

Reflection of Literature on using Lean Innovation Models for Start-Up Ventures

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ABSTRACT

This paper discusses lean innovations and lean startup methods for the engineering management field. The aim of the literature review is to explain the methods and processes used in a lean startup. First, we discuss the concept of the startup and the impact that innovation has on startups and organizations seeking to implement lean innovations models. The assumption made in the hypothesis is that lean startup can be applied to areas outside of high-tech entrepreneurship. This hypothesis is further explored in the research. The findings in this paper suggest that innovation and entrepreneurship are highly influenced by innovation and company cultures. We find that technology transfer plays a key role in fostering innovation. However, there are barriers to public-private innovation partnerships, which are discussed in this paper.

KEYWORDS

Lean innovations, Lean startup, Startup, entrepreneurship.

BACKGROUND AND INTRODUCTION

Introduction

In the current business environment, customer satisfaction must be met and/or exceeded. However, many products that are launched do not succeed, as they fail to meet the expectations of customers. Further, some products or services fail to solve the problems that they are intended to solve. There are many reasons why new products and services fail, some of which are lengthy development, taking too long to release the product and changes in the economy. One main reason for unsuccessful products is the failure to understand the needs and wants of the consumer. Another reason is targeting the wrong market.

The traditional business model has been characterized for collecting data regarding product or service performance, including the voice of the customer. Traditionally, this was done at the end of a process. In this model, companies typically have a detailed plan and assume that the plan will work. This approach leads to launching products and services that do not have a market and do not sell. Making strategic investment decisions in this fashion may work for established businesses and big corporations since they are in a better position to withstand the losses that result from failing products.

Smaller companies and startups, on the other hand, lack the resources necessary to enter existing markets. Existing markets are saturated with tried and true solutions for loyal customers' problems, and this makes entry difficult. Furthermore, the chaotic environment in which startups

operate renders traditional business planning tools and models inappropriate. This underlines the need for innovative tools that allow startups to compete and be profitable.

Innovative business models are characterized by entrepreneurship. Streams of research identify entrepreneurs as drivers of economic development, creators of competition, and drivers of change in the economy. The lean startup approach seeks to provide tools to decrease product development cycles by creating hypotheses and experiments through an iterative process. The iterative process is also a learning one through which information that is collected is validated.

This paper is comprised of six chapters. The second part contains the methodology employed to find significant information related to the topic of this paper. The third contains the literature analysis used for writing this paper through three parts: innovation, lean startup, and the application of lean startup in fields outside entrepreneurship. The fourth explains and discusses the findings. The fifth section discusses the implications and application of lean startup in project management, and it provides recommendations for future research, as well as limitations of this work. The final section concludes the paper with the overall findings.

Background

Barriers for SMEs to enter existing markets have paved the way for the introduction of innovative techniques to minimize the go-to-market cost. Smaller organizations do not have the resources to manufacture and release products before testing the functionality and performance through customer feedback. This disadvantage, together with turbulent business environments, pressures them to launch products on time and face competition, among other uncertainties, that make traditional business models inappropriate. The immersion of lean startup in the context of entrepreneurship provides tools and techniques for taking a product from development to manufacturing, thus bypassing the trial and error process of traditional business models for managers.

Research Statement

Extreme uncertainty in the business environment forces organizations to develop products of higher performance and functionality to remain competitive and sustainable. The lean startup offers an array of tools and processes for entrepreneurs to make informed decisions and optimized product launch. In other words, it is a technical approach to forming and managing startups and delivering the desired product to the customers. Lean startup, which finds its foundations in lean manufacturing and lean innovation models, focuses on a build-measure-learn recursive cycle.

Lean startup is proposed as a highly innovative approach to creating viable business models. However, its use is most popular in the fields of technology, such as software development and Smartphone app development, I.T, etc. It is our assumption that the lean startup approach can be implemented by entrepreneurs outside the technology realm.

Research Question

What is the role of innovation in a lean startup and can lean startups be implemented in areas outside entrepreneurship?

Originality

The hypothesis of this paper relates to the role of a lean startup in research. The literature demonstrates the importance of research and development, technology transfer, and the commercialization of innovations. It further exposes the dynamics and barriers that impact this private-public relationship.

Lean innovation models emphasize the importance of an innovation culture, as well as the fostering of ideas. Hence, the originality of this paper relates to supporting the study of the organizational structure of academic institutions in relation to business organizations. Such analysis can identify areas of collaboration and partnering.

Contribution to the Engineering & Project Management

This paper contributes to the engineering management field because it highlights the benefits lean startup can have in the design and manufacturing industry. The lean startup approach and lean innovations can unlock a stockroom of opportunities that benefit the industry regarding the proper approach to product development and industrial design. In the academic realm, it is important to point out the importance of the work that needs to be done to identify better collaboration channels between the public and private sectors.

LITERATURE REVIEW

Startup

This section studies the concepts of lean startup, its origin, and applications for the engineering management field. A discussion of the difference between traditional business models and the lean approach is included. The role of innovation as a competitive advantage tool in organizations is further highlighted. Steven Blank introduced the concept of lean startup, but the term was first coined by one of his graduate students, Eric Ries.

One definition of a startup is the natural urge designed to develop new products in an environment of extreme uncertainty (Niculescu, 2014). Startups go beyond the product or technological breakthroughs. Also, startups seek to build a business that is sustainable, which is achieved by validating products and services scientifically through experiments that permit the testing of business ideas. Lean startup adapts the scientific principle to the framework of free enterprise entrepreneurship.

The driving thinking of a startup is to create products and services based on ideas (Wooder, 2012). It seeks to measure the customer response and decides whether to make changes and to continue or discontinue the business effort. By dynamizing this cycle, startups create business models and opportunities. Their teams are cross-functional, a barrier-free team with members from different departments to be full-time participants. These teams are formed to engage in the development of fully functional prototypes.

Startups depend heavily on innovative technologies. Innovation drives the creative mind of entrepreneurs, and it is a necessity for growth and sustainability (Terry Frederick, 2014). Products are developed based on scientific sightings, forming business models that exploit new markets, repurposing existing technology. Some startups introduce existing products to new locations, often tapping new markets (Niculescu, 2014). The main problems faced by entrepreneurs are:

- Performing metrics and obtaining results,
- Setting up milestones, and

- Alternative selection.

The previous section discusses the nature of startups and concludes with the identification of the main problems facing entrepreneurship. In the next section, we discuss innovation and its importance to add economic value.

Innovation and Economic Value

The research argues that innovation is a key driver for a business opportunity. The budgetary challenges faced by businesses today (risk and uncertainties) spark the use of a leaner approach that puts innovation at the forefront, along with supporting structures and processes.

A lean innovation model seeks to provide tools for managers of organizations to strategically meet their business needs, utilizing repetitions of self-examination. Innovation cannot be replicated, and it often becomes the only asset for a company. Therefore, companies need to find ways to convert innovation into economic value. The questions then become: does the lean innovation model address the three main problems startups face and can value be added to innovation potential?

Companies create value by developing innovative technologies or by repurposing existing ones. Innovation can also be seen in the form of new ways to capture business, new administrative structures, or management practices (Heindl, 2013). Researchers argue that the prime reason for investing in a company is its ability to innovate since innovation is the only source of profit (Gandotra, 2010). For the review of this section, innovation is defined as a new idea applied to the inception or improvement of a product or service (Judge, 2012).

The research identified the misconception that funding R&D alone leads to added economic value. The literature states that the most prominent innovators spend less on research and development than their competitors. R&D programs will not bear results if they are not accompanied by a culture of innovation with supporting processes and commitment of leadership to innovation. Lean models for innovation address the process as a method to recognize and seize innovative ideas, make selections, and pursue the most promising one(s).

An important phase of business planning is preparing measures to resolve organizational and business problems. It also includes defining methods to identify new opportunities. The use of internal and external ideas, paths to market, advancing firm technology, and procuring outside solutions are all tools to create a culture of innovation (Shapiro, 2011). Innovation processes are profoundly dependent on social networking expertise. Also, a staff's technology literacy is determinant in the efficient use of social media tools and the adoption of automation technologies. This is consistent with research that likens innovation to a process shaped by culture and social interactions (Gandotra, 2010). Social interaction and networks influence innovation, the potential to add economic value, and ways to identify markets to test new products. Research demonstrates that I.T structures and technology literacy play a decisive role in innovation. Consequently, it affects an organization's ability to adopt useful lean innovation models for managers.

Development of the Lean Innovation Model

As implied by the terminology, an important part of the lean information model is evaluating the firm's innovation culture. The literature suggests that procedures and structures supporting and promoting a culture of innovation is a prerequisite for implementing lean innovation models.

There are three essential elements for the adoption of a sustainable, iterative innovation structure: culture, process, and infrastructure.

Research indicates that innovation culture assessment uses tools, such as surveys, to collect information concerning gaps. It also does so to identify weak areas in processes and behaviors that hamper innovation. The innovation model features an action grid that assists in creating action plans to close gaps and to improve performance in weak areas revealed from the survey (Terry Frederick, 2014). Non-rigid organization models that promote continuous development and permit time for learning from experimentation are good receptors of the lean innovation model.

The build-measure-learn feedback repetitive circle allows companies to employ the minimum value product concept of the minimum viable product (Ries, 2011). The idea is to measure the performance of a business plan to determine whether expectations are met and adjust the strategy to efficiently allocate resources. The minimum viable product method entails the identification of features necessary to satisfy early customers. The final set of features is determined after feedback has been received from early users. The iterations of the build-measure-learn loop drive continuous improvement and transformation of the product or service, which can be used for aligning the organization's objectives.

Following the application of the concepts discussed in the latter paragraph, the lean innovation model uses B. J Fogg's application of persuasive technology. This approach focuses on the use of computers, technology, and software development to influence social behavior. The idea is to map the trajectory to desired goals to be approached progressively and in measurable and manageable steps. Lean innovations introduce this concept to entrepreneurship as a framework of experimental measurement of results and continuous progress towards a business goal. According to (Terry Frederick, 2014) the application of the methods discussed constitutes the basis for creating a culture of innovation.

Lean innovation begins by performing an assessment of the organization to determine a baseline of innovation culture. The results are weighed and matched against the action grid to identify gaps. Making the adjustments suggested establishes the firm's minimum viable product element in its innovation model. The effect of implementing the recommended actions is evaluated at scheduled intervals, which is a new organization assessment or iteration of the loop.

The Lean Startup Model

The lean startup utilizes the scientific method to test hypotheses. In the context of a lean startup, a hypothesis refers to an entrepreneur's vision. In theory, the scientific method tests components of a business plan to identify parts that add value and parts that do not work. The primary hypothesis used by lean startup is value. There also are growth hypotheses that become variables to be monitored to control growth. The process of identifying non-value adding activities repeats continuously, making improvements to the business model (Niculescu, 2014). The goal is to achieve a minimum viable product to commence the build phase.

The research argues that a lean startup creates value because it works as an early indication that changes to the strategy are necessary and that it is time to return to the drawing table. This approach prevents the use of resources on uncertain business ventures and makes them available for launching innovative ideas. Customer retention, business patterns, and other innovation accounting tools can assist in learning what needs to be measured. From these

exercises, we identify what product to build, as well as what experiments are needed to obtain results.

The experimentation process employed by a lean startup constitutes a way to achieve sustainable progress. Sustainable progress is getting new customers because of past customers. The lean approach encourages companies to make a dynamic iteration process and quick customer feedback that brings a successful business model to the market (Ries, 2011). This method is designed for the build-measure-learn tool to drive the startup and to make continuous adjustments. This eliminates assumptions inherent in traditional business planning.

Internal Startup and Innovation Acceleration

Lean startup inspired other industries outside the entrepreneurial realm to adopt approaches of lean innovations with the introduction of an internal startup. In past decades, the aim of technology transfer was based on simple logic and the goal was competitiveness. Research suggests that in the 1990s, universities and public research institutions created spin-offs of the original models. As a result, differences between science-based and engineering firms arose. The spin-offs from universities and research institutions pushing technology transfer and engineering companies were focused on making a market pull. Nonetheless, a positive economic impact on fruitful technology exchanges existed.

Inspired by a lean startup, public research organizations adopt an initiative to support research and development projects that are innovative and industry-driven. The approach is based on the commercialization of better products, sustainable business models, fast launch to market, and sustainability. This initiative is known as an internal startup. In this concept, an organization launches an internal semi-independent enterprise to follow an innovative idea (Makjarvi, 2016). The methods of a lean startup have been prolonged outside its realm of high-technology application.

Universities are entering markets by promoting entrepreneurship and creating spin-offs with an impact on regional development. Considering that research organizations are vital players in research and development across industries, and despite the difficulties of a public-private partnership, companies that collaborate with research institutions have more innovative products and services than their competitors (Steinmo, 2016). However, the goals of public research institutions and private entrepreneurship differ in many aspects. This creates barriers for collaboration.

Universities and public organizations focus on the exploration of science, while business organizations focus on exploiting technology advances (Nelson, 2014). Despite these differences, the research community is benefitting from lean innovation methods. Recently, the technical research center of Finland began leading a technology company that offers research and innovation services to both private and public companies (Still, 2017). The research center realigned its focus based on lean innovation. The center changed its focus to growth and expects to bring its own innovations to the market.

APPROACH AND METHODOLOGY

This paper classifies information consisting of existing literature related to lean startup and lean initiatives in the engineering management field. The narrative review method does not support the standardization of methods that are used in numerous studies, but it does help with

combining the reviewed papers towards one conclusion. The effort of the review is to explore the lean startup model and its applications outside the context of the high-tech business model.

The study focuses on the lean start method as well as its applications. This paper discusses the role of lean innovation models in lean startup. It demonstrates the use of lean initiatives to streamline innovation and product development. Furthermore, the application of lean startup in research and development is analyzed in addition to the interactions between public research organizations and private enterprises.

Narrative Review as a Qualitative Literature Overview

The narrative review technique was selected because it facilitates reviewing diverse investigations, from which conclusions can be rendered and synthesized into one holistic view. The interpretation can contain contributions related to the writer's experience and theories. A narrative review delivers a broad range of studies, which eliminates restrictions met in statistical reviews. The literature review was organized in two approaches. The first approach was a simple search where its main focus was to find useful information about lean innovation and lean startup. The second approach was an organized search. In this step, we got all the helpful information from databases.

Simple Search for Literature Review

This step was based on searching for papers that show useful information about lean innovation and lean startup. Important areas, such as lean innovation, entrepreneurship, innovation, lean start-up, and continuous improvement, were identified. 15 articles were found. After that, we excluded some of the papers in an organized search.

Organized Search for Literature Review

In this search, three steps were used:

- (1) Planning the search: all lean innovation and lean startup papers were identified. One of these topics had to be a major concentration. The goal was to successfully get papers that add valuable information to this study.
- (2) Conceptualizing the review: we defined new terms to support the knowledge of our study by looking for other concepts showing relevance to the two concepts (i.e., lean innovation, entrepreneurship, innovation, lean start-up, and continuous improvement). The elimination of some specific terms was done, such as sustainment and optimization, because they were not helpful to our study.
- (3) Searching, evaluating, and selecting the literature: several databases were used to have these results, such as ABI/Inform Global, ProQuest, and ScienceDirect. Then, we evaluated the papers by looking to the abstract, introduction, and conclusion to make sure any relevant study with valuable information was considered. Finally, we selected the most relevant papers (80 papers). Figure 1 shows the process we used in the search and selection phase:

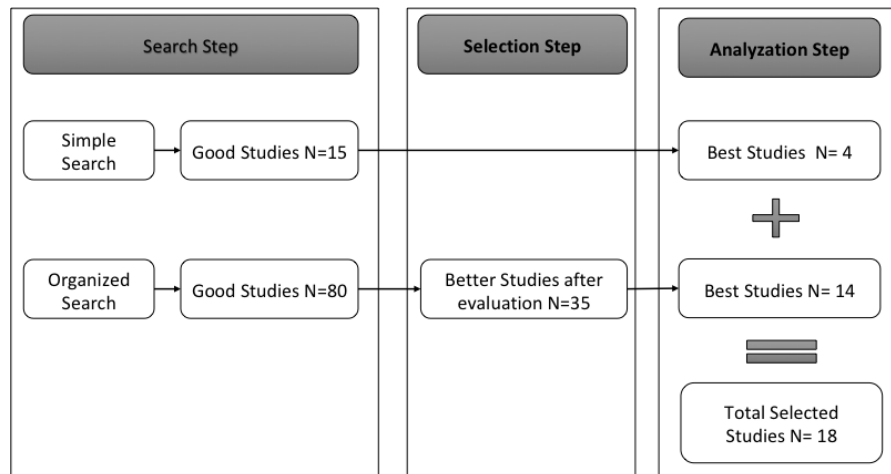


Figure 1 : Research approach for literature review.

The three steps are summarized in Figure 1, and the final total selected studies were 18 papers. In the selection step, we selected 35 studies. Papers were eliminated because of titles, abstracts, or duplication. Also, our goal was to focus on peer-reviewed articles, academic articles, and literature reviews. In the analyzation step, we narrowed down the selected studies to be N= 4 and N=14. We finally appraised each paper to have N=18 articles. The data was then used to create a knowledgeable background to answer the research question and to better understand lean startup, innovation, and entrepreneurship in the engineering management field.

FINDINGS

Results

Regarding lean innovation models, the literature demonstrates the effectiveness of the innovation assessment process. This is a cost-effective way to identify gaps in the innovation system. However, the literature also exposes weaknesses in the scoring measures of the assessment review. The authors suggest there should be further studies on this topic (Terry Frederick, 2014). This is an important insight because management tools and decision-making strategies should be applied to the bias of human behavior. It implies that assessment results are as good as the weighting methodology.

The literature found that lean startup models are reeducating processes (Negulescu, 2014). The notion of validated learning is an arduous technique for measuring progress in the context of high uncertainty, the context of startups. Validated learning gives proof that a team made truthful discoveries and ensures that data is not manipulated to hide failure (Jensen, 2007). The literature demonstrates that the lean approach to experimentation is more real, correct, and quicker than traditional business models and classical forecasting (Negulescu, 2014). Researchers suggest that classical business philosophies focus on executing perfect plans that have no good end. In the lean startup model, every step is validated through learning. All features of every product are passed through the scientific method to ensure that all outcomes are understood (Galli, 2018).

One interesting finding is that although the constructs of lean initiative advocate for a barrier-free organization concept, the lean startup initiatives may not work well with strategic planning conventions. This is because the process is lengthy and works against the notion of

quick experimentation. The concept of experimentation using the scientific method provides confidence to the manager to get started with a project campaign. Testing a hypothesis and obtaining satisfactory results means there is a product to build and test (Kalard, 2015). The purpose of going into the build phase is to enlist early consumer and commence experimentation on the new product. By the time the product is ready for mass manufacturing and distribution, there will be a market for it (Galli, 2017).

Authors found that in the public-private partnerships, specifically with universities, there were satisfactory results on the front-end processes. However, difficulty was found regarding value discovery. This phase was typically handled by the spin-off entity and not the university (Still, 2017).

Barriers

Barriers to lean innovations continue to be rigid company structure and culture. Some writers advised of the challenges of implementing lean innovations. Technology literacy and familiarity and experience with social media platforms are considered barriers to lean startup. Startups need great autonomy to work efficiently and to produce results. Traditional organizational structures discourage the cross-functional approach and impede the level of communication necessary to create an innovation culture. As a result, startup processes may not work well with traditional strategic planning methods for managers. Strategic planning takes time to develop, but a lean startup promotes quick experimentation (Galli & Kaviani, 2017).

Implications to the Field of Engineering & Project Management

Based on the papers reviewed, lean startup and project management coexist. A lean startup can be likened to agile project management teams. Working in sprints and scrums are what researchers refer to for internal startup. The agile approach focuses on inspecting the work every step of the way to correct deficiencies and to make improvements progressively. In agile, assumptions are made and then evaluated with the participation of stakeholders. Progressive improvement is made by testing new features continuously. Some authors argue that agile contributed to customer satisfaction in an environment of constant change, such as software development.

Based on the acquired skill and management strategies from the research, there is a need to make use of lean innovation models in conducting business projects and project management. This can be achieved by ensuring a lean innovation model approach that utilizes distinct skills to create a team that sees the company or project's ultimate goals. In this case, there is a need to invest substantially in lean innovation models before thinking of the mode of technology to use in the project or management. More specifically, these results highlight the importance of a top-down and bottom-up approach to leadership and strategic planning, especially when it comes to elements of lean innovation models, operations management, and process improvement. The results of this study highlight the criticality of integrating lean innovation models into the leadership styles and tools leaders use to manage their lean innovation models.

The findings from this study also highlight the importance of lean innovation models throughout all aspects of an organization; obviously, lean innovation models are an element in an organization's business model, but this study shows that the lean innovation models element directly impacts many other elements of an organization. Management and leadership of any organization need to have the training and skillsets to not only manage their lean innovation

models but also to effectively manage their overall organizational performance and innovation. This study has shown that many of the current-state issues seen within an organization's lean innovation models stemmed from the leadership's lack of effectively managing their employees and operational issues. If the leadership has the tools and knowledge to effectively manage their lean innovation models, instead of focusing on the bottom line (i.e., profits and costs), then the performance of an organization will improve. Thus, profits and costs will also improve.

Most importantly, this study highlights that business leaders tend to focus mainly on the financial elements of their business while ignoring or minimizing the lean innovation models element; this might work in the short-term, but the research shows that it is not a good long-term strategy. Over the long-term, leadership must have a multi-faceted approach where they manage all elements of the business, including lean innovation models, operations, HR, financials, performance, and strategy from one overarching understanding that all of these elements are critical and are all related. By understanding this view, a business leader will be better equipped to lead a successful company in both the short and long-term.

Contribution & Relevance

These variables, concepts, and models have been assessed in the majority of literature. However, a literature review has shown that the lean innovation models and how they relate have not been given enough attention in the literature. Thus, these aspects were addressed in this study, and a universal framework was also proposed. As a result, the research void within literature should be filled by this study.

There are several bodies of knowledge (i.e., project management, lean management, innovation, process improvement, and entrepreneurship) that are contributed to by the results of this research study. These results can enrich the information within these bodies of knowledge because they build upon pre-existing research and aim to address the research void. The key to having a better knowledge of these variables, concepts, models, and their relationships is to also know their advantages and disadvantages to better utilize these variables.

Additionally, this research provides new ideas for these bodies of knowledge in future research. Another goal of this study was to discover how the variables, concepts, and models relate to finding new perspectives on the factors under study. Finally, practitioners can benefit from the results and implications in this study, as new ideas can also be introduced to have these variables better utilized in the profession.

CONCLUSIONS

Recommendation for Future Research

Future research should explore a few different arenas. For example, future research could investigate these factors and the relationship in the context of other industries and managerial settings. In these settings or contexts, it would be interesting to study the strengths of these variables and the relationship, as well as the factors that impact these factors and their relationship. Another avenue of research could be to explore these factors and their relationship but from different perspectives, such as from an organizational, strategic, or cultural point of view. This would shed further light on how this relationship is perceived across many different views and further understand the degree of impact that factors, such as culture, strategy, human resources, operations have on the key variables and their relationship.

Future research is recommended in the areas of technology transfer regarding the relationship between business organizations and public research organizations, such as universities. The barriers inherent in the organizational structure of private and public sectors can be further studied to identify common grounds for collaboration. Another area of research can be the scoring criteria used in lean innovation model assessments. Finally, the relationship of the target actions grid and scoring assessment criteria can be researched.

Study Limitations

The major limitation as it relates to the research question is that most of the literature identified mainly discusses the methodologies, philosophies, and implementation of lean innovation models and lean startups. The literature was not necessarily informative regarding the application of lean startup outside technology and fast-changing environments.

The study and results are somewhat limited due to a few research limitations that should be discussed. The main limitation was the fact that the study had a limited sample size, and it only studied key factors from this limited sample size. The limitation of sample size introduces some potential bias and validity behind the findings and conclusions identified in the study, all of which could be alleviated by executing the study with a larger sample. Another limitation was that this study only examined the key factors and their relationship in terms of a project environment; therefore, the conclusions and analysis are specific to project environments and the findings cannot necessarily be extrapolated to other arenas, such as supply chain management, operations management, or strategic management. This is a limitation because the conclusions and analysis are specific; this limitation makes it difficult to argue that the findings from this study could be deployed and used in other industries or managerial settings.

Conclusion

As for what concerns innovation, it has been demonstrated that a focus on innovation culture and strategy, a tested business strategy, and a deep understanding of customer needs are foundational to adopt a lean innovation method. It is worth mentioning that the lean innovation model is not intended to be started from scratch, but to use existing processes and structures. Leveraging existing resources and the addition of investment in an innovative culture may produce better benefits that attempt a major organizational change. This makes the adoption of the profit cost-effective and provides opportunities to commence implementation without comprising resources.

A lean startup is an approach based on the scientific method intended to assist entrepreneurs in developing innovative services and products (Negulescu, 2014). The method stresses rapid iterations of business model components, customer insight, speed, and assertiveness. Cracking the lean startup concept to entrepreneurship can reveal an immense amount of human potential that has not been tapped into. The lean startup promotes testing assumptions, not as a form to create work, but as a legitimate way to uncover truths and insights regarding the project vision.

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