SYSTEMIC ANALYSIS OF THE SCIENTIFIC LITERATURE ON EXPERIMENTATION IN BUSINESS MODEL DEVELOPMENT

ANÁLISE SISTÊMICA DA LITERATURA SOBRE EXPERIMENTAÇÃO EM MODELOS DE NEGÓCIOS

ANÁLISIS SISTÉMICO DE LA LITERATURA SOBRE LA EXPERIMNETACIÓN EN MODELOS DE NEGOCIO

Rogério Tadeu de Oliveira Lacerda, Dr.
Universidade Federal de Santa Catarina/Brazil
rogerlacerda@gmail.com

Vanessa Regina Ostrowski, MSC
Universidade Federal de Santa Catarina/Brazil
vr.ostrowski@gmail.com

Júlia Fraga Cargnin da Silveira, BEL
Universidade Federal de Santa Catarina/Brazil
julia.f.c.s10@gmail.com

Ana Maria Simões Ribeiro, MSC
Universidade Federal de Santa Catarina/Brazil
anasimoesribeiro@gmail.com

ABSTRACT

This article aims to identify research opportunities related to experimentation in the business models development. For this purpose, the Proknow-C method was used. Portfolio selection resulted in a sample of 29 relevant articles on the topic. The portfolio articles were analyzed under five lenses: (a) concept of experiment, (b) singularity, (c) limited rationality, (d) context in which experimentation is used and (e) metrics to measure experimentation. Given the presented analysis lenses, in the evaluation of the most relevant articles to the theme, it is necessary to have a research that recognizes the singularity and the limited rationality of the entrepreneur, considering the importance of recognizing these factors in face of the challenges faced in the development of business models in uncertain environments. As a practical implication of this research is suggested an integrated research agenda for future research on the business model and experimentation based on the derived understanding of the concept and its current research streams.

Keywords: Experimentation; Business model innovation; Startup; Entrepreneurship.

RESUMO

Este artigo tem por objetivo identificar oportunidades de pesquisa relacionadas à experimentação no desenvolvimento de modelos de negócios. Para tal intento foi utilizado o método Proknow-C. A seleção do portfólio resultou em uma amostra de 29 artigos relevantes sobre o tema, analisados sob cinco lentes: (a) conceito de experimento, (b) singularidade, (c) racionalidade limitada, (d) contexto em que a experimentação é utilizada e (e) métricas para aferição da experimentação. Diante das lentes de análise apresentadas, em avaliação aos artigos mais relevantes ao tema, suscita-se ter uma pesquisa que reconheça a singularidade e a racionalidade limitada do empreendedor, considerando a importância destes fatores frente aos desafios enfrentados no desenvolvimento de modelos de negócio em ambientes incertos. Como implicação prática desta pesquisa, é sugerida uma agenda de pesquisa integrada para pesquisas futuras sobre o modelo de negócios e experimentação com base na compreensão derivada do conceito e seus fluxos de pesquisa atuais.

Palavras-chave: Experimentação*;* Inovação dos Modelos de Negócios; *Startup*; Empreendedorismo.

DOI: 10.53706/gep.v.23.6873

RESUMEN

Este artículo tiene como objetivo identificar oportunidades de investigación relacionadas con la experimentación en el desarrollo de modelos de negocio. Para ello se utilizó el método Proknow-C. La selección del portafolio resultó en una muestra de 25 artículos relevantes sobre el tema, analizados bajo cinco lentes: (a) concepto de experimento, (b) singularidad, (c) racionalidad limitada, (d) contexto en el que se utiliza la experimentación y (e) métricas para medir la experimentación. A la vista de los lentes de análisis presentados, en la evaluación de los artículos más relevantes a la temática, se sugiere contar con una investigación que reconozca la singularidad y la limitada racionalidad del emprendedor, considerando la importancia de estos factores frente a los desafíos enfrentados en el desarrollo de modelos de negocio en entornos incierto. Como implicación práctica, se sugiere una agenda de investigación integrada para futuras investigaciones sobre el modelo de negocio y la experimentación basada en la comprensión derivada del concepto y sus flujos de investigación actuales.

Palabras clave: Experimentación; Innovación del modelo de negocio; *Startup*; Emprendimiento.

1 INTRODUCTION

In an increasingly uncertain market, business model innovation is of paramount importance for the survival of organizations. The experimentation process can help the entrepreneur to learn and therefore understand viable business opportunities (Andries et al. 2013, Danielsen and Parhankangas 2019, Leifer et al. 2000, Rice et al. 2008). For this research, experimentation will be understood as a process that generates learning through tests (Chesbrough 2010), helping the entrepreneur in creating or adding value to the organization's products and/or services in uncertain environments (Veilleux et al. 2018, Zott et al. 2011).

In order to advance in this line of knowledge, this paper aims to identify research opportunities related to experimentation from the scientific literature. For this, the authors used the methodology Proknow-C (Knowledge Development Process - Constructivist) which is divided into bibliographic portfolio selection, bibliometrics and systemic analysis that was performed from January 2019 to July 2019.

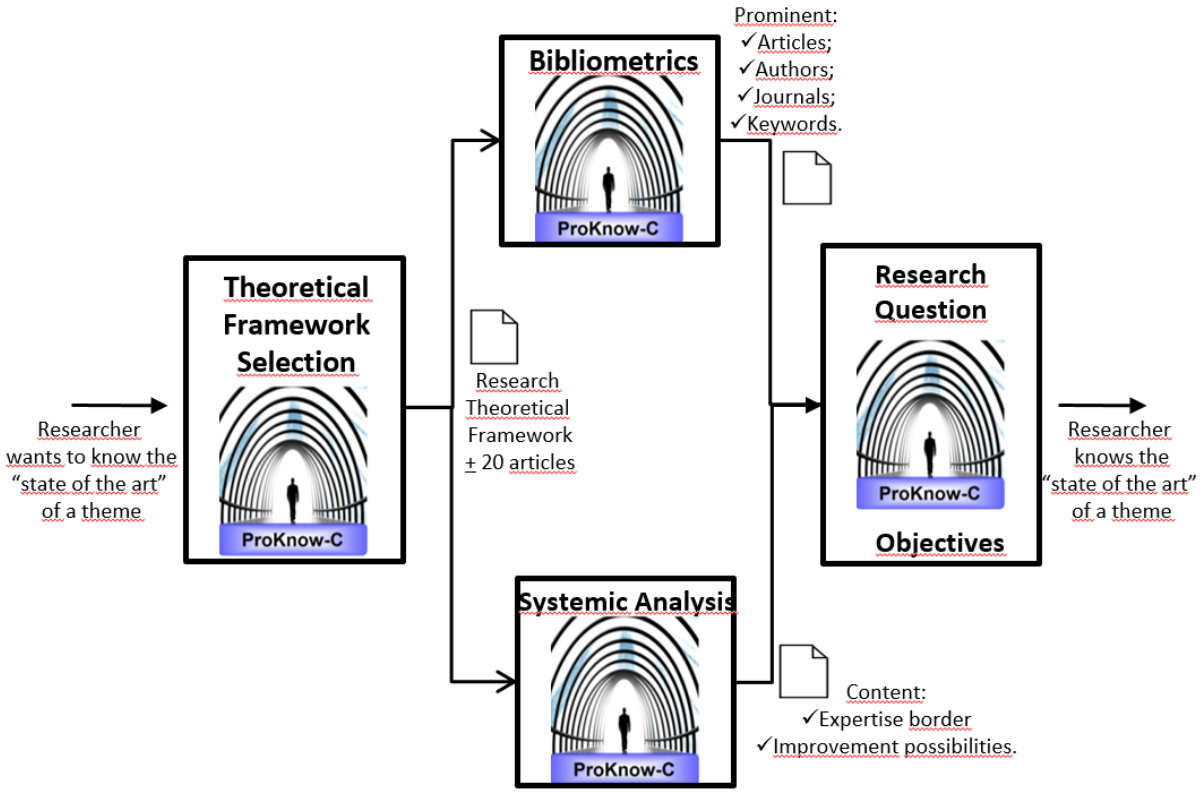
In the first stage of Proknow-C, 29 articles were selected to compose the bibliographic portfolio representative of the theme experimentation in business models. The second step developed was bibliometrics when the “data analysis of articles in the bibliographic portfolio” was performed (Calvetti et al. 2019). The third stage of the Proknow-C methodology is the systemic analysis of the articles in the bibliographic portfolio. At this stage, the articles were analyzed under five lenses: (i) concept of experiment; (ii) singularity; (iii) limited rationality; (iv) context in which experimentation is used; (v) metrics for the measurement of experimentation.

This paper is divided into 5 sessions. The first session will demonstrate the methodological procedures, the second session will present the selection of the bibliographic portfolio, the next session will present the bibliometrics, the subsequent session will present the systemic analysis, where the research lenses and opportunities will be presented and in the last session the limitations of the research will be presented.

2 METHODOLOGICAL PROCEDURES

The ProKnow-C instrument is a constructivist process for identifying research opportunities (Lacerda et al. 2012, Lacerda et al. 2016), it was developed by researchers from LabMCDA (Laboratory of Multicriteria Decision Support Methodologies of the Federal University of Santa Catarina) (Azevedo et al. 2013, Ensslin et al. 2013). The process is divided into four steps as shown in Figure 1.

Figure 1 - Proknow-C Steps



Source: adapted from L. Ensslin et al. (2010).

The first step is the selection of a bibliographic portfolio that is representative in the research theme (Lacerda et al. 2009). In this research the selection was made in the research field of business model experimentation. The second step is bibliometrics, which is a quantitative and statistical technique used to measure the indexes of production and dissemination of scientific production (Braga 1987), thus highlighting the articles, authors, and periodicals.

The third step is the systemic analysis that consists of the content analysis of the bibliographic portfolio. This analysis takes place through epistemological lenses derived from the concepts that are the focus of the research (Lacerda et al. 2018). Systemic analysis results in the demonstration of research opportunities by shutting down Proknow-C. The fourth step of the method will not be developed in this research.

2.1 Selection of the bibliographical portfolio

The selection of the theoretical framework begins with the selection of the words that make up the research axes: (a) axis 1 "experimentation" and (b) axis 2 "entrepreneurship". Based on these axes the keywords were chosen for axis 1 *(a) heuristic, (b) effectuation, (c)lean startup, (d) circular business, (e) uncertainty, (f) fail*, (g) experiment*, (h) strategic legitimation (i) business mode**, and for axis 2: *(a) new venture, (b) small and medium enterprise, (c)*m* *(d) startup e (e) new company*.

The asterisk was used at the end of some words to broaden the search for words that might appear with slight variations. Keywords from Axis 1 were related to keywords from Axis 2 under the "and" criterion.

From these combinations came 45 combinations that were entered into the Scopus database. These searches resulted in a total of 9195 articles.

The database returned a total of 5200 unrepeated articles. By reading the titles, 5077 were excluded, as they were different from the purpose of the research. Thus, 123 articles had the title aligned with the research theme. The Google Scholar site obtained the number of citations from each of the 123 articles, which were transposed into a spreadsheet that was organized in descending order to apply the Pareto Diagram. In the diagram 25 articles obtained 80.52% of citations, thus these were already selected for the next step of the process. After reading the abstracts to verify alignment with the theme, 22 articles remained in the K repository.

The 98 articles that obtained 19.48% of citations underwent a new phase in which the articles that had more than two years since the date of publication were separated, which totaled 55 articles that had authors matched with the authors found in the first phase. Of the 22 articles in the K repository, only 1 article had a common author, so it was incorporated into the K repository, while the remaining 54 articles were definitively discarded. Of the 98 articles that obtained 19.48% of citations, 43 articles were published less than two years ago, after reading their abstracts, only 4 articles were aligned with the research theme.

The final stage of portfolio selection involves the complete reading of the 27 articles to verify alignment with the research theme.

The selection of the bibliographic portfolio with 29 articles was completed, as shown in table 1, including the inclusion of 4 articles published in the years 2020 and 2021, to keep the portfolio up to date, when this paper was published.

Table 1 - Articles from the bibliographic portfolio

PORTFÓLIO BIBLIOGRÁFICO	
1	Aldrich, H. E. and T. Yang (2014). "How do entrepreneurs know what to do? learning and organizing in new ventures." Journal of Evolutionary Economics 24(1): 59-82.
2	Andries, P., et al. (2013). "Simultaneous experimentation as a learning strategy: Business model development under uncertainty." Strategic Entrepreneurship Journal 7(4): 288-310.
3	Baldassarre, B., et al. (2017). "Bridging sustainable business model innovation and user-driven innovation: A process for sustainable value proposition design." Journal of Cleaner Production 147: 175-186.
4	Balocco, R., et al. (2019). "Lean business models change process in digital entrepreneurship." Business Process Management Journal.
5	Bocken, N. M. P., et al. (2017). "Business model experimentation for circularity: Driving sustainability in a large international clothing retailer." Economics and Policy of Energy and the Environment 2017(1): 85-122.
6	Bocken, N. M. P., et al. (2018). "Experimenting with a circular business model: Lessons from eight cases." Environmental Innovation and Societal Transitions 28: 79-95.
7	Bojovic, N., et al. (2018). "Learning, signaling, and convincing: The role of experimentation in the business modeling process." Long Range Planning 51(1): 141-157.
8	Breuer, H. (2013). "Lean venturing: Learning to create new business through exploration, elaboration, evaluation, experimentation, and evolution." International Journal of Innovation Management 17(03): 1340013.
9	Chandler, G. N., et al. (2011). "Causation and effectuation processes: A validation study." Journal of Business Venturing 26(3): 375-390.
10	Cosenz, F. and G. Noto (2018). "A dynamic business modelling approach to design and experiment new business venture strategies." Long Range Planning 51(1): 127-140.

11	Deligianni, I., et al. (2017). "Do Effectuation Processes Shape the Relationship Between Product Diversification and Performance in New Ventures?" Entrepreneurship: Theory and Practice 41(3): 349-377.
12	Ganguly, A. and J. Euchner (2018). "Conducting Business Experiments: Validating New Business ModelsWell-designed business experiments can help validate assumptions and reduce risk associated with new business models." Research Technology Management 61(2): 27-36.
13	Guo, H., et al. (2016). "Business model innovation: The effects of exploratory orientation, opportunity recognition, and entrepreneurial bricolage in an emerging economy." Asia Pacific Journal of Management 33(2): 533-549.
14	Guo, H., et al. (2017). "Opportunity recognition and SME performance: the mediating effect of business model innovation." R and D Management 47(3): 431-442.
15	Guo, R., et al. (2016). "Effectuation and causation in new internet venture growth: The mediating effect of resource bundling strategy." Internet Research 26(2): 460-483.
16	Kerr, W. R., et al. (2014). "Entrepreneurship as experimentation." Journal of Economic Perspectives 28(3): 25-48.
17	Li, Y., et al. (2011). "Fast adaptation, strategic flexibility, and entrepreneurial roles." Chinese Management Studies 5(3): 256-271.
18	Maine, E., et al. (2015). "The role of entrepreneurial decision-making in opportunity creation and recognition." Technovation 39-40(1): 53-72.
19	Mansoori, Y. and M. Lackéus (2019). "Comparing effectuation to discovery-driven planning, prescriptive entrepreneurship, business planning, lean startup, and design thinking." Small Business Economics.
20	Patel, P. C., et al. (2015). "Entrepreneurial orientation-as-experimentation and firm performance: The enabling role of absorptive capacity." Strategic Management Journal 36(11): 1739-1749.
21	Reymen, I. M. M. J., et al. (2015). "Understanding Dynamics of Strategic Decision Making in Venture Creation: A Process Study of Effectuation and Causation." Strategic Entrepreneurship Journal 9(4): 351-379.
22	Reymen, I., et al. (2017). "Decision making for business model development: a process study of effectuation and causation in new technology-based ventures." R and D Management 47(4): 595-606.
23	Roach, D. C., et al. (2016). "Effectuation, innovation and performance in SMEs: an empirical study." European Journal of Innovation Management 19(2): 214-238.
24	Trimi, S. and J. Berbegal-Mirabent (2012). "Business model innovation in entrepreneurship." International Entrepreneurship and Management Journal 8(4): 449-465.
25	Weissbrod, I. and N. M. Bocken (2017). "Developing sustainable business experimentation capability–a case study." Journal of Cleaner Production 142: 2663-2676.
26	Shepherd, D. A., & Gruber, M. (2021). The lean startup framework: Closing the academic–practitioner divide. Entrepreneurship Theory and Practice, 45(5), 967-998.
27	Konietzko, J., Baldassarre, B., Brown, P., Bocken, N., & Hultink, E. J. (2020). Circular business model experimentation: Demystifying assumptions. *Journal of cleaner production*, 277, 122596.
28	Hampel, C., Perkmann, M., & Phillips, N. (2020). Beyond the lean start-up: experimentation in corporate entrepreneurship and innovation. *Innovation*, 22(1), 1-11.
29	Baldassarre, B., Konietzko, J., Brown, P., Calabretta, G., Bocken, N., Karpen, I. O., & Hultink, E. J. (2020). Addressing the design-implementation gap of sustainable business models by prototyping: A tool for planning and executing small-scale pilots. *Journal of Cleaner Production*, 255, 120295.

Source: authors.

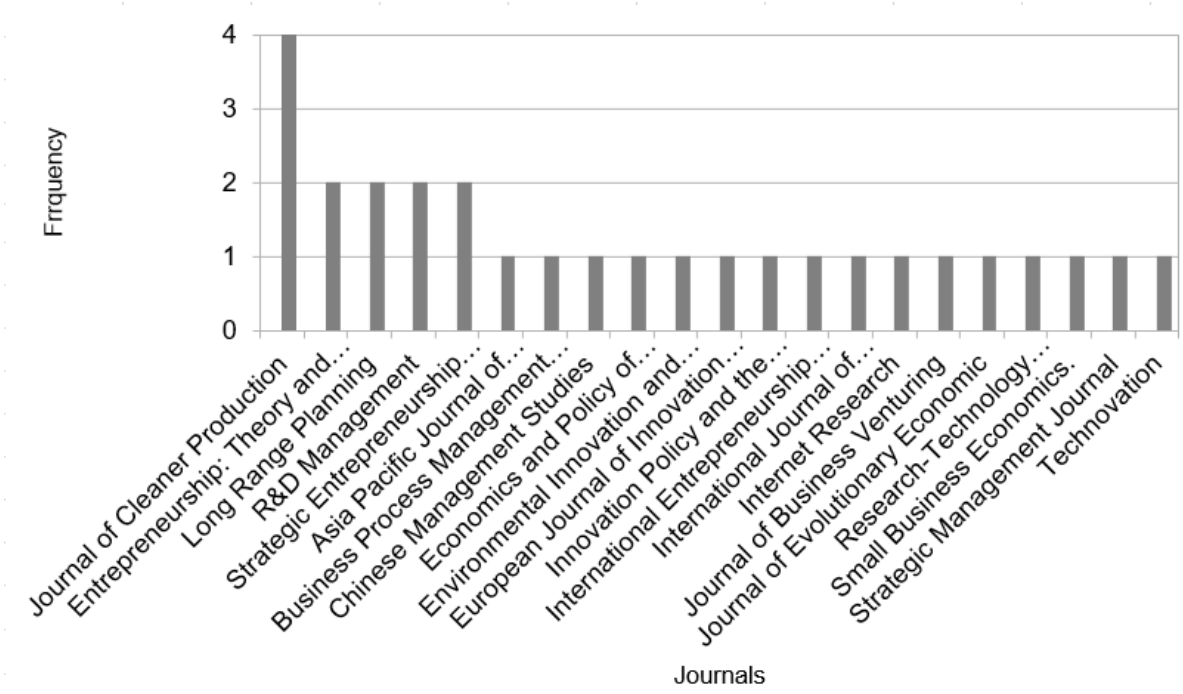
2.2 Bibliometric

In bibliometrics, a data analysis of 29 articles from the bibliographic portfolio was performed.

2.2.1 Portfolio Bibliometric Analysis

Four featured journals appear in the portfolio: (a) *Journal of Cleaner Production*, (b) *Long Range Planning, (c) RandD Management, (d) Strategic Entrepreneurship Journal and (e) Entrepreneurship: Theory and Practice*, according to figure 2.

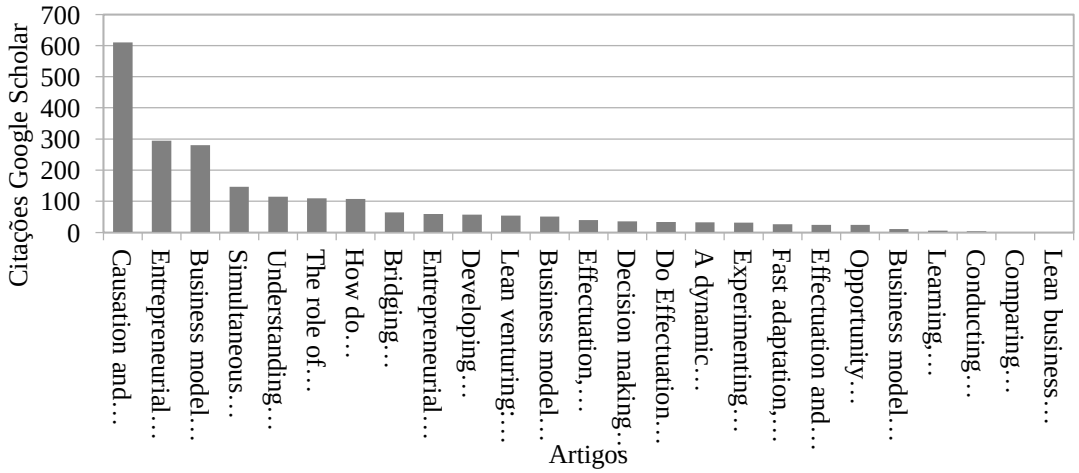
Figure 2 - Frequency of journals in articles in the bibliographic portfolio.



Source: authors.

The most cited article, (a) Chandler, G. N., et al. (2011). "Causation and effectuation processes: A validation study." Journal of Business Venturing 26 (3): 375-390; with 610 citations; has significant relevance compared to other articles in the bibliographic portfolio. The second and third most cited articles (b) Kerr, W. R., et al. (2014). "Entrepreneurship as experimentation." Journal of Economic Perspectives 28 (3): 25-48; (c) Trimi, S. and J. Berbegal-Mirabent (2012). "Business model innovation in entrepreneurship." International Entrepreneurship and Management Journal 8 (4): 449-465; with 295 and 280 citations respectively, according to figure 3.

Figure 3 - Representativeness of articles in the bibliographic portfolio



Source: authors.

In the next step, it was verified the relevance of the authors of the bibliographic portfolio, in which one author presented greater representation, being one of the authors in four articles in the portfolio:

- Nancy M. P. Bocken author in four articles in the bibliographic portfolio:

(A) Baldassarre, B., Calabretta, G., Bocken, N. M. P., and Jaskiewicz, T. (2017). *Bridging sustainable business model innovation and user-driven innovation: A process for sustainable value proposition design. Journal of Cleaner Production, 147*, 175-186.

(B) Bocken, N. M., Miller, K., Weissbrod, I., Holgado, M., and Evans, S. (2017). *Business model experimentation for circularity: Driving sustainability in a large international clothing retailer. Economics and Policy of Energy and the Environment;"*

(C) Bocken, N. M., Schuit, C. S., and Kraaijenhagen, C. (2018). *Experimenting with a circular business model: Lessons from eight cases*. *Environmental innovation and societal transitions, 28*, 79-95;"

(D) Weissbrod, I., and Bocken, N. M. P. (2017). *Developing sustainable business experimentation capability* – A case study. *Journal of Cleaner Production, 142*, 2663-2676;"

3 SYSTEMIC ANALYSIS

The systemic analysis is the process by which researchers analyze the articles in the bibliographic portfolio using research lenses in order to identify theoretical gaps (Marafon et al. 2012, Marafon et al. 2015) on the subject of business model experimentation.

This section presents the result of the analysis performed on each of the 29 scientific articles that participate in the bibliographic portfolio considering the following analysis lenses: (i) Concept of Experiment; (ii) singularity; (iii) Limited Rationality; (iv) Context in which experimentation is used; and, (v) Metrics to measure experimentation.

3.1 Analysis Lens 1: Experiment Concept

The literature on experimentation is still scarce, so there is no consensus in the literature on the concept of experiments (Frederiksen and Brem 2017). It is possible to observe in the 29 articles, which participate in the bibliographic portfolio, that the definitions of experimentation permeate three aspects: “what is”, “how it is done” and “what it is used for”.

3.1.1 What is experimentation?

In the definition of what is an experiment one can observe in the articles of the bibliographic portfolio some distinctions and thus fit them into two categories. In the first category, experimentation is understood as a **tool** for the selection of entrepreneurial opportunities that enable the entrepreneur to test various business models for the most viable. As it can be seen in the work of Aldrich and Yang (2014), Andries et al. (2013), Baldassarre et al. (2017), Baldassarre et al. (2020), Bocken et al. (2017), Bocken et al. (2018), Bojovic et al. (2018), Cosenz and Noto (2018), Ganguly and Euchner (2018), Hai Guo et al. (2016), Hampel et al. (2020), Guo et al. (2017), Kerr et al. (2014), Konietzko et al. (2020), Mansoori and Lackéus (2019), Trimi and Berbegal-Mirabent (2012) and Weissbrod and Bocken (2017). Share this view too Balocco et al. (2019), Chandler et al. (2011), Deligianni et al. (2017), Shepherd et al. (2021) and Reymen et al. (2017) address this concept as a key feature of experimentation in developing business models.

The second category of articles understands experimentation as a **capacity** for the development of innovation in uncertain environments because through the processes of experimentation the organization's chances of long-term survival are enhanced. This category includes the works of Runping Guo et al. (2016), Li et al. (2011), Maine et al. (2015), Patel et al. (2015) and Roach et al. (2016).

3.1.2 How is experimentation done?

Still regarding the concept of experimentation 16 portfolio articles present “how” the experimentation processes are performed: Andries et al. (2013), Baldassarre et al. (2017), Baldassarre et al. (2020), Bocken et al. (2017), Bocken et al. (2018), Bojovic et al. (2018), Breuer (2013), Cosenz and Noto (2018), Ganguly and Euchner (2018), Hampel et al. (2020), Kerr et al. (2014), Konietzko et al. (2020), Roach et al. (2016), Trimi and Berbegal-Mirabent (2012) and Weissbrod and Bocken (2017). Maine et al. (2015) argue that experimentation is carried out through small structured tests based on limited resources to generate learning, as well as Balocco et al. (2019), Chandler et al. (2011), Deligianni et al. (2017), Shepherd et al. (2021), Reymen et al. (2017) and Reymen et al. (2015).

In this view, experiments are specifically designed to provide validated knowledge about a new product or service through close and constant interactions with current and potential customers and used to validate or pivot key assumptions of the venture. However, the literature does not address important questions of how experimentation is operationalized. How does the entrepreneur define his hypotheses for testing? What resources are required for such activity? What is the goal to be pursued in experimentation? How learning is measured? Such questions raise important research gaps that have yet to be clarified in future research.

3.1.3 What is experimentation for?

Value is the essence of organizations, so creating a business model begins with defining a value proposition, but this definition is not easy in uncertain environments (Bocken et al. 2017). In this way, an auxiliary or entrepreneurial experimentation experiences various business models quickly and systematically (Andries et al. 2013).

In this sense, 13 articles support the idea that experimentation should be used for entrepreneur learning, helping to select their business model more systematically and reliably, reducing uncertainty in the value proposition. These works are: Andries et al. (2013), Baldassarre et al. (2017), Baldassarre et al. (2020), Bocken et al. (2017), Bocken et al. (2018), Bojovic et al. (2018), Breuer (2013), Deligianni et al. (2017), Ganguly and Euchner (2018), Guo et al. (2016), Guo et al. (2017), Konietzko et al. (2020), Mansoori and Lackéus (2019), Shepherd et al. (2021), Runping Guo et al. (2016) and Weissbrod and Bocken (2017).

However, Chandler et al. (2011), Li et al. (2011) and Patel et al. (2015) address experimentation as an enterprise's ability to reorganize in the face of changes in context and limited resources using the strategic flexibility. In this view, the works of Maine et al. (2015), Hampel et al. (2020), Reymen et al. (2015) and Balocco et al. (2019) approach experimentation as a process of shaping business opportunities from limited resources.

Thus, there was an opportunity for research in the analysis of this lens, because there is a need for an integrative concept or a more complete conceptualization of what is the experimentation process, and especially how it is performed in startups.

Experimentation with the organization's business model can imply changes in various processes, activities, and resources that are linked to value creation, delivery, and capture (Andries et al. 2013, Baldassarre et al. 2017). However, according to some articles in the portfolio, experimentation is structured on the components of the business model and, because there is no consensus on these components, there is no clarity regarding the processes that can be tried and therefore there is an opportunity to search.

3.2 Analysis Lens 2: Singularity

Regarding the perspective of singularity analysis, the 29 articles in the bibliographic portfolio can be divided into three categories, as shown in table 2.

The first category has identified articles in which the authors believe that the entrepreneur is the central point of the choice of business models. The choice of business model will be made by the entrepreneur based on his preferences, beliefs, persistence, and goals, the entrepreneur can pivot models that do not meet their requirements and follow the one that suits them (Andries et al. 2013), so the choices are unique, and therefore each business is singular. This category includes works by Aldrich and Yang (2014), Andries et al. (2013), Bocken et al. (2018), Bojovic et al. (2018), Cosenz and Noto (2018), Ganguly and Euchner (2018), Kerr et al. (2014), Konietzko et al. (2020), Maine et al. (2015), Reymen et al. (2015), Shepherd et al. (2021), Trimi and Berbegal-Mirabent (2012) and Weissbrod and Bocken (2017),

In the second category of articles, the authors agree that there is no way for an entrepreneur to formulate business models by comparing or reproducing other cases of companies already established in the

market, because each venture is an idiosyncratic effort that generates unique elements of a singular structure (Breuer, 2013) for which there is no standard measure (Li et al. 2011). The articles of Mansoori and Lackéus (2019), Chandler et al. (2011), Runping Guo et al. (2016), Deligianni et al. (2017) and Balocco et al. (2019) also converge on this view.

The third category encompasses articles that claim that innovation produces unprecedented applications for existing resources (Roach et al. 2016), improvement opportunities leading to market transformation or disruption (Bocken et al. 2017), therefore the singularity comes from innovation, as in Baldassarre et al. (2017), Roach et al. (2016), Bocken et al. (2017), Guo et al. (2016), Hampel et al. (2020), Guo et al. (2017) and Patel et al. (2015).

Table 2 - Singularity Lens

What makes the singularity present?	**Authors**
Entrepreneur decisions	Aldrich and Yang (2014) Andries et al. (2013) Baldassarre et al. (2020) Bocken et al. (2018) Bojovic et al. (2018) Cosenz and Noto (2018) Ganguly and Euchner (2018) Kerr et al. (2014) Konietzko et al. (2020) Maine et al. al. (2015) Reymen et al. (2015) Shepherd et al. (2021) Trimi and Berbegal-Mirabent (2012) Weissbrod and Bocken (2017).
Impossibility of comparison	Balocco et al. (2019) Breuer (2013) Chandler et al. (2011) Deligianni et al. (2017) Runping Guo et al. (2016) Li et al. (2011) Mansoori and Lackéus (2019),
Resource application innovation	Baldassarre et al. (2017) Bocken et al. (2017) Bocken et al. (2017) Guo et al. (2016) Guo et al. (2017) Hampel et al. (2020) Patel et al. (2015) Roach et al. (2016) Roach et al. (2016)

Source: authors.

In the literature it is evident the recognition of the singularity of business models, so there is no management standard to follow, each entrepreneur will manage the experimentation according to their choices and preferences. Therefore, other experiences, successes, and failures of other companies may enrich the entrepreneur's knowledge, but they cannot be used as a comparative for a new venture.

3.3 Analysis Lens 3: Limited Rationality

The articles in the bibliographic portfolio can be organized into two categories, according to the researchers' understanding, regarding the entrepreneur's limited rationality. The first category consists of articles in which the authors understand that the existence of limited rationality comes from uncertainty, while the second category observes the unpredictability of the business model as a determinant of limited rationality. Table 3 presents the lens rationality limited schematically.

Table 3 - Limited Rationality Lens

What determines limited rationality?	Authors
Uncertainty	Balocco et al. (2019) Breuer (2013) Deligianni et al. (2017) Konietzko et al. (2020) Maine et al. (2015) Mansoori and Lackéus (2019) Reymen et al. (2015) Reymen et al. (2017) Roach et al. (2016) Shepherd et al. (2021)
Business model unpredictability	Aldrich and Yang (2014) Andries et al. (2013) Baldassarre et al. (2017) Baldassarre et al. (2020) Bocken et al. (2017) Bocken et al. (2018) Bojovic et al. (2018) Chandler et al. (2011) Cosenz and Noto (2018) Ganguly and Euchner (2018) Guo et al. (2016) Guo et al. (2017) Hampel et al. (2020) Kerr et al. (2014) Li et al. (2011) Runping Guo et al. (2016) Trimi and Berbegal-Mirabent (2012) Weissbrod and Bocken (2017)

Source: authors.

The first approach refers to market, customer, and government uncertainty that through their financing, preferences, and regulations interfere with market dynamics making it unpredictable. In this context, the innovations exploited by the entrepreneur are opportunities and concomitantly risks (Bocken et al. 2017). Predicting the future of the market is difficult as generally known information is incomplete, volatile, there is a high degree of uncertainty (Kerr et al. 2014) and development strategies do not have their future defined (Bocken et al. 2017).

The entrepreneur facing the uncertain market is unaware of all the variables that may interfere with the success or failure of his business, so until the entrepreneur has effectively invested in a business it is unlikely to know if he will be successful. The works of Balocco et al. (2019), Breuer (2013), Deligianni et al. (2017), Maine et al. (2015), Mansoori and Lackéus (2019), Reymen et al. (2015), Shepherd et al. (2021), Reymen et al. (2017) and Roach et al. (2016) share this view,

The second approach of this lens highlights the unpredictability in business model selection, because even if the entrepreneur can glimpse a large number of business models, knowing which one is feasible is very difficult, the articles by Aldrich and Yang (2014), Andries et al. (2013), Baldassarre et al. (2017), Baldassarre et al. (2020), Bocken et al. (2017), Bocken et al. (2018), Bojovic et al. (2018), Chandler et al. (2011), Cosenz and Noto (2018), Ganguly and Euchner (2018), Guo et al. (2016), Guo et al. (2017), Hampel et al. (2020), Kerr et al. (2014), Li et al. (2011), Runping Guo et al. (2016), Trimi and Berbegal-Mirabent (2012) and Weissbrod and Bocken (2017) fit this view.

An opportunity for research envisioned by researchers was to deepen the understanding of the context in which a technology-based startup is inserted, because in the literature there is information about the uncertainty and unpredictability of the business model, but there is not much information regarding the variables that interfere with startups' business models.

3.4 Analysis lens 4: Context in which experimentation is used

Traditional planning does not meet the fast decisions that the dynamic market demands, so in environments of uncertainty, experimentation and business model redefinition will result in greater entrepreneur effectiveness (Sarasvathy 2009). The entrepreneur faces unpredictable scenarios in which decision making becomes complex due to the lack of knowledge of the variables that may influence the success or failure of the business in the future. Within a realization logic, the entrepreneur may use experimentation to discover future information or trends in an environment of unpredictable phenomena making the process less expensive and more adapted to market needs (Fisher 2012).

Innovation companies face a market of uncertainty, especially technology-based startups that tend to thrive in dynamic environments (Trimi and Berbegal-Mirabent 2012). In these types of markets, marketing new ideas has very high associated risk (Kerr et al., 2014) and choosing the right time and the right strategy for a product or service is of paramount importance (Trimi and Berbegal-Mirabent, 2012).

Uncertainty arising from innovation in the business model may arise from the need to use new channels, new partnerships, new technologies or to gain a new customer niche (Ganguly and Euchner, 2018). Understanding the market will only emerge when entrepreneurial activities result in business development, so previous experimenting with business models seems indispensable in uncertain environments (Andries et al., 2013).

There is unanimity among the authors regarding the need for the entrepreneur to use experimentation in a context of uncertainty. The biggest challenge in managing uncertainty, to any degree, is finding the balance between planning and learning, entrepreneurs must be flexible to take the right approaches at the right time (De Meyer, Loch, and Pich, 2002). Faced with the scenario of uncertainty, it is observed as a research opportunity to

verify how entrepreneurs perceive uncertainty and how they manage it. Another research opportunity is the possibility of using experimentation as a context transformation tool.

3.5 Analysis Lens 5: Metrics for Measuring Experiments

The entrepreneurs must be clear about their objectives and limitations with the experiments before starting them, to know when to finish the experiment, learn the lessons from the failures that have elapsed and start the next one, or make the necessary contributions to include the experiment as a routine (Chesbrough, 2010).

The manager uses a structure to identify, understand and map the needs and interests of clients accumulating knowledge to form the value proposition appropriate to their company (Baldassarre et al., 2017). Experimentation is composed of iterative processes and requires regular controls (Bocken et al., 2017). The literature provides guidelines, but there is no clarity on how these controls should be performed (Andries et al., 2013).

The portfolio articles mention the creation of quantitative and qualitative indicators in six articles Weissbrod and Bocken (2017), Breuer (2013), Bocken et al. (2017), Bocken et al. (2018), Trimi and Berbegal-Mirabent (2012), Maine et al. (2015), Ganguly and Euchner (2018), Konietzko et al. (2020), Chandler et al. (2011), Baldassarre et al. (2020), Shepherd et al. (2021), Balocco et al. (2019), Hampel et al. (2020), and Deligianni et al. (2017). Although articles talk about indicators there is no information on how to create them by creating a research opportunity.

Some entrepreneurs select a business model too early and keep the experiments in the hope that the model will become viable (Andries et al., 2013). However, there is a research opportunity, as there is no indication of when the entrepreneur should end the experiment.

Creating a value proposition may require several iterations between product and market so that over time the entrepreneur can choose the best business model that will add the most economic value (Baldassarre et al., 2017). In this sense, an important guideline incorporated in the literature is the reduced investment experiments that recur in four articles Andries et al. (2013), Bocken et al. (2017), and Ganguly and Euchner (2018). There is evidence in the literature that experiments should have their cost reduced, however, there is no development of this topic demonstrating a research opportunity.

In the articles of Guo et al. (2016), Guo et al. (2017), Li et al. (2011), Mansoori and Lackéus (2019), Patel et al. (2015), Baldassarre et al (2017), Bojovic et al. (2018), Aldrich and Yang (2014), Kerr et al. (2014), Cosenz and Noto (2018), Roach et al. (2016), Runping Guo et al. (2016), Reymen et al. (2015) and Reymen et al. (2017) there is no mention regarding the use of metrics to measure the experiment.

Table 4 - Lens Metrics for measuring the experiment

There is information about the need for indicators?	Authors
Yes	Baldassarre et al. (2020) Balocco et al. (2019) Bocken et al. (2017) Bocken et al. (2018) Breuer (2013) Chandler et al. (2011) Deligianni et al. (2017) Ganguly and Euchner (2018) Hampel et al. (2020) Konietzko et al. (2020) Maine et al. (2015) Shepherd et al. (2021) Trimi and Berbegal-Mirabent (2012) Weissbrod and Bocken (2017)
No	Aldrich and Yang (2014) Baldassarre et al. (2017) Bojovic et al. (2018) Cosenz and Noto (2018) Guo et al. (2016) Guo et al. (2017) Kerr et al. (2014) Li et al. (2011) Mansoori and Lackéus (2019) Patel et al. (2015) Reymen et al. (2015) Reymen et al. (2017) Roach et al. (2016) Runping Guo et al. (2016)

Source: authors.

It is evident the opportunity of research regarding the measurement metrics of experiments, seeking to understand if any type of control is performed at the time of experimentation, and how the measurement indicators are defined.

4 FINAL CONSIDERATIONS AND RESEARCH OPPORTUNITIES

The experimentation process becomes a useful tool for discovery by trial, error, learning, and adaptation (Chesbrough, 2010). Throughout the experimentation processes, the entrepreneur will gain knowledge that will reduce the uncertainty regarding the assumptions underlying the business model (Andries et al., 2013).

Thus, the aim of this paper was to identify research opportunities related to experimentation from the scientific literature. In this intent, a systemic analysis of the selected bibliographic portfolio was performed using the Proknow-C method. The selection of the portfolio resulted in a sample of 29 relevant articles on the subject. In the systemic analysis, the articles in the portfolio were analyzed under five lenses: (a) concept of experiment,

(b) uniqueness, (c) limited rationality, (d) context in which experimentation is used and (e) metrics to measure experimentation.

Given the analysis lens presented, in the evaluation of the most relevant articles on the subject, it is necessary to have a research that recognizes the uniqueness and limited rationality of the entrepreneur, considering the importance of recognizing these factors in face of the challenges in the development of business models in uncertain environments.

The literature advocates that entrepreneurs innovate their business model, but there is no clarity on how this should be done (Andries et al., 2013). The entrepreneur's commitment to experimentation is not about a lack of awareness on the viability of the business model, it is a deliberate choice given the large number of variables that an uncertain market presents (Andries et al., 2013). The variables may come from various actors: customers, competitors, government, investors, suppliers, among others, as well as environmental factors (Trimi and Berbegal-Mirabent, 2012).

Still based on the lens, it is noteworthy the opportunity for research regarding the measurement metrics of experiments, seeking to understand if any type of control is performed at the time of experimentation, and how the measurement indicators are defined. For further details, from the systemic analysis of related articles in the bibliographic portfolio, Table 5 presents the research opportunities based on each analysis lens.

Table 5 - Research Opportunities

LENS	RESEARCH OPPORTUNITIES
Experiment Concept	• To develop of an integrative concept; • To analyze if planning tools can be combined with experimentation; • To understand if experimentation is a simultaneous business process, and therefore cyclical or temporary; • To define the processes that can be experienced.
Singularity	• To verify if the uniqueness can result from the application of new features;
Limited Rationality	• To deepen knowledge of the variables that interfere with the startups' business model;
The context in which experimentation is used	• To investigate how entrepreneurs, perceive uncertainty and manage it; • To assess whether experimentation can change the context in which it is inserted.
Metrics for experimentation measurement	• To understand how experiment controls can be performed; • To understand how indicators are built; • To investigate when the entrepreneur should end the experiment. • To understanding how much resource the entrepreneur has for experiments.

Source: authors.

It is noteworthy as a limitation of this research that the bibliographic portfolio is not exhaustive, therefore, the selection of articles resulting from the first stage of Proknow-C does not represent the state of the art of the theme, but a significant sample of relevant articles on model experimentation of business. The coding of the research was performed by only one researcher, the senior researcher focused on the review and was, therefore, an interpretive coding.

Acknowledgments

This article was written with financial support from CNPq (National Council for Scientific and Technological Development) through the Technological Development and Innovative Extension Productivity Scholarship - Level 2 and with the support of the Higher Education Personnel Improvement Coordination - Brazil (CAPES) - Financing Code 001.

Artigo submetido para avaliação em 27/10/2020 e aceito para publicação em 27/05/2022

REFERENCES

Aldrich, H. and Yang, T. (2014) 'How do entrepreneurs know what to do? Learning and organizing in new ventures', *Journal of Evolutionary Economics*, 24(1), 59-82.

Andries, P., Debackere, K. and Van Looy, B. (2013) 'Simultaneous experimentation as a learning strategy: Business model development under uncertainty', *Strategic entrepreneurship journal*, 7(4), 288-310.

Azevedo, R. C. d., Ensslin, L., Lacerda, R. T. d. O., França, L. A., Jungles, A. E. and Ensslin, S. R. (2013) 'Model for performance evaluation: application on a budget of a construction work', *Production*, 23(4), 705-722.

Baldassarre, B., Calabretta, G., Bocken, N. and Jaskiewicz, T. (2017) 'Bridging sustainable business model innovation and user-driven innovation: A process for sustainable value proposition design', *Journal of Cleaner Production*, 147, 175-186.

Baldassarre, B., Konietzko, J., Brown, P., Calabretta, G., Bocken, N., Karpen, I. O., & Hultink, E. J. (2020). Addressing the design-implementation gap of sustainable business models by prototyping: A tool for planning and executing small-scale pilots. *Journal of Cleaner Production*, 255, 120295.

Balocco, R., Cavallo, A., Ghezzi, A. and Berbegal-Mirabent, J. (2019) 'Lean business models change process in digital entrepreneurship', *Business Process Management Journal*.

Bocken, N., Miller, K., Weissbrod, I., Holgado, M. and Evans, S. (2017) 'Business model experimentation for circularity: Driving sustainability in a large international clothing retailer', *Economics and Policy of Energy and the Environment*.

Bocken, N., Schuit, C. and Kraaijenhagen, C. (2018) 'Experimenting with a circular business model: Lessons from eight cases', *Environmental innovation and societal transitions*, 28, 79-95.

Bojovic, N., Genet, C. and Sabatier, V. (2018) 'Learning, signaling, and convincing: The role of experimentation in the business modeling process', *Long Range Planning*, 51(1), 141-157.

Braga, G. M. (1987) 'Bibliometria: teoria e prática', *Ciência da Informação*, 16(1).

Breuer, H. (2013) 'Lean venturing: Learning to create new business through exploration, elaboration, evaluation, experimentation, and evolution', *International Journal of Innovation Management*, 17(03), 1340013.

Calvetti, E. S., Lacerda, R. T. d. O. and Bernardes, M. L. (2019) 'A bibliometric study on performance evaluation in agile software development process from the constructivist perspective', *Revista Brasileira de Gestão e Inovação (Brazilian Journal of Management & Innovation)*, 6(3), 1-28.

Chandler, G., DeTienne, D., McKelvie, A. and Mumford, T. (2011) 'Causation and effectuation processes: A validation study', *Journal of business venturing*, 26(3), 375-390.

Chesbrough, H. (2010) 'Business model innovation: opportunities and barriers', *Long Range Planning*, 43(2-3), 354-363.

Cosenz, F. and Noto, G. (2018) 'A dynamic business modelling approach to design and experiment new business venture strategies', *Long Range Planning*, 51(1), 127-140.

Danielsen, A. and Parhankangas, A. (2019) 'Learning and unlearning in firms commercialising product innovations: the short-term performance implications of business model changes', *International Journal of Entrepreneurship and Innovation Management*, 23(1), 72-95.

Deligianni, I., Voudouris, I. and Lioukas, S. (2017) 'Do effectuation processes shape the relationship between product diversification and performance in new ventures?', *Entrepreneurship Theory and Practice*, 41(3), 349-377.

Ensslin, L., Ensslin, S. R. and de Moraes Pinto, H. (2013) 'Processo de investigação e Análise bibliométrica: Avaliação da Qualidade dos Serviços Bancários', *RAC-Revista de Administração Contemporânea*, 17(3), 325-349.

Fisher, G. (2012) 'Effectuation, causation, and bricolage: A behavioral comparison of emerging theories in entrepreneurship research', *Entrepreneurship Theory and Practice*, 36(5), 1019-1051.

Frederiksen, D. L. and Brem, A. (2017) 'How do entrepreneurs think they create value? A scientific reflection of Eric Ries' Lean Startup approach', *International Entrepreneurship and Management Journal*, 13(1), 169-189.

Ganguly, A. and Euchner, J. (2018) 'Conducting Business Experiments: Validating New Business Models Well-designed business experiments can help validate assumptions and reduce risk associated with new business models', *Research-Technology Management*, 61(2), 27-36.

Guo, H., Su, Z. and Ahlstrom, D. (2016) 'Business model innovation: The effects of exploratory orientation, opportunity recognition, and entrepreneurial bricolage in an emerging economy', *Asia Pacific Journal of Management*, 33(2), 533-549.

Guo, H., Tang, J., Su, Z. and Katz, J. A. (2017) 'Opportunity recognition and SME performance: The mediating effect of business model innovation', *R&D Management*, 47(3), 431-442.

Guo, R., Cai, L. and Zhang, W. (2016) 'Effectuation and causation in new internet venture growth: the mediating effect of resource bundling strategy', *Internet Research*, 26(2), 460-483.

Hampel, C., Perkmann, M., & Phillips, N. (2020). Beyond the lean start-up: experimentation in corporate entrepreneurship and innovation. *Innovation*, 22(1), 1-11.

Kerr, W. R., Nanda, R. and Rhodes-Kropf, M. (2014) 'Entrepreneurship as experimentation', *Journal of Economic Perspectives*, 28(3), 25-48.

Konietzko, J., Baldassarre, B., Brown, P., Bocken, N., & Hultink, E. J. (2020). Circular business model experimentation: Demystifying assumptions. *Journal of cleaner production*, 277, 122596.

Lacerda, R. T., Ensslin, L. and Ensslin, S. R. (2009) *A study case about a software project management success metrics*, translated by IEEE, 45-54.

Lacerda, R. T. d. O., de Oliveira, L. V., Bernardes, M. L. and Calvetti, E. S. (2018) 'Research perspectives on performance evaluation and project management', *Revista de Gestão e Secretariado*, 9(2), 96.

Lacerda, R. T. d. O., Ensslin, L. and Ensslin, S. R. (2012) 'Uma análise bibliométrica da literatura sobre estratégia e avaliação de desempenho', *Gestão & Produção*, 19(1).

Lacerda, R. T. d. O., Ensslin, L., Rolim Ensslin, S., Knoff, L. and Martins Dias Junior, C. (2016) 'Research opportunities in business process management and performance measurement from a constructivist view', *Knowledge and Process Management*, 23(1), 18-30.

Leifer, R., McDermott, C. M., O'connor, G. C., Peters, L. S., Rice, M. P. and Veryzer Jr, R. W. (2000) *Radical innovation: How mature companies can outsmart upstarts*, Harvard Business Press.

Li, Y., Su, Z., Liu, Y. and Li, M. (2011) 'Fast adaptation, strategic flexibility and entrepreneurial roles', *Chinese Management Studies*, 5(3), 256-271.

Maine, E., Soh, P.-H. and Dos Santos, N. (2015) 'The role of entrepreneurial decision-making in opportunity creation and recognition', *Technovation*, 39, 53-72.

Mansoori, Y. and Lackéus, M. (2019) 'Comparing effectuation to discovery-driven planning, prescriptive entrepreneurship, business planning, lean startup, and design thinking', *Small Business Economics*, 1-28.

Marafon, A. D., Ensslin, L., Ensslin, S. R. and Lacerda, R. T. (2012) 'Revisão sistêmica da literatura sobre avaliação de desempenho na gestão de P&D', *Revista Gestão Industrial*, 8(3).

Marafon, A. D., Ensslin, L., Lacerda, R. T. d. O. and Ensslin, S. R. (2015) 'The effectiveness of multi-criteria decision aid methodology: A case study of R&D management', *European Journal of Innovation Management*, 18(1), 86-109.

Patel, P. C., Kohtamäki, M., Parida, V. and Wincent, J. (2015) 'Entrepreneurial orientation-as-experimentation and firm performance: The enabling role of absorptive capacity', *Strategic Management Journal*, 36(11), 1739-1749.

Reymen, I., Berends, H., Oudehand, R. and Stultiëns, R. (2017) 'Decision making for business model development: a process study of effectuation and causation in new technology-based ventures', *R&D Management*, 47(4), 595-606.

Rice, M. P., OConnor, G. C. and Pierantozzi, R. (2008) 'Implementing a learning plan to counter project uncertainty', *MIT Sloan Management Review*, 49(2), 54.

Roach, D. C., Ryman, J. A. and Makani, J. (2016) 'Effectuation, innovation and performance in SMEs: an empirical study', *European Journal of Innovation Management*, 19(2), 214-238.

Sarasvathy, S. D. (2009) *Effectuation: Elements of entrepreneurial expertise*, Edward Elgar Publishing.

Shepherd, D. A., & Gruber, M. (2021). The lean startup framework: Closing the academic–practitioner divide. *Entrepreneurship Theory and Practice*, 45(5), 967-998.

Trimi, S. and Berbegal-Mirabent, J. (2012) 'Business model innovation in entrepreneurship', *International Entrepreneurship and Management Journal*, 8(4), 449-465.

Veilleux, S., & Haskell, N. (2018). Opportunity recognition by international high-technology start-up and growth photonics firms. International Journal of Entrepreneurship and Innovation Management, 22(1/2), 126-151.

Weissbrod, I. and Bocken, N. M. (2017) 'Developing sustainable business experimentation capability–A case study', *Journal of Cleaner Production*, 142, 2663-2676.

Zott, C., Amit, R. and Massa, L. (2011) 'The business model: recent developments and future research', *Journal of management*, 37(4), 1019-1042.