensions, variables, or evaluation criteria); the stages of an entrepreneurial journey; maturity levels (progress); and the progression criteria. DIMEP showed its applicability in the context of evaluation of projects linked to the university ecosystem to incubated projects, from the perspective of incubator managers. DIMEP also proved to be applicable as a tool to present relevant information to projects for the self-assessment of projects and reflection on their development throughout the pre-acceleration process. Finally, DIMEP proved to be applicable as an instrument for monitoring the pre-acceleration process itself, evaluating the progress of the projects as a whole.

The main strengths of the methodology, reported in the case study, include its generality, the structuring around a well-defined entrepreneurial journey, the possibility of carrying out qualitative and quantitative analyzes throughout the process, the flexibility to be customized according to the journey of each institution, and its ability to organize both the journey and the assessments around each undertaking. On the other hand, as limitations, DIMEP needs to have its concepts and criteria well understood by the evaluators to standardize the evaluation and grading process and require evidence of evaluation and progress of the subdimensions.

## 6 Conclusions and future trends

This paper presented the DIMEP methodology for assessing the maturity level of innovative ventures (startups) in higher education institutions, structured based on the concepts of the entrepreneurial journey and critical success factors for startups. DIMEP organizes five fundamental dimensions that make up an entrepreneurial project and supports the classification of these dimensions into maturity levels. The paper also described the application of DIMEP in the context of a pre-acceleration program implemented at the Mackenzie Presbyterian University in the state of São Paulo, Brazil.

DIMEP demonstrated its applicability for monitoring the program and its usefulness in supporting the analysis of projects, allowing the diagnosis of the particular aspects of each project and the most challenging dimensions for all projects within the program. The results of the application of DIMEP point to its applicability in evaluating startups in other higher education institutions, contributing to the achievement of objectives of their innovation and

entrepreneurship ecosystems, concerning monitoring the entrepreneurial journey and analysis of points of attention in the process.

One way to standardize the evaluation process and the assignment of grades is to carry it out through a panel, which will be responsible for evaluating and interviewing entrepreneurs. Furthermore, the methodology questions can be more granularized, separating those that guide the subdimensions. For example, the business model could be analyzed for clarity, innovation, and scalability. Each criterion could have a distinct grade/weight assigned in a specific new column to be added to the model.

The improvement of the methodology implies its continuous application in new entrepreneurial journeys at Mackenzie and other universities. The continuous use of DIMEP will improve its dimension structure, the evolution of concepts for assessment and the determination of a set of key evidence (artifacts/products/results) to be used for each evaluation step. There is also room for improvement and/or development of new automated tools for managing entrepreneurial journeys based on the methodology.

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