

Industries, frameworks, and key drivers of lean startup: a systematic literature review

Sectores, marcos de trabajo y factores clave del lean startup: una revisión sistemática de la literatura

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Abstract: Lean Startup provides an iterative, hypothesis-driven approach to business creation and product development, promoting data-driven decision-making by involving potential users and customers during the development cycle. Despite increased academic attention, the debate on the benefits of Lean Startup is open. To contribute to the understanding of how organisations incorporate Lean Startup principles, this study conducts a systematic literature review and identifies the industries in which its application has been analysed, the adaptation models followed by organisations, and the key drivers for its adoption in new and established organisations. The study's findings contribute to advancing knowledge on the adoption of Lean Startup principles, tools, and techniques in organisations. The results also help to the academic debate surrounding the usefulness and application of Lean Startup principles across different organisational contexts.

Keywords: Lean Startup; innovation; product development; systematic literature review; continuous experimentation.

Resumen: El Lean Startup proporciona un enfoque iterativo y basado en hipótesis para la creación de negocios y el desarrollo de productos, promoviendo la toma de decisiones basada en datos al involucrar a los potenciales usuarios y clientes desde el principio. A pesar del creciente interés académico, la discusión sobre la utilidad y los beneficios del Lean Startup continúa. Con el objetivo de contribuir a la comprensión de cómo las organizaciones incorporan los principios del Lean Startup, se realiza una revisión sistemática de la literatura para identificar los sectores en los que se ha analizado su aplicación, los modelos de adaptación seguidos por las organizaciones, y los factores clave para su adopción en organizaciones establecidas. Estos hallazgos contribuyen a avanzar en el conocimiento sobre la adopción de los principios, herramientas y técnicas del Lean Startup en las organizaciones, y facilitan el progreso en el debate académico en torno a su utilidad y aplicación en diversos contextos organizacionales.

Palabras clave: Lean Startup; Innovación; Desarrollo de producto; Revisión sistemática de la literatura; Experimentación continua.

1. Introduction

In today's context of continuous technological disruptions, the emergence of new global competitors with differential value propositions and business models, not to mention constantly evolving consumer habits (Czinkota et al., 2021; European Commission, 2015), makes it necessary for organisations, both startup and established, to leverage innovation for long-term competitiveness, productivity, and sustainability (Dougherty & Hardy, 1996). In this sense, launching new products and services is of the essence (Cooper & Kleinschmidt, 2011; Di Benedetto, 1999).

However, the success rate of new products and services is very low (Hill et al., 2014; Salnikova et al., 2019; Simon-Kucher & Partners, 2014), leading to high risks, costs, and inefficiencies for organisations. Therefore, organisations require a process that helps identify consumer needs and problems to be solved, and determines the appropriate technology and business strategy solutions (Bohn & Kundisch, 2020).

To address this challenge, the Lean Startup approach (Ries, 2011) develops an iterative, hypothesis-driven method (Blank & Dorf, 2012) for business creation and product development. It involves engaging potential users and customers from the beginning, with minimal upfront planning, facilitating a shift from opinion-based to data-driven decision-making, while enabling adaptive design of products and services in an incremental manner (Bianchi et al., 2020). Lean Startup is based on the principles of Lean Manufacturing and Customer Development (Blank, 2020), and incorporates tools from other theories and methods, such as the Business Model Canvas and the Value Proposition Design approach (Osterwalder et al., 2014; Osterwalder & Pigneur, 2010), agile software development principles (Beck et al., 2001; Dybå & Dingsøyr, 2008), and Design Thinking (Brown, 2008). Thus, Lean Startup promotes the application of the scientific method to business development problem-solving, with validated learning through purposeful experimentation at the core of the methodology, focusing on value creation for customers and users (Ries, 2011, 2017).

Entrepreneurs, academics and organisations have widely applied the Lean Startup approach for its role in fostering innovation and the development of new products and services (Blank, 2013; Blank & Euchner, 2018; Moogk, 2012), gaining significant attention in recent years. Although the approach was initially conceived to support entrepreneurs in validating and innovating their business models through market testing and early customer feedback (Ghezzi & Cavallo, 2020), it is often applied in software-driven companies targeting B2C markets (Harms et al., 2015). Additionally, the approach has been successfully applied to other types of technologies (Sońta-Drączkowska & Mrożewski, 2020) and various contexts, including incubators and entrepreneurship programmes (Mansoori, 2017), food products (Lazo-Durand et al., 2021), retail (Solaimani et al., 2022), sports (Ranaweera et al., 2022) and education (Robb et al., 2020), among others. Furthermore, the application of Lean Startup is not limited to startups; it is also implemented in established organisations of different sizes (Bortolini et al., 2021; Furr & Dyer, 2014; Gaffney et al., 2014; Owens & Fernandez, 2014). Moreover, universities are incorporating Lean Startup principles into their academic curriculum (Youtie & Shapira, 2017).

While Lean Startup has received increasing attention from academia, the discussion regarding its usefulness and benefits in practice is ongoing (N. Bocken & Snihur, 2020). This lack of knowledge about implementation, as pointed out by Mansoori (2017), is reflected in criticisms such as those of Bieraugel (2015), who argues that Lean Startup was not originally designed to be incorporated into established organisations, or the lack of scientific evidence regarding its benefits in large organisations (Edison et al., 2015). On the other hand, authors like Popowska and Nalepa (2015) suggest that manufacturing companies may find it more challenging to follow the methodology due to their higher capital intensity and slower iteration cycles. In addition, Lean Startup might have limited applicability in certain product domains, such as healthcare or aerospace, because it might be too expensive and insecure (Racolța-Paina & Andrieș, 2017).

Thus, the academic progress on Lean Startup is still in its early stages (Leatherbee & Katila, 2020), triggering discussions about its practical application by organisations (Bocken & Snihur, 2020; Felin et al., 2020). To further knowledge in this

area, previous bibliographic analyses related to Lean Startup have been conducted with significant limitations in terms of quality of research materials used due to the topic's novelty. [Bortolini et al. \(2021\)](#) carried out a historical review of academic and professional literature, not only including peer-reviewed papers, but also sources as books, professional journals, and other literature. [Silva et al. \(2020\)](#) conducted a systematic literature review with a small number of references, including scientific articles and conference contributions, so not all publications related to Lean Startup were considered during the selection of works, and no criteria was established to consider its quality. [York and York \(2019\)](#) also used a limited number of references in their literature review, including scientific articles and other non-peer-reviewed documents such as student academic works, blog entries, business publications, or another web content. Finally, [Lizarelli et al. \(2022\)](#) used limited keywords during the literature search, and only in the publication title field of databases, including also conference contributions. Moreover, these contribution works are limited to a very specific aspect of Lean Startup application, as [Bortolini et al. \(2021\)](#) and [York and York \(2019\)](#) pointed out. Because the field is attracting more and more interest by researchers and is therefore evolving very quickly, further efforts are required to provide a comprehensive understanding of the conditions under which Lean Startup can be implemented with better outcomes.

To overcome that gap, we conducted a systematic literature review following the stages suggested by [Tranfield et al. \(2003\)](#) and the guidelines of PRISMA ([Moher et al., 2009](#)) to identify the sectors where Lean Startup application has been analysed, the adaptation models followed by organisations, and the key drivers for successful Lean Startup adoption in established organisations. Accordingly, the following Research Questions (RQ) are proposed in this study:

- RQ1. In which sectors is the application of Lean Startup analysed?
- RQ2. What frameworks do organisations follow to adopt Lean Startup principles?
- RQ3. What are the key drivers for successful Lean Startup adoption in established organisations?

By tackling these research questions, the study contributes to Lean Startup literature in several ways. First, we underscore that Lean Startup is being successfully adopted beyond the IT industry. Second, the frameworks used by organisations to adapt Lean Startup are classified to maximise the benefits of its application. Third, key drivers to be considered when implementing Lean Startup, such as Top Management Team commitment to change or scale up from small teams have been identified and explained.

2. Theoretical Framework

2.1 Products and services development models

Innovation is crucial for organisations' success in today's world and embodies companies' inclination to encourage and support new ideas, experimentation, and creative processes ([Lumpkin & Dess, 1996](#)). It is essential for gaining a competitive advantage in markets ([Crossan & Apaydin, 2010](#)) by enabling the identification of opportunities to create resources capable of generating economic value in an organised, intentional, and systematic manner ([Drucker, 2006](#)).

Thus, innovation is the process by which organisations transform ideas into new or improved products, services, or processes, aiming to progress, compete, and successfully differentiate themselves in their market ([Baregheh et al., 2009](#)). Managing innovation differs from managing operations, routine standardised processes, or defined and controlled projects because it involves high uncertainty ([Bieraugel, 2015](#)).

There are numerous products and services development models that incorporate varying stages, all starting with a concept and concluding with its commercialisation (Bessant & Tidd, 2015). Among them is the classic innovation funnel defined by Clark and Wheelwright (1992), consisting of three stages (idea generation, problem-solving, and implementation). In this model, product development begins with conceptualisation from a large pool of ideas that are analysed and refined before moving to implementation and commercialisation. Some companies adapt the original model to their needs by adding intermediate entry and exit options, resulting in most products and services development processes being linear and unidirectional, divided into several sequential stages. These models are effective in stable environments (Cooper & Kleinschmidt, 1996) but lack involvement of customers, users, or suppliers, and are not connected to market conditions before the actual product launch (Bayik, 2017). This implicitly assumes that the organisation already knows what the customer wants or needs.

In this regard, some of the most commonly used product development models in established companies are the Stage-Gate model (Cooper, 1990) or the waterfall model (Boehm, 1995), where the innovation development is structured into phases and organised linearly. The Stage-Gate model has been widely used in product development (Vliet, 2020), significantly influencing organisations' work methods over the past two decades (York & Danes, 2014). The original model consists of a five-stage or gate process, although its adaptation in organisations leads to processes with a greater or fewer number of stages, considering their internal organisation (Phillips et al., 1999). At the completion of each stage, validation according to certain criteria is required to progress to the next stage or discontinue the project, as each stage incurs higher costs than the preceding one, and the process is based on an increased commitment level in the product or service developed (Cooper, 1990).

On the other hand, the growing dynamism and uncertainty in many industries have led organisations to orient their products and services development models towards facilitating agility, flexibility, and customer orientation, diverging from highly structured approaches. These models prioritise communication and collaboration with the customer, continuously testing advancements to determine their usability and function (Rigby et al., 2016).

Therefore, organisations apply new approaches, as the agile software development (Beck et al., 2001), to facilitate rapid realignment of customer feedback, requirement interpretation, and error resolution through short, collaborative work cycles. This fosters continuous exchange of ideas, progress, and problem-solving among teams and stakeholders, all aimed at advancing toward a solution. Alternatively, Design Thinking principles (Brown, 2022) are also used, in order to promote innovation by identifying the most relevant challenges faced by a specific customer segment, and resolving them through products, services, or processes that enable superior value strategies, improving the definition process of innovative business models (Brown, 2008; Geissdoerfer et al., 2016). Even the Stage-Gate model has evolved to add spiral development, resembling an iterative process known as NextGen Stage-Gate (Cooper, 2008).

Lastly, aligned with these novel approaches, Lean Startup develops an iterative and hypothesis-driven method (Blank & Dorf, 2012) for business creation and product development. It involves potential customers from the beginning, with minimal upfront planning, allowing a shift from opinion-based to data-driven decision-making, while facilitating adaptive products and services design incrementally (Bianchi et al., 2020).

2.2 The Lean Startup approach

Lean Startup can be defined as the methodology oriented to build sustainable business models through continuous experiments and iteration (Ries, 2011), thus being an entrepreneurial mindset that aims to change the way businesses are developed and new products are launched (Nirwan & Dhewanto, 2015).

In this sense, Lean Startup is a framework for efficiently developing entrepreneurial ideas (J. M. York, 2018), with validated learning through purposeful experimentation at its core, emphasising flexibility and affordable loss to focus

on activities that create value for potential customers (Frederiksen & Brem, 2017) through market testing and analysis customer feedback (Ghezzi & Cavallo, 2020). Also, the Lean Startup approach offers a framework for a trial-and-error process, providing an experimental methodology to resolve uncertainty in business (J. M. York, 2018) and minimise the risks of new business initiatives (Grossman, 2016). It is often referred to as a scientific method applied to startups (Picken, 2017), highlighting a disciplined process of exploration based on hypotheses about the functionalities of new products and business models, enabling the validation and refinement of the business concept as a first step in enterprise development (Aulet, 2013).

To develop the methodology conceptually, Ries (2011) drew inspiration from the principles of Lean Manufacturing (Ohno, 1988), which aim to avoid waste and optimise resource expenditure, and from Steve Blank's previous work in Customer Development (Blank, 2013; Blank & Euchner, 2018). As Mansoori *et al.*, (2019) analyse, the ideas underlying the methodology also come from contributions in the field of disciplined entrepreneurship (Sull, 2004), the discovery-driven planning (McGrath & MacMillan, 2000), the process of testing and learning (Lynn *et al.*, 1996), and the hypothesis-driven entrepreneurship (Eisenmann *et al.*, 2012). These approaches emphasise early customer contact, reflective experimentation, and speed of learning. Moreover, the methodology incorporates elements from other theories and methods, such as the Business Model Canvas and the Value Proposition Design approach as tools for collecting hypotheses to validate (Osterwalder *et al.*, 2014; Osterwalder & Pigneur, 2010), principles of agile software development (Beck *et al.*, 2001; Dybå & Dingsøyr, 2008), and creative problem-solving from Design Thinking (Brown, 2008).

Therefore, as pointed out by Coviello and Tanev (2017), Lean Startup has popularised fundamental concepts from entrepreneurship theory, such as effectuation (Sarasvathy, 2001) and the entrepreneurship management (Stevenson & Jarillo, 2007), by making them more tangible and practical for practitioners.

The Lean Startup approach follows small iterative learning cycles using Minimum Viable Products (MVPs) based on assumptions about what the market is willing to accept (Bohn & Kundisch, 2020). MVPs are not fully-featured versions of the ideal product but the simplest and cheapest version that can be quickly produced to rigorously validate specific product features or business model specifications with potential customers based on product or business model vision (Rasmussen & Tanev, 2015).

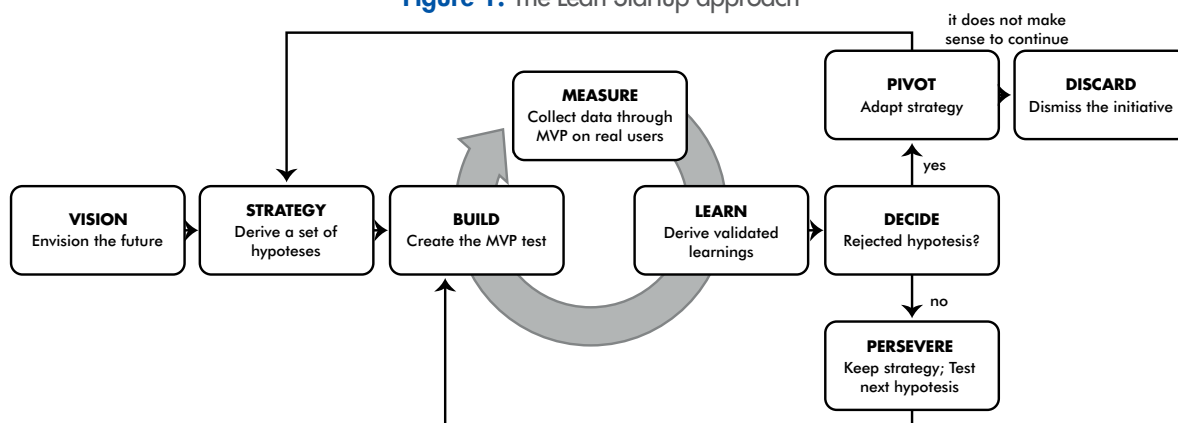
The validated Lean Startup learning cycle (Figure 1) is iterative and helps the entrepreneur assess whether to continue on the current path or if a change, known as pivoting, is necessary. According to Ries (2011), it starts with formulating an idea related to a problem and its possible solution. This idea is broken down into assumptions called hypotheses (Blank & Dorf, 2012) which are translated (BUILD) into a low-cost MVP. Within a controlled experiment, the MVP is used to validate the value proposition and associated business model elements. While it may not be possible to test the entire business model, each individual component can be tested and validated separately. Data and information are collected as the tests are carried out, which are then analysed and interpreted to draw conclusions (MEASURE). By reflecting on the results, in the third phase (LEARN), these are interpreted.

Once the learning cycle is completed, and if the hypotheses are considered true, a decision must be made: either develop the product if the iterations carried out are sufficient, or continue confirming the hypotheses proposed (persevere). If the hypotheses are not confirmed, new ways must be found to develop new hypotheses that fit the strategy (pivoting). These new hypotheses will be tested again in the next iteration, or the idea may be discarded if it does not make sense to continue despite the pivots made.

By systematising the innovation process and assessing the success or failure of a proposal, the Lean Startup approach creates a space for innovation in established organisations (Bieraugel, 2015) and influences the way companies manage these processes (Tanev, 2012). Lean Startup provides a strategy for entrepreneurs to achieve their vision for a business and obtain the best results (Ries, 2011) by minimising the risk of developing a product that the market is not willing to pay for,

adjusting it to customer preferences with fewer resources. It significantly shortens the technological development cycle and the time from proposal conceptualisation to commercialisation, helping companies to define viable business models using minimal resources (Furr & Dyer, 2014).

Figure 1: The Lean Startup approach



Source: based on Bohn and Kundisch (2020).

The Lean Startup concept has attracted considerable attention, especially in entrepreneurial, professional and, to a lesser extent, academic circles (Frederiksen & Brem, 2017). However, despite its importance in the business world and its increasing presence in the academic literature (De Cock et al., 2020; Yang et al., 2019), Lean Startup still lacks evidence of its effectiveness according to some researchers (Mansoori et al., 2019).

2.3 Comparison between Lean Startup and other new products and services development models

The Lean Startup approach shares certain similarities with the Stage-Gate model by presenting innovation as a process that can be managed, and the NextGen Stage-Gate version also considers an iterative approach for product conceptualisation through iterations (DelVecchio et al., 2013), aligning with lean thinking (Cooper & Edgett, 2009). However, while the Stage-Gate model assumes a fit between the product and the market, proceeding through a refinement process where the decision at the end of each stage is to continue or terminate the project, in Lean Startup the onset is that the organisation is still searching for the business model and the alignment between the product and the market. Hence, the decision is to continue or pivot (Seggie et al., 2017). This perspective in Lean Startup can represent a complete change in strategy, whereas in the Stage-Gate model it is assumed that the correct strategy is defined before starting the process: if customer feedback suggests major redesigns, the product should not progress through its gates, at least in the traditional version of the process. Therefore, the Stage-Gate model is useful for eliminating work and swiftly creating a product, whereas Lean Startup accelerates the learning cycle (DelVecchio et al., 2013).

Besides, the Lean Startup approach benefits from agile software development principles (Dybå & Dingsøyr, 2008), with the major difference being that while Lean Startup associated practices are primarily outward-oriented, enhancing market and customer orientation as an endogenous factor in the development process of new products and services, agile practices are mainly inward-oriented, supporting planning flexibility in ongoing implementation activities. In this manner, agile is focused on incremental improvements of an existing product and predominantly refer to dimensions like time, cost, and quality (Sońta-Drączkowska & Mrożewski, 2020).

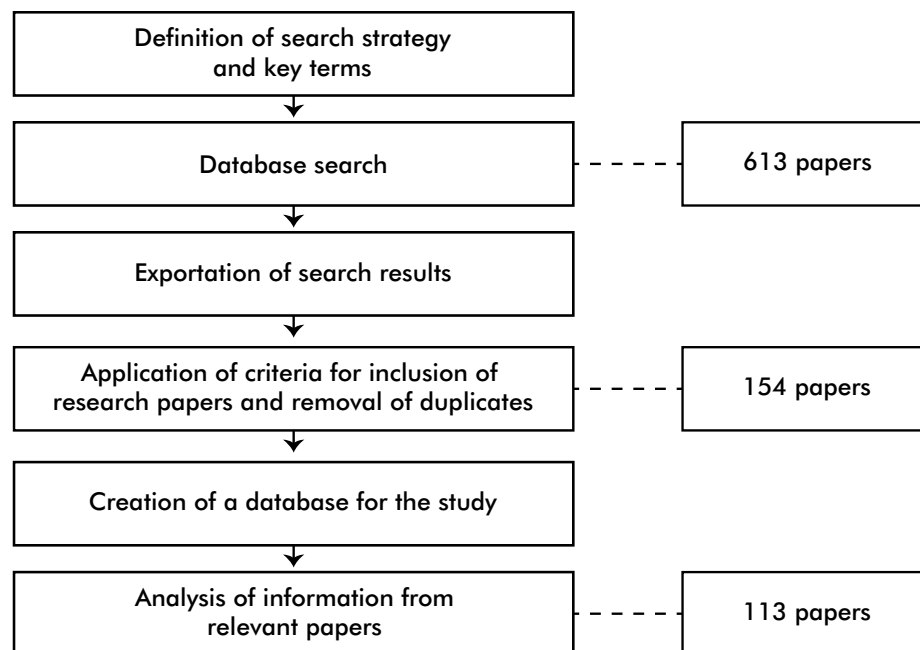
Finally, Design Thinking and Lean Startup address related issues and can contribute to increasing innovation process agility (Lichtenthaler, 2020b). Although they share a focus on customer needs, utilise creativity, rapid development and iterative experimentation, they differ in the stage of idea generation (Design Thinking includes idea generation, whereas Lean Startup generally begins from an existing idea), the role of business models (Design Thinking addresses problem-solving and solution optimisation in general, whereas Lean Startup heavily focuses on the business model and final implementation), and the use of quantitative data (Design Thinking concentrates on qualitative customer feedback, while Lean Startup emphasises the benefits of capturing and analysing quantitative data) (Baldassarre *et al.*, 2017; Lichtenthaler, 2020b; Müller & Thoring, 2012).

3. Methodology

The methodology used in this study was a Systematic Literature Review (SLR). To ensure the reliability and validity of the findings, the study adopted the stages suggested by Tranfield *et al.* (2003) to have a rigorous framework for application. This framework included planning, which involves the identification of the research questions; conducting the review; searching for relevant literature; and analysing the literature through selection, extraction, and coding. The results were then reported and disseminated. Figure 2 describes the procedure followed and the results (number of papers) obtained in each phase, adapting the guidelines of the PRISMA statement (Moher *et al.*, 2009).

The study included papers written in English published in academic journals, excluding book chapters, reviews, international conference proceedings, and grey literature, with complex inclusion and uncertain methodological quality (Hopewell *et al.*, 2005).

Figure 2: Procedure followed during the Systematic Literature Review and results obtained in each phase.



3.1 Information collection

Search strategy and key terms

The first step in collecting information involved defining the key terms used in the search. To ensure a fit-for-purpose search string, the most relevant terms were chosen after an initial review of scientific papers on Lean Startup. The process of determining the search terms was iterative, starting with a simple search using the terms "lean AND startup" and "lean AND start-up". After analysing the results, the terms were refined. Finally, the terms used were: "lean", "startup", "MVP", "minimum viable product", "customer development", "pivot", and "business AND model AND innovation".

The range of terms used, all of which encompass the Lean Startup framework, ensured a low probability of excluding references of interest.

Search in databases

The bibliographic databases Web of Science, Scopus and ScienceDirect were used for the search, along with the search engine Google Scholar, which specialises in scientific-academic content and bibliography. These databases were chosen for their broad scope and quality (Falagas et al., 2008; Martín-Martín et al., 2018; Wang & Waltman, 2016), particularly Web of Science in the social sciences field (Crossan & Apaydin, 2010; West & Bogers, 2014). The use of multiple databases created some overlap in the results, but it ensured that relevant papers were included based on the search criteria.

Each database structures its contents and search functionalities differently; therefore, the search strategies were adapted in each case to ensure a broad range of references, avoiding the loss of those most relevant. The aim was to identify scientific papers published in peer-reviewed journals, which gives them quality and credibility, as the research work is assessed independently, subjectively and critically (Bedeian, 2004). This step was based on the assertion of Crossan and Apaydin (2010) and Podsakoff et al. (2005) that only publications in peer-reviewed journals can be considered validated knowledge with a significant impact on academic discourse.

The search string with the terms "lean AND startup" in title and abstract fields of papers was enough to cover the entire existing literature on the subject, since using other combinations described above produced overlaps in the results. The first search was conducted in January 2020, followed by two identical searches in August 2020 and August 2021 to incorporate new papers published during those periods. Table 1 presents the main search strategies used in each database and the results obtained in August 2021. In sum, 613 references were identified.

Table 1: Search strategies used in each database and results in August 2021.

Database	Search strategy	Results
Web of Science	(TS=(lean startup)) OR TI=(lean startup)	152
ScienceDirect	TITLE-ABS KEY (lean AND startup) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English"))	48
Scopus	Title, abstract, keywords (lean AND startup)	131
Google Scholar [1]	Results with <i>allintitle lean startup</i>	282

¹ The search is less restrictive as it does not distinguish between types of documents. Therefore, the results include not only scientific papers but also contributions to conferences, books, or other academic papers not peer-review.

3.2 Information extraction

Using the export tools provided by the search engines, the 613 results were transferred to a Microsoft Excel spreadsheet for analysis to build the database of publications. Metadata such as title, abstract, author(s), document type, journal of publication, year, and keywords were included. After removing the 287 duplicate search results, all remaining papers were downloaded for further review.

Criteria for inclusion of research papers

The next step consisted of selecting those papers that contained objective and relevant information contributing to the research objectives. The titles, keywords, and abstracts of papers were reviewed based on specific inclusion criteria:

- Language: full text in English.
- Topic: The study focuses on the application of Lean Startup principles within an organisational context. It may involve defining a specific framework tailored to a particular case, which could be supported by quantitative, qualitative, or mixed empirical studies. Alternatively, the paper may adopt a conceptual or theoretical perspective for developing the concept.
- Quality: each paper underwent a quality audit, which considered factors such as the clarity of the research question(s), the robustness of the methodology, sample size, theoretical framework, and the validity of the findings.
- Unit of analysis: papers with application of the Lean Startup approach in any type of organisation were included (large companies, SMEs, startups, universities, or governments).
- Type of documents: Only scientific papers published in peer-review journals were considered. Conference contributions, posters, book chapters, editorials, and other academic works were not included in this review.

Applying these criteria, the number of papers for in-depth analysis was reduced to 154.

3.3 Information analysis

The 154 papers were carefully and analytically read to identify and extract information based on predefined categories. After a thorough reading, 41 works were discarded, and 113 papers were selected as valid for the purpose of the research. A summary table containing information on the papers included in the SLR can be found in [Appendix A](#).

4. Results and Discussion

4.1 Sectors and fields of application

Almost half of the total papers considered in the SLR, excluding theoretical and conceptual studies, are related to the application of Lean Startup in startups operating in new technology sectors (e.g. [Ghezzi, 2019](#); [Ghezzi & Cavallo, 2020](#); [Humphreys, 2015](#); [Miski, 2014](#); [Popowska & Nalepa, 2015](#); [Tohanean & Weiss, 2019](#); [Xu & Koivumäki, 2019](#)). This is not surprising considering the origin of Lean Startup in the software and new technologies industries ([Edison, 2020](#)).

However, given the unique characteristics of each business and market, Lean Startup can serve as a guiding framework (Popowska & Nalepa, 2015), prompting organisations to assess the most suitable way to apply this approach. As pointed out by Poppendieck and Poppendieck (2003), practices cannot be directly transposed from one discipline to another without interpretation and translation. Similarly, Harms et al. (2015) emphasise the need for significant customisation of the methodology when applied outside the software field, particularly in operational environments. This is because regardless of whether a proposal is suitable or far from the market, Lean Startup improves the likelihood of success (Ries, 2011) and provides organisations with a valuable tool for managing early-stage businesses (Blank, 2013).

Considering RQ1, 25 sectors and fields of application of Lean Startup principles beyond digital, ICT or new technology initiatives were identified. As listed in Table 2, these sectors and fields include startup accelerators, agriculture, automotive, libraries, biopharmaceutical, biotechnology, public research centers and universities, cinema, construction and energy efficiency, consultancy, local development, electric power distribution, consumer electronics, social entrepreneurship, education, tyre manufacturing, financial, governmental, industry 4.0, Living Labs, advanced materials, health, social work, tourism, and clothing retail.

Table 2: Sectors and fields of application of Lean Startup principles sorted alphabetically.

Sector or field of application	Authors
Advanced materials	Harms (2015)
Agriculture	Brecht, Hendriks, et al. (2021); Cavallo et al. (2019); Peralta, Echeveste, Martins, et al. (2020)
Automotive	Pillai et al. (2020)
Biopharmaceutical	Boni (2016)
Biotechnology	Silva et al. (2021)
Cinema	Gay (2014)
Clothing retail	Bocken et al. (2017); Weissbrod and Bocken (2017)
Construction and energy efficiency	Baldassarre et al. (2017)
Consultancy	Magistretti et al. (2019)
Consumer electronics	Hwang and Shin (2019)
Education	Armstrong (2017); Ávalos et al. (2019); Harms (2015); Kaylan et al. (2021); Nientied (2015); Qin et al. (2020); Reis et al. (2019); Robb et al. (2020); Schultz (2022); Shiradkar et al. (2021); Uansa-ard and Wannamakok (2020)
Electric power distribution	Leal et al. (2021)
Financial	Vliet (2020)
Governmental	Burgi et al. (2017)
Health	Johnson et al. (2016)
Industry 4.0	Baloutsos et al. (2020)
Libraries	Ahmad et al. (2020); Bieraugel (2015)
Living Labs	Schuurman and Protic (2018)
Local development	Khandros (2019)
Public research centres and universities	Still (2017)
Social entrepreneurship	Semcow and Morrison (2018)
Social work	Traube et al. (2017)
Startup accelerators	Ghorashi and Asghari (2019); Mansoori et al. (2019)
Tourism	Millán Vázquez de la Torre et al. (2019)
Tyre manufacturing	Ganguly and Euchner (2018)

4.2 Frameworks for adopting Lean Startup principles in organisations

Lean Startup principles must be adapted to the context and nature of each organisation and the sector in which they are applied, and several papers have defined specific adaptations and developed conceptual frameworks to enhance operational efficiency (Dahle *et al.*, 2020).

Based on the frameworks described in the literature, it is proposed to classify them into three levels according to the degree of customisation to the organisation adopting Lean Startup principles (RQ2).

At the first level, there are general frameworks that explain how to integrate Lean Startup into any organisation, making explicit how to integrate or combine different tools, principles, and practices of Lean Startup, also considering approaches such as Customer Development, Lean Product, Lean Innovation, Machine Learning or big data. In this level are included the M-Lean framework (Nashaat *et al.*, 2019), the Customer Value Measurement and Identification framework (Peralta, Echeveste, Lermen, *et al.*, 2020), the Toolbox for Green Product Innovation (Buhl, 2018), and the model that combines the Lean Startup and big data developed by Seggie *et al.* (2017).

The second level includes frameworks aimed at integrating Lean Startup principles into specific functions of the organisation, such as marketing, through the Lean Commercialisation framework (Gbadegesin, 2018), or mentoring activities by means of the Lean Mentorship framework (Aguiar *et al.*, 2019). This level also includes frameworks focused on defining a sustainable value proposition (Baldassarre *et al.*, 2017) and transitioning towards circular and sustainable business models (Bocken *et al.*, 2018).

The third level corresponds to the adaptation of Lean Startup principles to specific sectors or types of organisations. These frameworks consider sector-specific aspects such as the operating environment, current innovation models' limitations, and sector-specific phases of innovation and product development. At this level are classified the Minimum Viable Accelerator framework (Ghorashi & Asghari, 2019) for startup accelerators; the Lean Accelerator Canvas (Iazzolino *et al.*, 2020) for university spin-offs; the Innovation Acceleration Model (Still, 2017) for public research organisations and universities; the Lean Discovery Process (Carroll & Casselman, 2019) and the Smart Platform Experiment Cycle (Brecht, Niever, *et al.*, 2021) for digital businesses; and the RIGHT model by Fagerholm *et al.* (2017) for software product development. Startup-specific frameworks also include the framework for generating a new startup concept (Reis *et al.*, 2021), the B2B-Startup Experimentation Framework (Brecht, Hendriks, *et al.*, 2021) for B2B environments, and the SMED4BMC model (Balocco *et al.*, 2019) for digital initiatives.

Table 3 exhibits the 17 frameworks resulting from Lean Startup adaptations identified during the SLR. These frameworks are categorised according to the three levels of Lean Startup customisation described above.

4.3 Key drivers for successful Lean Startup adoption in established companies

The research has identified nine key drivers for the efficient adoption of Lean Startup principles in established companies (RQ3). These drivers are essential in facilitating successful implementation and enabling companies to foster innovation, adapt to market changes, and create sustainable competitive advantages in today's dynamic business environment. Key drivers are described below and summarised in Table 4.

Table 3: Lean Startup frameworks from the literature.

Title of the adaptation (framework)	Description	Author/s
<i>Level 1. General frameworks that make explicit the integration or combination of Lean Startup tools, principles, and practices in any type of organisation.</i>		
M-Lean	Guides companies in designing, developing, evaluating, and implementing B2B predictive systems using Machine Learning to maximise business value and eliminate inefficient development practices.	Nashaat et al. (2019)
Customer Value Measurement and Identification (CVMl)	Integrates Customer Development, Customer Value, Lean Product, Lean Startup and Lean Innovation, with a focus on understanding and meeting customer demands.	Peralta, Echeveste, Lermen, et al. (2020)
Model combining Lean Startup and big data	Provides an integrated process for learning innovation by combining Lean Startup principles with big data analysis.	Seggie et al. (2017)
Toolbox for Green Product Innovation	Aims to validate and refine green product innovation ideas, increasing the chances of bringing valuable proposals to market.	Buhl (2018)
<i>Level 2. Frameworks for integrating Lean Startup principles into specific organisational functions.</i>		
Lean Commercialisation	Combines Lean Startup principles with commercialisation knowledge to transform technology and knowledge into products and services efficiently, enabling quick validation of technologies and business for technology-based companies.	Gbadegesin (2018)
Lean Mentorship	Organises mentoring activities in organisations promoting entrepreneurship, such as science and technology parks, universities, incubators, and accelerators, following the lean mentality.	Aguar et al. (2019)
Model for defining a sustainable value proposition	Integrates the sustainable value proposition framework with an iterative user-driven process to develop comprehensive and dynamic value propositions.	Baldassarre et al. (2017)
Circular Business Experiment Cycle	Guides companies in transitioning to circular and sustainable business models through experimentation.	Bocken et al. (2018)
<i>Level 3. Frameworks for adapting Lean Startup principles to specific sectors or types of organisations.</i>		
Minimum Viable Accelerator (MVA)	Combines Lean Startup principles with the structural framework of startup accelerators to improve validated learning and reduce resource usage in new accelerator programmes.	Ghorashi and Asghari (2019)
Lean Accelerator Canvas	Addresses the growth challenges of university spin-offs by monitoring five risk areas (technological, market, implementation, governance and financial) and performance metrics.	Iazzolino et al. (2020)
Innovation Acceleration Model	Overcomes limitations of current innovation models in public research organisations and universities, focusing on four phases of discovery: customers, solutions, value propositions, and growth.	Still (2017)
Lean Discovery Process	Applies lean principles early in the development of digital business concepts, reducing uncertainty through market experimentation.	Carroll and Casselman (2019)
Smart Platform Experiment Cycle (SPEC)	Validates digital platform business models to increase success rates and mitigate the risk of developing unwanted or unprofitable products or services.	Brecht, Niever, et al. (2021)
RIGHT Model	Enables continuous experimentation in software product development by integrating requirements, design, implementation, testing, and maintenance phases.	Fagerholm et al. (2017)
Framework for generating a new startup concept	Supports startups in their early stages by combining Lean Startup, Business Model Canvas, and Design Thinking to achieve profitable and sustainable growth.	Reis et al. (2021)
B2B-Startup Experimentation Framework (B-SEF)	Guides startups operating in a B2B environment through Lean Startup principles, Growth Hacking, and Customer Development to validate and improve their business models effectively.	Brecht, Hendriks, et al. (2021)
SMED4BMC Model	Assists digital startups in navigating business model transformation through experimentation and validation, drawing parallels with the SMED lean production tool.	Balocco et al. (2019)

Table 4: Key drivers for successful Lean Startup adoption in established companies.

Key driver	Description	Author/s
Top Management Team commitment to change	Having the commitment of the Top Management Team is of utmost importance in supporting the implementation of Lean Startup. This entails providing the necessary resources, legitimising the initiative, empowering employees, and fostering a culture that inspires innovation.	Lindgren and Münch (2016); Seggie <i>et al.</i> (2017); Yaman <i>et al.</i> (2017)
Create aligned opportunity spaces with strategy	Create opportunity spaces aligned with the organisational strategy to foster innovation and value creation for both the organisation and customers. These spaces should have a clear process to support the advance of innovations.	Edison <i>et al.</i> (2018); Euchner (2019)
Identify the right profiles	Effective implementation of Lean Startup requires interdisciplinary teams composed of individuals with diverse backgrounds, experiences, and roles, capable of working in high-uncertainty contexts.	Edison <i>et al.</i> (2018); Euchner (2019); Leatherbee and Katila (2020); Magistretti <i>et al.</i> (2019)
Train profiles in Lean Startup principles	Teams need training to interact with customers, plan and conduct experiments, analyse results, work on new ideas outside their regular work, and gain confidence in applying Lean Startup principles. Additionally, teams require appropriate assets and tools for experimentation.	Fagerholm <i>et al.</i> (2017); Lindgren and Münch (2016); Weissbrod and Bocken (2017)
Reduce bureaucracy and allow autonomy to experiment and pivot	Empower teams with autonomy to experiment and deviate from certain organisational processes, rules, or policies, enabling a continuous mode of operation. However, efforts should be made to minimise organisational tensions.	Edison <i>et al.</i> (2018); Hwang and Shin (2019)
Motivate employees	Design an incentive structure that provides innovators a transparent career path allows them to share in the success of their innovations, and fosters a culture where taking risks does not result in severe consequences. This can be achieved through financial benefits or intrinsic motivators, such as new professional experiences.	Hwang and Shin (2019); Weissbrod and Bocken (2017); Yaman <i>et al.</i> (2017)
Scale up from small teams	Implement the continuous experimentation approach by starting with small-scale trials and gradually expanding them to the rest of the organisation. This approach facilitates the improvement of exploration-exploitation activities without causing abrupt changes within the organisation.	Magistretti <i>et al.</i> (2019)
Control the process	Establish innovation accounting and a controlled investment model, including feedback loops that facilitate the flow of relevant information from experiments to different parts of the organisation. This enables informed decision-making regarding new investments, pivoting, or discontinuation of ideas.	Euchner (2019); Fagerholm <i>et al.</i> (2017)
Prior knowledge of the market	Prior knowledge of the market is essential as it positively influences the ability to interpret and act on the information obtained during the validation process.	De Cock <i>et al.</i> (2020)

Top Management Team commitment to change

Strategic changes require support and commitment from the Top Management Team to ensure sustainability through funds and assets that enable their deployment and maintenance (Edison *et al.*, 2015; Gaffney *et al.*, 2014). Therefore, it is essential for organisations to be motivated and understand the needs, as time and effort are necessary for these change processes (Yaman *et al.*, 2017). On the other hand, as pointed out by Edison (2020), Top Management Team support is fundamental for effective decision-making in managing business risks that fall outside the authority of the project team. It also helps maintain the legitimacy of the initiative through management support, which mobilises resources, empowers, and inspires innovation, ensuring the impact on the organisation. A positive organisational culture that values experimentation is a success factor in this regard (Lindgren & Münch, 2016).

It should also be noted that implementing any strategic change is complex, and there are several challenges involved, including coordinating change and adaptation, communication and comprehension, agility and ambition, pressure for short-term results, and competition for scarce resources within the organisation (Seggie *et al.*, 2017).

Create aligned opportunity spaces with strategy

Euchner (2019) proposes the creation and clarification of opportunity spaces aligned with the strategy, which allow innovations to generate value for the organisation and customers. These spaces have a clear configuration of resources, products, and processes that support them.

On the other side, Edison et al. (2018) highlight the importance of involving the Top Management Team transparently throughout the process. This involvement ranges from presenting ideas and obtaining permission to work on them to reporting progress and requesting resources at all stages. It is very significant to convince the Top Management Team that the chosen idea will generate revenue without disrupting existing business or customer-supplier relationships.

Identify the right profiles

Effective implementation of experimentation requires interdisciplinary teams, made up of people with diverse backgrounds, disciplines, experiences, and roles (Magistretti et al., 2019). This configuration is necessary to enhance the decision-making process, foster collaboration, and reduce communication gaps, as pointed out by Edison et al. (2018), who also recommend that these profiles carry varying importance at different stages of hypothesis validation, development, and business growth. Additionally, these teams should possess specific assets and tools to facilitate interaction and collaboration (Magistretti et al., 2019).

The composition of the team plays a significant role in fully leveraging the benefits of Lean Startup (Leatherbee & Katila, 2020). However, not all professional profiles are suited for working in a startup mode. Certain individuals excel in stable contexts, while others thrive amidst high uncertainty. Moreover, some teams require a slower pace of progress to fully comprehend their work, which may be incompatible with Lean Startup principles (Edison et al., 2015). Therefore, it is decisive to identify the appropriate profiles within the organisation.

Dedication to Lean Startup activities within these teams can create internal tensions, particularly as the initiative expands. Euchner (2019) suggests that as long as the team's resource needs are constrained, they can operate somewhat unnoticed, gathering the necessary resources and permissions without significant challenges. However, when greater internal resources, larger budgets, or the development of non-embeddable business models arise, the involvement of the Top Management Team becomes necessary to avoid tensions within the organisation.

Train profiles in Lean Startup principles

Teams need comprehensive training to effectively implement Lean Startup principles. This includes interacting with customers to derive assumptions, planning experiments, and reporting results for decision-making (Fagerholm et al., 2017). They should also be encouraged to work on new ideas outside of their regular tasks (Gaffney et al., 2014), and develop confidence in working with Lean Startup principles and uncertainty (Weissbrod & Bocken, 2017). Moreover, equipping teams with the necessary tools and techniques for continuous experimentation is imperative (Lindgren & Münch, 2016).

Reduce bureaucracy and allow autonomy to experiment and pivot

Organisational structure defines how activities are controlled and coordinated to achieve organisational goals (Koberg et al., 1996). Established organisations rely heavily on bureaucracy, standardisation, and formalisation: bureaucracy

encompasses institutionalised rules, policies, and routines dictating task performance, while standardisation governs employee interactions and decision-making processes. In addition, employees already hold specific formal jobs and responsibilities (Edison *et al.*, 2018).

However, there are instances where it becomes necessary to remove bureaucratic barriers and depart from organisational rules to increase the speed of innovation. Teams using Lean Startup need a certain level of autonomy to foster learning and building MVPs at the required pace, avoiding excessive reliance on other teams to address specific challenges (Edison, 2020; Hwang & Shin, 2019) while mitigating internal organisational tensions.

Motivate employees

The formation of teams using Lean Startup principles, along with its motivation, is as important as identifying the right profiles (Weissbrod & Bocken, 2017). Equally significance is the design of an incentive structure that enables innovators to have a career path and participate in the success (Gaffney *et al.*, 2014; Hwang & Shin, 2019), while specifying consequences if objectives are not achieved (Edison, 2020). These incentives need not be solely tied to financial benefits such as bonuses, salary increments, or shares. They can also be driven by intrinsic motivation, such as involvement in and learning from new professional experiences.

In the early stages of implementation of Lean Startup, it is important to begin with motivated teams that understand the importance of the new development approach and their role in the introduction process. This establishes them as experts for future experiments within the organisation (Yaman *et al.*, 2017). Sustained motivation and timely execution of experiments are essential, as an extended duration can have a negative impact on motivation and persistence within organisations.

Scale up from small teams

Organisations often exhibit a cultural orientation toward traditional approaches and processes, and usually resist to new methods focusing on flexibility and agility (Magistretti *et al.*, 2019). However, to improve the balance between exploration and exploitation activities, and successfully implement approaches such as Lean Startup, organisations must systematically evaluate and filter ideas, choosing the appropriate business processes – whether traditional or lean (Gaffney *et al.*, 2014). The adoption of a new method should be considered on a project-by-project basis, encouraging its use when it can enhance results.

The transformation towards continuous experimentation, promoted by Lean Startup, should be gradually disseminated throughout the organisation. This can be achieved by conducting small-scale tests with small development teams (Olsson *et al.*, 2012), that foster success, allowing for gradual expansion to the rest of the organisation. This paced and directed approach facilitates incremental change without imposing abrupt disruptions to the *status quo* that could hinder the initiative.

Control the process

Establishing a mechanism for measuring success using innovation accounting beyond standard company objectives is vital (Gaffney *et al.*, 2014). This principle aligns with Lean Startup's emphasis on feedback loops suggested by Ries (2011), enabling the flow of relevant progress information to various parts of the organisation (Fagerholm *et al.*, 2017). To this end, Euchner (2019) proposes a Stage-Gate process approach linked to Lean Startup activities, incorporating intermediate deliverables and realistic timelines.

This approach provides a clear sense of progress, facilitates investment decisions, and creates a space for continuous learning about market progress and potential product development. At this point, breakthroughs are explicitly discussed for each stage of the process, incorporating milestone-based funding while aligning pivot decisions with the necessity to demonstrate progress. In Lean Startup, pivots are evidence-based; however, within organisations, innovations are measured by milestones, not solely by acquired knowledge. Hence, making this learning visible becomes imperative.

Prior knowledge of the market

Integrating Lean Startup with the capacity to interpret and respond to gathered market data through user or customer experimentation is essential for its effective implementation (De Cock et al. 2020). This empowers organisations to learn from market insights, facilitating to make major changes to their business models or value propositions.

In this sense, prior market knowledge holds profound importance, as organisations lacking such knowledge embark on an unstructured trial-and-error learning process. Consequently, their experiments fail to yield convergence.

5. Conclusions and future research directions

This study has identified the sectors and fields in which Lean Startup is applied, beyond the software or digital industry where it originated (Edison, 2020) showing, both, theoretically and empirically, that the application of Lean Startup is not limited to these types of organisations. Fields of applications as agriculture, biotechnology, cinema, consultancy, education, financial, health or startup accelerators, among others, are some examples analysed where Lean Startup can be applied to enhance the organisation performance.

Additionally, the frameworks to adapt Lean Startup principles to maximise benefits are described and organised considering the degree of customisation to the organisation, ranging from general frameworks that make explicit the integration or combination of Lean Startup tools, principles, and practices to those tailored for integrating Lean Startup principles into specific organisational functions.

Finally, nine key drivers for established organisations to efficiently adopt Lean Startup principles and achieve optimal results are described. These are (1) Top Management Team commitment to change, (2) create aligned opportunity spaces with strategy (3) identify the right profiles, (4) train profiles in Lean Startup principles, (5) reduce bureaucracy and allow autonomy to experiment and pivot, (6) motivate employees, (7) scale up from small teams, (8) control the process, and (9) prior knowledge of the market.

These insights contribute to advancing knowledge regarding the adoption of Lean Startup principles, tools, and techniques, allowing organisations to apply them to their products and services development processes most effectively, with discernment and confidence. The conclusions presented through the SLR facilitate the gathering of numerous examples that demonstrate the utility of Lean Startup, and under what conditions, within organisations operating across diverse contexts. On the other hand, the described adaptation models serve as a basis for organisations, alongside the factors for driving a successful adoption.

Furthermore, findings deepen the current understanding in literature concerning Lean Startup, contributing to the academic discourse on its usefulness and application in organisations, offering avenues for improvement. This allows to move beyond the uncertainties about real-world implementation highlighted by authors such as Mansoori (2017) and Schuurman and Protic (2018), progressing towards a consensus regarding the utility and boundaries of its principles,

thereby advancing the theoretical foundation of the approach. It also aids in defining future research directions beneficial for organisations. Eventually, our findings provide insights and evidence for the academic teaching of Lean Startup principles in formal entrepreneurship programmes at universities and business schools.

Like any research, this study has limitations, although efforts were made to minimise them by adopting the stages suggested by Tranfield et al. (2003) and following the guidelines of the PRISMA statement (Moher et al., 2009). However, the criteria for including research papers reduced the number of works considered in the SLR. Focusing solely on peer-reviewed journals ensures the information's quality (Crossan & Apaydin, 2010), yet it omits available knowledge from other sources like book chapters or conference contributions. Moreover, works written in languages other than English were excluded, leaving out a substantial body of academic work that could have contributed to the analysis. Lastly, there might be bias in the auditing process for the quality of each work included in the SLR, which was minimised by clearly establishing the acceptance criteria.

As potential directions for future research, we suggest conducting specific and comparative analyses of Lean Startup applications to identify common attributes among organisations in sectors where these principles are employed. This research could also explore different integration methods within organisations. For instance, organisations may opt for varying degrees of adaptation and customisation of Lean Startup principles based on the frameworks analysed in this study. This could involve hybrid organisations that integrate traditional and alternative processes (Magistretti et al., 2019), starting with the adoption of Lean Startup principles by a working group or internal division (Jurado & Olano, 2014; Magistretti et al., 2019), developing complete internal processes (Guinan & Parise, 2017; Power, 2014), or establishing independent dedicated entities within the organisation based on Lean Startup principles (Edison, 2020).

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Appendix

Appendix A: Summary Table of Papers Included in the Systematic Literature Review

Work number	Author/s and year	Type of organisation analysed or proposed application	Sector or field of application	Methodology used	Lean Startup framework proposed
1	Aas and Alaassar (2018)	Startup	Diverse sectors (digital and non-digital)	Qualitative (single case study)	
2	Aguiar et al. (2019)	Startup accelerator, business incubator, or science park	Advanced technologies across multiple sectors	Qualitative (single case study)	Lean Mentorship
3	Ahmad et al. (2020)	Established company	Libraries	Quantitative	-
4	Armstrong (2017)	University	Education	Conceptual/Theoretical	-
5	Ávalos et al. (2019)	University	Education	Mixed (quantitative and qualitative)	-
6	Axelson and Bjurström (2019)	Established company (spin-off)	Advanced technologies across multiple sectors	Qualitative (single case study)	-
7	Bajwa et al. (2017)	Startup	Software	Qualitative (multiple case study)	-
8	Baldassarre et al. (2017)	Not defined. Comprising conceptual and theoretical works	Construction and energy efficiency	Qualitative (single case study)	Model for defining a sustainable value proposition
9	Balocco et al. (2019)	Startup	Digital	Qualitative (multiple case study)	SMED4BMC Model
10	Baloutsos et al. (2020)	Established company (large company)	Industry 4.0	Qualitative (multiple case study)	-
11	Bieraugel (2015)	Established company	Libraries	Conceptual/Theoretical	-
12	Blank and Euchner (2018)	Governmental	Theoretical work	Other (SLR, interview)	-
13	Bocken and Snihur (2020)	Not defined. Comprising conceptual and theoretical works	Theoretical work	Conceptual/Theoretical	-
14	Bocken et al. (2017)	Established company (large company)	Clothing retail	Qualitative (single case study)	-
15	Bocken et al. (2018)	Any type of organisation (established and startups)	Diverse sectors (digital and non-digital)	Qualitative (multiple case study)	Circular Business Experiment Cycle
16	Bohn and Kundisch (2020)	Startup	Digital	Qualitative (single case study)	-
17	Bohnsack and Liesner (2019)	Any type of organisation (established and startups)	Theoretical work	Conceptual/Theoretical	-
18	Boni (2016)	Established company	Biopharmaceutical	Conceptual/Theoretical	-
19	Bortolini et al. (2021)	Not defined. Comprising conceptual and theoretical works	Theoretical work	Other (SLR, interview)	-
20	Brecht, Hendriks, et al. (2021)	Startup	Agriculture	Qualitative (multiple case study)	B2B-Startup Experimentation Framework (B-SEF)
21	Brecht, Niever, et al. (2021)	Startup	Digital	Qualitative (single case study)	Smart Platform Experiment Cycle (SPEC)

Appendix A: Summary Table of Papers Included in the Systematic Literature Review (Continued)

22	Buhl (2018)	Any type of organisation (established and startups)	Diverse sectors (digital and non-digital)	Conceptual/Theoretical	Toolbox for Green Product Innovation
23	Burgi et al. (2017)	Not defined. Comprising conceptual and theoretical works	Governmental	Qualitative (single case study)	-
24	Čalopa et al. (2020)	Startup accelerator, business incubator, or science park	Diverse sectors (digital and non-digital)	Quantitative	-
25	Carroll and Casselman (2019)	Startup	Digital	Qualitative (single case study)	Lean Discovery Process
26	Cavallo et al. (2019)	Established company (SME)	Agriculture	Qualitative (single case study)	-
27	Chesbrough and Tucci (2020)	Established company	Diverse sectors (digital and non-digital)	Conceptual/Theoretical	-
28	Contigiani and Levinthal (2019)	Any type of organisation (established and startups)	Theoretical work	Conceptual/Theoretical	-
29	Coviello and Tanev (2017)	Startup	Advanced technologies across multiple sectors	Other (SLR, interview)	-
30	De Cock et al. (2020)	Startup	Digital	Qualitative (multiple case study)	-
31	Edison et al. (2018)	Established company (large company)	Software	Qualitative (multiple case study)	-
32	Euchner (2019)	Established company	Theoretical work	Conceptual/Theoretical	-
33	Fagerholm et al. (2017)	Any type of organisation (established and startups)	Software	Qualitative (multiple case study)	RIGHT Model
34	Felin et al. (2020)	Not defined. Comprising conceptual and theoretical works	Theoretical work	Conceptual/Theoretical	-
35	Frederiksen and Brem (2017)	Any type of organisation (established and startups)	Theoretical work	Conceptual/Theoretical	-
36	Ganguly and Euchner (2018)	Established company	Tyre manufacturing	Qualitative (single case study)	-
37	Gay (2014)	Startup	Cinema	Conceptual/Theoretical	-
38	Gbadegeshin (2018)	Any type of organisation (established and startups)	Advanced technologies across multiple sectors	Qualitative (single case study)	Lean Commercialisation
39	Ghezzi and Cavallo (2020)	Startup	Digital	Qualitative (multiple case study)	-
40	Ghezzi (2019)	Startup	Digital	Mixed (quantitative and qualitative)	-
41	Ghezzi (2020)	Startup	Digital	Qualitative (multiple case study)	-
42	Ghorashi and Asghari (2019)	Startup	Startup accelerator	Conceptual/Theoretical	Minimum Viable Accelerator (MVA)
43	Harms and Schwery (2020)	Startup	Software	Quantitative	-
44	Harms (2015)	University	Education	Quantitative	-
45	Harms et al. (2015)	Any type of organisation (established and startups)	Advanced materials	Conceptual/Theoretical	-

Appendix A: Summary Table of Papers Included in the Systematic Literature Review (Continued)

46	Humphreys (2015)	Startup	Digital	Qualitative (multiple case study)	-
47	Hwang and Shin (2019)	Established company (large company)	Consumer electronics	Qualitative (single case study)	-
48	Iazzolino et al. (2020)	University (spin-off)	Diverse sectors (digital and non-digital)	Qualitative (multiple case study)	Lean Accelerator Canvas
49	York and Danes (2014)	Not defined. Comprising conceptual and theoretical works	Theoretical work	Conceptual/Theoretical	-
50	York and York (2019)	Not defined. Comprising conceptual and theoretical works	Theoretical work	Other (SLR, interview)	-
51	York (2018)	Not defined. Comprising conceptual and theoretical works	Theoretical work	Conceptual/Theoretical	-
52	York (2020)	Not defined. Comprising conceptual and theoretical works	Theoretical work	Conceptual/Theoretical	-
53	Johnson et al. (2016)	Established company	Health	Qualitative (single case study)	-
54	Kaylan et al. (2021)	University	Education	Qualitative (single case study)	-
55	Khandros (2019)	Governmental	Local development	Qualitative (single case study)	-
56	König et al. (2019)	Startup	Diverse sectors (digital and non-digital)	Mixed (quantitative and qualitative)	-
57	Ladd and Kendall (2017)	Startup	Diverse sectors (digital and non-digital)	Quantitative	-
58	Lalic et al. (2012)	Startup	Diverse sectors (digital and non-digital)	Mixed (quantitative and qualitative)	-
59	Leal et al. (2021)	Established company (large company)	Electric power distribution	Qualitative (single case study)	-
60	Leatherbee and Katila (2020)	Startup	Advanced technologies across multiple sectors	Quantitative	-
61	Lichtenthaler (2020a)	Established company	Diverse sectors (digital and non-digital)	Conceptual/Theoretical	-
62	Lichtenthaler (2020b)	Any type of organisation (established and startups)	Theoretical work	Conceptual/Theoretical	-
63	Lindgren and Münch (2016)	Established company	Software	Qualitative (multiple case study)	-
64	Lizarelli et al. (2022)	Not defined. Comprising conceptual and theoretical works	Theoretical work	Other (SLR, interview)	-
65	Magistretti et al. (2019)	Established company (large company)	Consultancy	Qualitative (single case study)	-
66	Mansoori and Lackeus (2020)	Not defined. Comprising conceptual and theoretical works	Theoretical work	Conceptual/Theoretical	-
67	Mansoori (2017)	Startup	Digital	Qualitative (single case study)	-
68	Mansoori et al. (2019)	Startup accelerator, business incubator, or science park	Startup accelerator	Qualitative (single case study)	-
69	Millán Vázquez de la Torre et al. (2019)	Any type of organisation (established and startups)	Tourism	Qualitative (single case study)	-

Appendix A: Summary Table of Papers Included in the Systematic Literature Review (Continued)

70	Miski (2014)	Not defined. Comprising conceptual and theoretical works	Software	Qualitative (single case study)	-
71	Moogk (2012)	Any type of organisation (established and startups)	Theoretical work	Conceptual/Theoretical	-
72	Nashaat et al. (2019)	Established company	Digital	Qualitative (single case study)	M-Lean
73	Neubert (2017)	Startup	Advanced technologies across multiple sectors	Qualitative (multiple case study)	-
74	Neubert (2018)	Startup	Advanced technologies across multiple sectors	Qualitative (multiple case study)	-
75	Newbert et al. (2020)	Startup	Diverse sectors (digital and non-digital)	Quantitative	-
76	Nientied (2015)	Startup	Education	Qualitative (single case study)	-
77	Peralta, Echeveste, Lermen, et al. (2020)	Not defined. Comprising conceptual and theoretical works	Theoretical work	Conceptual/Theoretical	Customer Value Measurement and Identification (CVMI)
78	Peralta, Echeveste, Martins, et al. (2020)	Startup	Agriculture	Qualitative (single case study)	-
79	Pillai et al. (2020)	Established company	Automotive	Quantitative	-
80	Popowska and Nalepa (2015)	Startup	Software	Qualitative (single case study)	-
81	Qin et al. (2020)	University	Education	Qualitative (single case study)	-
82	Racolța-Paina and Andrieș (2017)	Startup	Diverse sectors (digital and non-digital)	Qualitative (single case study)	-
83	Rasmussen and Petersen (2017)	Established company	Diverse sectors (digital and non-digital)	Qualitative (multiple case study)	-
84	Rasmussen and Tanev (2015)	Startup	Advanced technologies across multiple sectors	Conceptual/Theoretical	-
85	Reis et al. (2019)	University	Education	Qualitative (single case study)	-
86	Reis et al. (2021)	Startup	Diverse sectors (digital and non-digital)	Conceptual/Theoretical	Framework for generating a new startup concept
87	Robb et al. (2020)	University	Education	Quantitative	-
88	Rübling (2016)	Startup	Diverse sectors (digital and non-digital)	Mixed (quantitative and qualitative)	-
89	Scheuenstuhl et al. (2021)	Established company	Software	Quantitative	-
90	Schultz (2022)	University	Education	Quantitative	-
91	Schuurman and Protic (2018)	Startup	Living Labs	Conceptual/Theoretical	-
92	Seggie et al. (2017)	Established company	Theoretical work	Conceptual/Theoretical	Model combining Lean Startup and big data
93	Semcow and Morrison (2018)	University (research)	Social entrepreneurship	Qualitative (single case study)	-

Appendix A: Summary Table of Papers Included in the Systematic Literature Review (Continued)

94	Shanbhag and Pardede (2019)	Startup	Software	Conceptual/Theoretical	-
95	Shepherd and Gruber (2021)	Not defined. Comprising conceptual and theoretical works	Theoretical work	Conceptual/Theoretical	-
96	Shiradkar et al. (2021)	University	Education	Qualitative (single case study)	-
97	Silva et al. (2020)	Not defined. Comprising conceptual and theoretical works	Theoretical work	Other (SLR, interview)	-
98	Silva et al. (2021)	Startup	Biotechnology	Qualitative (multiple case study)	-
99	Sołta-Drączkowska and Mrożewski (2020)	Startup	Advanced technologies across multiple sectors	Qualitative (multiple case study)	-
100	Still (2017)	Startup accelerator, business incubator, or science park	Public research centres and universities	Qualitative (single case study)	Innovation Acceleration Model
101	Tanev (2017)	Startup	Advanced technologies across multiple sectors	Conceptual/Theoretical	-
102	Tohanean and Weiss (2019)	Startup	Digital	Qualitative (single case study)	-
103	Traube et al. (2017)	Not defined. Comprising conceptual and theoretical works	Social work	Conceptual/Theoretical	-
104	Uansa-ard and Wannamakok (2020)	University	Education	Quantitative	-
105	Vliet (2020)	Not defined. Comprising conceptual and theoretical works	Financial	Conceptual/Theoretical	-
106	Weissbrod and Bocken (2017)	Established company	Clothing retail	Qualitative (single case study)	-
107	Welter et al. (2021)	Startup	Diverse sectors (digital and non-digital)	Quantitative	-
108	Xu and Koivumäki (2019)	Startup accelerator, business incubator, or science park	Digital	Qualitative (single case study)	-
109	Yaman et al. (2017)	Established company	Software	Qualitative (multiple case study)	-
110	Yang et al. (2019)	Any type of organisation (established and startups)	Libraries	Quantitative	-
111	Yordanova (2017)	Not defined. Comprising conceptual and theoretical works	Undefined sector	Quantitative	-
112	Yordanova (2018)	Not defined. Comprising conceptual and theoretical works	Undefined sector	Quantitative	-
113	Zijdemans and Tanev (2014)	Startup	Theoretical work	Conceptual/Theoretical	-