An integrated methodology for supporting the development and the performance evaluation of academic spin-offs

Gianpaolo Iazzolino, Domenico Greco, Saverino Verteramo, Andrea Luca Attanasio, Gilda Carravetta and Teresa Granato

Abstract

Purpose – *This paper aims to propose an integrated methodology for evaluating academic spin-offs (ASOs) for supporting both the development phase and performance evaluation. The ASOs have peculiar characteristics compared to other start-up companies and the debate on their evaluation is still open.*

Design/methodology/approach – *The proposed methodology, adopting a lean approach, faces the typical problems that characterize the growth of an ASO: the excessive attention to the technological aspects with respect to the commercial and managerial ones; and the need for evaluation systems that try to evaluate all risk areas and to highlight any misalignment. The methodology was built also starting from the results of an Erasmus + research project, co-funded by the European Commission, called spin-off lean acceleration.*

Findings – *The methodology proposes to monitor the main risk areas (market, technological, implementation, governance and financial). For each of these areas, at first, a framework and a checklist are proposed for supporting the qualitative assessment of the potential of each areas. In the second part, a set of metrics for monitoring the performances and to understand if the spinoff is developing in the right direction is proposed. Moreover, the methodology was applied to the spin-offs at the University of Calabria (Italy), and the paper reports the first results obtained.*

Originality/value – *A new canvas model (lean acceleration canvas), more specific and suited to the context of ASOs, was developed and tested. A lean approach has been adopted also for understanding the weakness of traditional methods. The proposed methodology could be used by the technology transfer offices in their institutional activity of supporting ASOs.*

Keywords *Performance measurement, Spin-off, Technology transfer, Canvas, Lean startup*

Paper type *Research paper*

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1. Introduction

The academic debate on innovation and technology transfer has underlined the role of high-tech startup companies, in particular, the academic spin-offs (ASOs).

An ASO – or university spin-off (USO) – is a new company that is established by the exploitation of core technology or technology-based idea generated within a university (Smilor *et al.*, 1990).

The interest in ASOs is relevant because they are considered as one of the results of the technology transfer policy of a university (the so-called third mission). More, in general, it is widely recognized the crucial role that the ASOs play in accelerating technology innovation and promoting economic development (Block *et al.*, 2017; Visintin and Pittino, 2014; Guerrero *et al.*, 2015).

The ASOs have peculiar characteristics compared to other start-up companies: being founded within the university by researchers, they offer an innovative product/service

resulting from university research. For this reason, they typically have great potential in terms of research and innovation but often their weakness depends on the fact that the founders are weak in terms of managerial and commercial skills. The success and growth of an academic startup depend mainly on the ability as follows:

- to combine technical skills with the real needs of the market;
- to manage the relationship with stakeholders (investors, universities, commercial and industrial partners); and
- to develop operational and management skills that often lack the founders (typically more focused on their technical skills).

Several actors are strongly interested in the evaluation process of ASOs: the universities because the effectiveness of their technology transfer policy is measured through the number, quality and performances of the ASOs (and consequently, this contributes to determining the number of public funds allocated to the single university). Also, external investors (as business angels, venture capitalists) are strongly interested to understand where is better to invest, starting from the high tech on the edge technologies usually developed by these kinds of firms. Obviously, the founders need to understand as soon as possible what the critical weakness is and how to better focus their business model. Therefore, great attention is devoted to the development of methodology supporting the evaluation of ASOs potentialities and their performances. As showed by Hossinger *et al.* (2019) and Mathisen and Rasmussen (2019), in their recent literature reviews, the debate on drivers, barriers, key success factors and evaluation methodologies for ASOs is still open: several factors have to be considered a different level of analysis (micro-level, university and environment) and there is not still a widely accepted framework or methodology. The traditional assessment methods, in fact, are designed for companies that operate in a structured manner, in which analysts have developed a certain experience and benchmarking capabilities. Consequently, they are based on a "waterfall" approach (the different stages of the development of a company can be considered as a linear sequence). In the start-up context, especially in the ASOs ones, this approach is losing. The "lean approaches" proposed, among others, by Ries (2011), Blank (2013) and Maurya (2012), propose a continuous adaptation of business model and operational choices starting from the continuous feedback provided by early adopters and others stakeholders.

Over the years, however, it is necessary to analyze the results actually achieved by the spin-off, to understand if, how and where to intervene to support company growth. The evaluation changes according to the years of the life of the startup and the phase of the lifecycle it is going through (the critical factors to evaluate and the weight of a result change depending on the considered phase).

Another open question is the perspective of the evaluation: *ex post* or *ex ante*. The "*ex ante*" evaluation systems aim to analyze the potential of the business, whereas the "*ex post*" ones the performance achieved. The problem is that sometimes these phases are managed with theoretical frameworks and tools that are not fully coherent with each other, and moreover, these methodologies are often designed to evaluate traditional companies, without taking into account the specificities of companies born in the academic field.

This paper proposes an integrated methodology for evaluating ASOs, the so-called LAC-lean acceleration canvas, for supporting both the development phase and the performance evaluation of ASOs. This methodology monitors five main risk areas (market, technology, implementation, governance and financial risk). For each of these areas, at first, a framework is proposed that can support the qualitative assessment of the potential. In the second part, a set of metrics is proposed that helps to monitor the performances and to understand if the spinoff is growing in the right direction. A set of performance indicators,

coherent with the LAC framework, has been developed. The proposed methodology considers also the different phases of the life-cycle.

The methodology has been developed within an Erasmus + research project, co-funded by the European Commission, called spin-off lean acceleration (SOLA). The partners involved in this project are nine European and Latin-American universities and their technology transfer offices (TTOs).

Moreover, the methodology was applied to a subset of eight spin-offs at the University of Calabria (Italy) and the paper reports the first results obtained.

2. Literature review: evaluation of academic spin-offs

Literature debate on ASOs that are companies created with the aim of commercializing academic discoveries, as well as developed technologies, is still open and evolving.

2.1 Factors affecting development and performance of academic spin-offs

A significant number of papers on the performance measurement of ASOs are focused on identifying the factors that influence the performances themselves (Bigliardi *et al.*, 2013; Hayter, 2013; Iacobucci and Micozzi, 2015; Helm *et al.*, 2018; Poponi *et al.*, 2017; Hossinger *et al.*, 2019; Mathisen and Rasmussen, 2019).

Visintin and Pittino (2014), suggests that business performance may be affected by the composition of the entrepreneurial team (Rodríguez-Gulías *et al.*, 2017). Evers *et al.* (2016) argue that the international relationships of involved researchers, typical of the academic world, strongly influence the internationalization of an ASO.

Other researchers argue that the calculation of spin-off performance depends also on the technological transfer systems implemented and the "incubators" available in the university of origin (Sternberg, 2014; Carrasco and Aceytuno, 2015; Furlan and Grandinetti, 2014; Minguillo and Thelwall, 2014; Vinig and Lips, 2015; Rodríguez-Gulías *et al.*, 2016; Soetanto and Jack, 2016).

Poponi *et al.* (2017) identified nine factors associated with the performance: sustaining the start-up, the heterogeneity of the founding skills, access to finance, environmental richness, network capital, size, reliability, innovation and motivation.

Many studies discuss the barriers and the reasons that hinder the growth of spin-offs (Ayoub *et al.*, 2016; Galati *et al.*, 2016; Neves and Franco, 2018), taking into account that creating an ASO is relatively simple, more difficult is supporting the growth, especially if the economic and social context is not favorable.

Barbieri *et al.* (2018) compare the work of the researchers, in terms of the number of publications made and the number of patents filed, before and after the creation of the company, as well as of the possible change of relationship with other companies.

Another critical point is to decide the right time, for a spin-off, to leave the university. The premature exit can lead to the failure of the company (Müller, 2008).

Furlan and Grandinetti (2014) identify, in the early years of a start-up, two development phases: incubation and emergency phase. They focus on the factors, for each of the phases that influence the survival and early growth of start-ups.

2.2 Methodologies for evaluating the academic spin-offs and measuring their performance

Research-based spin-offs are a particular case of start-ups: they are firms strongly based on an innovative product, as it directly derives from research. ASOs are potentially the most efficient way to transfer new technological knowledge into business, i.e. into new products

and services. This kind of start-ups has a great advantage, over patents or other transfer mechanisms that the tacit knowledge of the academics, which is otherwise so difficult to transfer, is indeed transferred – straight into a new company (Sternberg, 2014).

Many scholars analyzed methods for evaluating the performance of spin-offs, as well as the impact these have on the surrounding environment both in terms of economic and social development (Cesaroni and Piccaluga, 2015; Iacobucci and Micozzi, 2015; Brown, 2016; Del Giudice *et al.*, 2017; Helm *et al.*, 2018; Boh *et al.*, 2016; Fini *et al.*, 2017). Some authors studied the value creation measurement in knowledge-based organizations (Iazzolino and Laise, 2016).

Helm *et al.* (2018) compare different kinds of indicators (not only financial but also economic) to measure the performance of companies. They propose a theoretical framework for evaluating the performance from a different point of view, but it is still not clear if the spin-off classification varies according to the index used.

Cesaroni and Piccaluga (2015) identify the variables necessary to evaluate the efficiency of the knowledge transfer (KT) office. They measure it in terms of the success in commercializing the generated technology, and more in general, to concretize the so-called "third mission." The amount of KT generated by Italian, European and US universities was compared.

Vinig and Lips (2015) present an innovative approach to measuring university technology transfer performance using meta-data analysis. In particular, they use the research products (patents, licensing deals and spin-offs) as meta-data to estimate the potential for technology transfer.

However, the analysis carried out shows that a methodology has not yet been developed specifically for the rating of ASOs.

2.3 The lean approaches for supporting startup development

Several statistics note that the startups have a high level of failure: 75 per cent following a Harvard Business School's Shikhar Ghosh research (Blank, 2013).

One of the main reason arise from the difficulty to define and make stable their business models. Many scholars started to analyze that this condition is structural for a startup, then the typical tools supporting the first phase of innovative new venture firms are not suitable in this case. The business plan, for example, following a waterfall approach (based on a linear sequence: idea generation, search a technical solution, build a business model, implement this solution and collect the feedback), determines the typical situation shown in Figure 1, where the amount of resources allocated are maximum in the first phase, but customer feedback is evaluated only in the last phases, when a large amount of resources are now lost, especially in the case of hypotheses not validated by their target market.

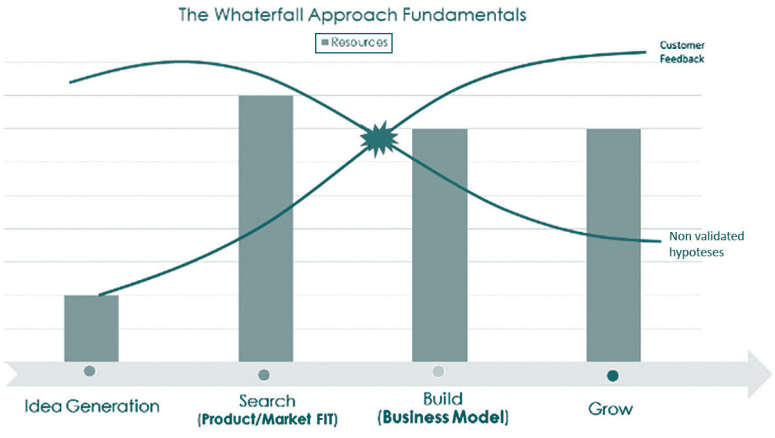
A startup seeks its balance through the definition of its own business model. The balance must be:

- overall because the development areas of a spin-off are different and each is fundamental for the success of the business project; and
- dynamic because, in full compliance with the principles of lean thinking, the balance must be built and fed through tests and feedbacks that generate learning as a necessary tool to decide, which development path must be chosen.

According to the lean startup methodology (Ries, 2011) the learning process of the new company is based on some fundamental activities including:

- tests and feedback collection;

Figure 1 The waterfall approach



Source: Greco *et al*. (2016)

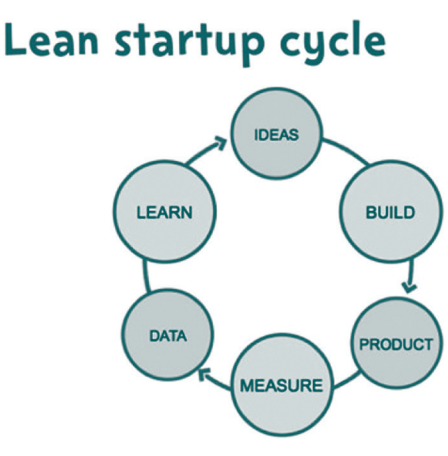
- feedback measurement and evaluation; and
- learning based on tests.

Figure 2 shows more in detail the phases related to the learning process.

Blank (2013) proposed the customer discovery process method, which outlines the ideal path of a startup in the phases represented in Figure 3.

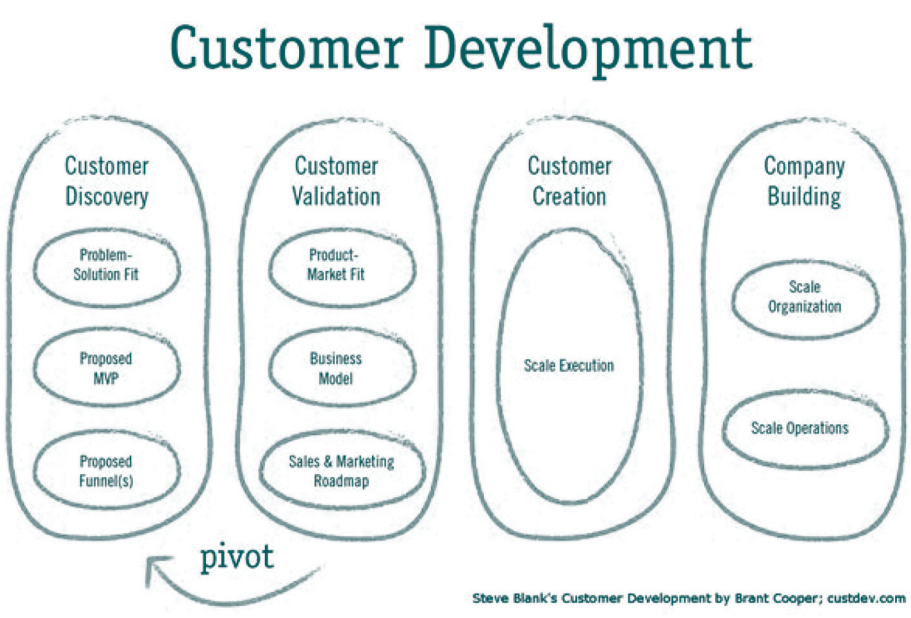
It is clear that the initial phases of discovery and validation are essential for the business model research, rather than for its execution. This activity, moreover, is a typically managerial activity related to a waterfall approach, based on the implementation of strategic plans (business plans) based on already validated hypotheses that obviously a startup cannot have.

Figure 2 The lean startup cycle



Source: Ries (2011)

Figure 3 The customer discovery process

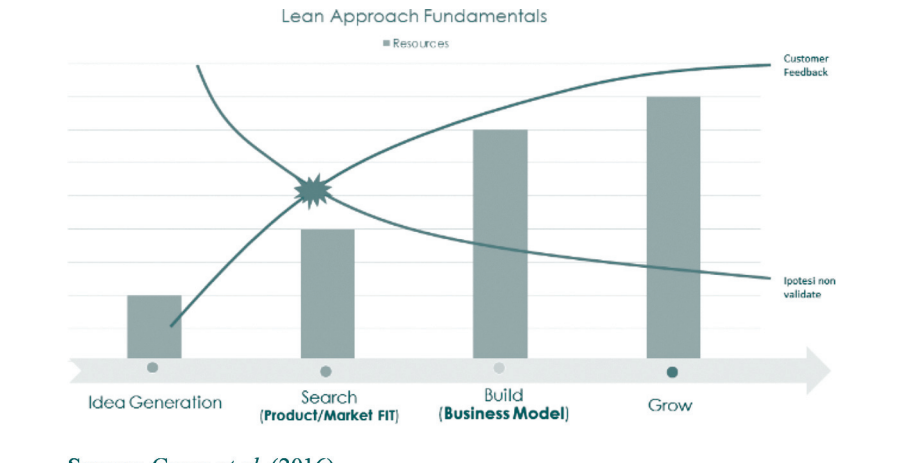


Source: Blank (2013)

It is these difficult affirmation and development conditions for the startups that have favored the birth and development of the lean startup approach as a valid alternative to the waterfall approach. It can be noted the differences between the two approaches, with respect to the expected economic fundamentals of the business project as shown in Figure 4.

Practically, the lean approach makes possible to replace quickly not-validated hypotheses because of feedback collected from customers – in this case early adopters – already in the

Figure 4 The lean approach



Source: Greco *et al*. (2016)

critical phases of the startup project (product-market FIT), in which the invested resources (not only financial) are still "low" (compared to the waterfall approach), and above all, manageable with a pivoting methodology.

According to the most recent and established approaches, it is necessary to conceptualize a business model to describe and visualize the startup logic to create, supply and capture value. The most recent innovations in this sense refer to the use of the "canvas" models, which help to "visualize" the ways a startup creates value, and above all, enable all the benefits of visual thinking, today an increasingly affirmed and effective methodology for the development of "innovations in organizations." The most widespread and appreciated contributions in this sense are those proposed by Osterwalder and Pigneur (2010), and more recently, the one proposed by Maurya (2012) that can be considered as an upgrade of the first business model canvas in lean perspective (Figure 5).

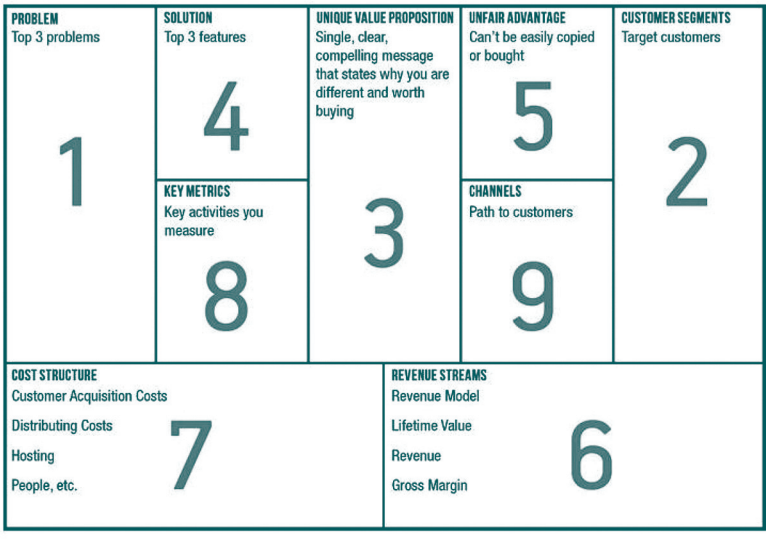
These models have the worth of effectively breaking down, within a canvas, "problems to be solved or tasks to be performed" typical of a startup project. The canvas is then used as prototypes of business models, to be refined and consolidated through continuous cycles of experiments and tests.

3. The proposed methodology for evaluating and measuring academic spin-off performance

The debate on start-up performance evaluation is still open. The traditional assessment methods are designed for companies that operate in a structured manner: vice versa startups are by definition looking for a more stable definition of the product, market, business model, organizational structure and partners.

The ASOs have peculiar characteristics compared to other start-up companies: drivers, involved stakeholders, barriers and key success factors are more complex compared a typical start-up company (Hossinger *et al.*, 2019; Mathisen and Rasmussen, 2019). For this

Figure 5 The lean canvas



Source: Maurya (2012)

reason, they typically have great potential in terms of research and innovation but various factors can influence the final result.

Various kind of stakeholders are interested to understand as soon as possible, which ASOs are more promising and where to invest and allocate the resources supporting their growth: these stakeholders can be both private investors (as business angels and venture capitalist) and public actors (as universities interested in increasing their "third mission" through, for example, the TTO).

Therefore, these stakeholders are looking for methodology specifically "ASOs calibrated" both for recognizing the potential in the early stage and for measuring if the growth is going toward a sustainable and scalable path in the next stages.

The starting point is that before measuring quantitative performance, the critical point for an ASO is to understand as soon as possible if the main typical risk areas are adequately managed. Market analysis, partnerships and managerial operating issues are frequently underestimated from researchers more oriented to technical matters.

Another critical point is to adequately consider the age class of companies, taking into account that before arriving at complete consolidation, the spin-off goes through specific stages in the first years of life (Furlan and Grandinetti, 2014) that need to be analyzed by using different indicators.

Thus, it is important to design a performance evaluation system taking into account both the potential and the actual results of an academic startup (and the lifecycle stage).

3.1 The lean approach adopted for designing and defining the proposed methodology

The methodology here proposed has been developed within an Erasmus + research project, co-funded by the European Commission, called SOLA. The partners involved in this project are nine European and Latin-American universities and their TTOs.

The aim of the research was to design a methodology that could be used first of all by the TTOs and by the university incubators in their institutional activity of supporting ASOs.

Several scholars analyzing the startup's development consider the lean approach very effective because it is founded on the continuous refining of the first proposed solutions taking into account the validation received by the early adopters.

Although the previously presented canvas models based on lean approach for startups are very effective and successful, in this research work it was considered appropriate to define a model that can answer more directly and comprehensively to the needs of university spin-offs, characterized by very specific problems on which the most recent models (especially the last "lean canvas") do not place the necessary emphasis.

The most widespread model of lean canvas focuses particularly on three aspects of a startup risk/value: product, customer and market (Figure 6).

The model has to be adapted to the specificities of ASOs and to the contribution that the TTOs or incubators can offer.

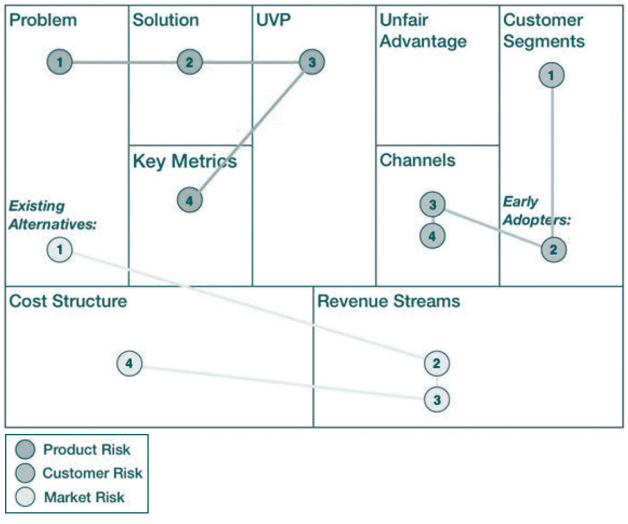
There are two main questions:

Q1. What are the critical issues of university startup that have to be take into account?

Q2. What is the TTOs specific contribution to the ASOs that can be improved with the use of a lean methodology?

Following a founding principle of the lean approach, ("get out of the building," that is "go outside to learn") the first choice has been to directly involve a "startupper" with particular

Figure 6 Lean canvas for startup



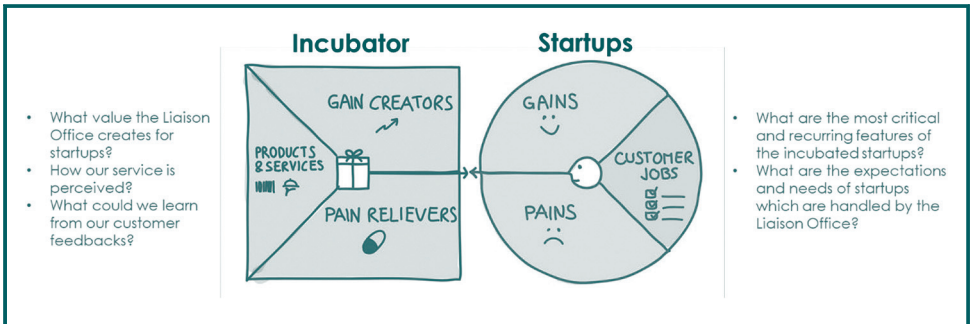
Source: Maurya (2012)

sensitive to the lean startup methodologies, to have precious "in house" examples, practices and methods.

The second step has been the choice of a methodology, based on the idea to apply the statement: "to develop a lean project we must think lean": a known canvas model has been applied to highlight the current and desired product-market FIT between the TTO (the incubator "Liaison Office" at University of Calabria in the real case) (supplier) and startups incubated (customers). The application of this model has a two-fold objective as follows:

1. to respond in a systematic and demonstrable way to the questions outlined in Figure 7, to approach the development of a specific "spin-off lean canvas"; and
2. to apply and to learn how to use a basic model to support startups on the market-fit concept.

Figure 7 The issues addressed for developing the ASOs lean canvas



Source: Greco *et al.* (2016)

Because of this approach, it was possible to clearly and operationally highlight the spin-offs needs and expectations, a fundamental starting point for the design of a new analysis framework specific for spinoffs.

Five workshops were held in this phase and the following sections describe the methodology elaborated by the actors involved in the research project.

3.2 The "lean acceleration canvas" framework

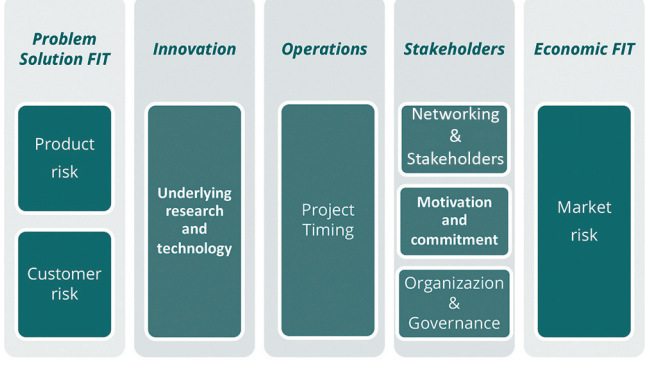
Following an analysis carried out jointly by the TTOs involved in the project, some critical features were found, additional to those of the generic startups, which the general lean model canvas underestimate:

- *Governance and organization*: what are the expected roles in the startup and how is the leadership distributed on the most important decisions?
- *Networking and stakeholders*: which stakeholders are needed to make the project sustainable? How can we meet the expectations of the stakeholders involved?
- *Management skills*: what are the currently available skills and which ones are missing and should be acquired?
- *Motivation and commitment*: how much have they decided to invest the founders, not only monetarily but also in terms of commitment?
- *Scientific research and/or underlying technology*: what are the research studies underlying the startup? Which intangibles are connected to the underlying research and/or technologies and how can they be valorized and defended?
- *Project timing*: how long will it be possible to obtain a first minimum viable product (MVP)?

Due to the nature of the ASOs and their characteristics, the proposed methodology is focused on a canvas model based on five fundamental risk areas, three of which specifically cover the criticalities of the spin-offs while the remaining two refer to the critical risk elements already considered by the lean canvas (Figure 8):

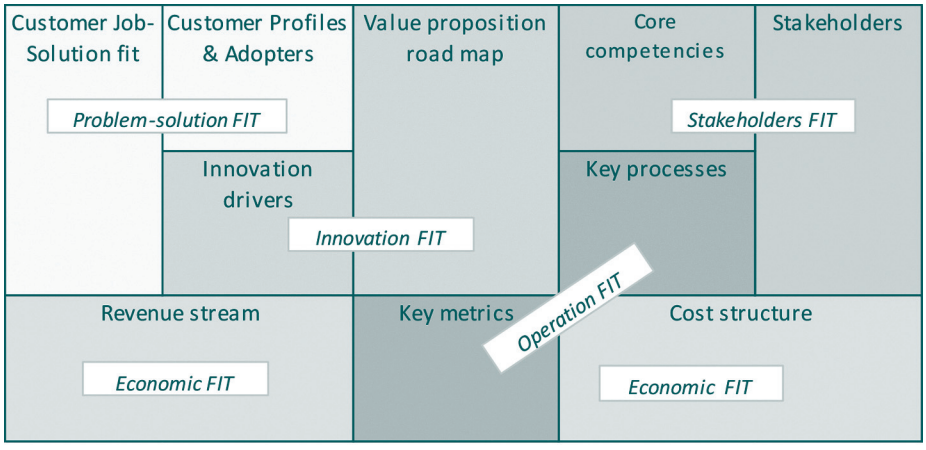
Each of the areas identified is necessary to achieve a dynamic balance in the development of the business as follows (Figure 9):

Figure 8 LAC: the five risk area



Source: Greco *et al*. (2016, 2017)

Figure 9 LAC framework: the five FIT to be analyzed



Source: Greco *et al.* (2016, 2017)

- problem-solution FIT: market risk;
- innovation FIT: technological risk;
- operations FIT: risk of implementation;
- stakeholders FIT: risk of governance; and
- economics FIT: economic and financial risk.

The model breaks down the spin-off evaluation into 5 macro-areas and 10 blocks. Each macro-area identifies a critical element for the risk and the value of the spin-off, while each block represents an operational problem that lends itself to specific solutions, facilitated by the use of certain methods of analysis and design thinking techniques.

3.2.1 Problem-solution FIT. The first macro-area of the model (problem-solution FIT) takes into consideration the ability of the basic idea of the spin-off to effectively satisfy market expectations. Specifically, there are at least two operational problems to be addressed in this area as follows:

1. to identify the most "important" problems or job-to-be-done for the target customer profile and the product alternatives available today; and
2. to identify the possible early adopters, which are the target customers to test the product and to provide the right knowledge for its development; from this first target customers, it will be possible to derive the necessary knowledge to "trace" the final spin-off target market.

This is the main risk factor and the most difficult challenge for each startup: the consistency of the associations between solutions and jobs/problems of a well-defined target market.

3.2.2 Innovation FIT. First, once the objective characteristics of the product/service and the target market have been identified, it is necessary to implement a product development roadmap, taking into consideration the main elements of the innovation generated. In this second macro-area, we face the second fundamental element of dynamic equilibrium for the spin-off: the innovation FIT, i.e. the ability to introduce effective product innovation through a sustainable roadmap for the target market.

3.2.3 Operations FIT. Once the development of the value proposition aspects has been defined from a lean perspective, each spin-off must organize the operations necessary for its customer discovery process. In particular, it is necessary, to activate and organize the processes that will enable the relationship with the customers and the market in general.

3.2.4 Stakeholders' FIT. One of the most critical but less debated aspects of the recent "start-up thinking" refers to the balance between the reference stakeholders for a spin-off before attempting amazing climbs, even before the validation of a (hopefully) successful product. This section deals with the decisive challenge of building and maintaining a stakeholder FIT, i.e. a balance between the necessary core competencies and the various stakeholders involved in a spin-off; this challenge is crucial to activating concrete possibilities to scale the business.

3.2.5 Economic FIT. Every choice concerning the macro-areas examined above and the FITs that derive from them obviously influences on the economic variables of the spin-off. Of course, that a spin-off can be truly sustainable, it must find a consistent FIT between the fundamental variables of revenues and costs represented in the two final blocks of the LAC model. Coherently with the "customer-centric approach" here adopted, the revenue block have to be analyzed first because it is the main unloading point of the relationship with the "final" customer and it is the result of both the value recognized by each customer and the growth engine of the customer base.

3.3 The first part of the proposed methodology: supporting the development of academic spin-offs

Starting from the LAC framework just described, a series of issues to be investigated (Table I) were identified (qualitative part). These issues have to be evaluated through interviews held by a team of evaluators with the founders. The information obtained from the interviews are necessary to provide an overview of the company situation and to know its evolution over time. The interviews have to be conducted by at least three evaluators who, first individually, and then as an evaluation group, express a qualitative judgment on each of the aspects investigated, both by giving a score from one to six and by noting relevant aspects. Tables II and III are an example of the evaluation sheets held by the evaluators during the interview.

The weights of the various aspects considered change as the age class of the ASO being evaluated varies. The team of evaluators before establishes them jointly to start. The numerical evaluations of the individuals are appropriately normalized and summed to obtain an overall score and the overall judgments are given to the founders.

For example, the evaluators, within the SOLA project in which the methodology was developed and applied, were members of a TTO interested in monitoring the progress of incubated startups to support them in the growth process and the allocation of resources.

The average scores obtained by the spin-offs can be reported in diagrams showing more clearly where the weak areas are, as well as the evaluations that emerged during the meetings are very useful to the founders.

Table I First part of proposed methodology: the issues to be analyzed through in-depth interviews

Problem-solution FIT	*Innovation FIT*	*Operations FIT*	*Stakeholders FIT*	*Economics FIT*
Problem to be solved	Central innovation	Development and prototyping	Team skills	Revenue stream
Solution offered	Mega-trends	Production process	Team compactness	Cost structure
Early adopters	Intangibles	CRM	Partnerships	Resource plan
Targeting	Protectability	Metrics	The clarity in agreements and programs	Business scalability
Market potential	MVP	Priority	Involvement	The readiness of the investment

Table II An example of the evaluation sheet on market risk

Problem-solution FIT: market risk	*Qualitative evaluation (scale from one to six)*	*Weight (depending on age group)*
Focus on the problems to be solved How good were they to identify the most important market target problems to be solved?		
Focus on the solutions to offer How good they were in defining the solutions they intend to offer to solve the problems of the target		
Focus on early adopters How good are they in defining and identifying early adopters?		
Focus on targeting How well have they been able to identify and describe their market targets practically?		
Market potential How important is the market potential to which the startup can aspire?		
Total evaluation		

Table III An example of the evaluation sheet on technological risk

No.	*Innovation FIT: technological risk*	*Qualitative evaluation (scale from one to six)*	*Weight (depending on age group)*
1	*Central innovations in the solution* How do we evaluate the uniqueness of the innovations made?		
2	*Mega-trend* How do we evaluate the correlation between the proposed innovation and the current social and market trends?		
3	*Intangibles* How much awareness is there regarding intangibles related to innovation?		
4	*Protectability* How much do we think they were good at defending innovation?		
5	*MVP* What skills do in predicting MVPs and the resulting iterations?		
	Total evaluation		

3.4 The second part of the proposed methodology: the performance evaluation of academic spin-offs

The second part of the methodology aims to define appropriate quantitative indicators that refer to the obtained performance in the various areas identified in the LAC framework.

This part aims to provide an evaluation of the sustainability and scalability of the business model pursued by the existing startups.

Coherently with the multidimensional approach before adopted, the key performance indicators (KPIs) and the metrics measured have been organized following a balanced scorecard approach based on the five dimensions identified in the LAC model (Table IV).

Tables V and VI are an example of the metrics considered for two of the five dimensions here proposed. Data have to be collected both through a survey and public data.

The weights of the various aspects considered change as the age class of the startup being evaluated varies. The resulting values are appropriately normalized and weighed to obtain

Table IV Second part of proposed methodology: the KPIs to be measured and monitored

Problem-solution FIT	*Innovation FIT*	*Operations FIT*	*Stakeholders FIT*	*Economics FIT*
Commercial independence Strong customer relationships Customer traction Product traction	Efficiency in innovation Investment in innovation Human capital Continuity in research Implementation efficiency Validation	Efficiency in product development Customer traction Operational growth Efficiency of HR management	Relationship with the university Social structure Skills in spinoff	EBITDA Revenue Asset turnover Value-added % Research Capitalization Intangible assets

Note: HR = Human resources

Table V KPIs and metrics for market risk

Problem-solution FIT *KPI*	*Metrics*
Commercial independence	1/% Turnover main client
Strong customer relationships	% Relevant turnover
Customer traction	Turnover last year/number of years of activity (last balance sheet)
Product traction	Turnover last year/no. products TRL 5-9

Note: TRL = technology readiness level

Table VI KPIs and metrics for technological risk

Innovation FIT *KPI*	*Metrics*
Efficiency in innovation	Number of IPR titles/years of seniority
Investment in innovation	Intangibles/total fixed assets
Human capital	The number of projects funded/years of seniority
Continuity in research	Number of people employed with PhD or master/total workers
Implementation efficiency	Number products TRL 5-9/years of seniority
Validation	No. customers/No. products TRL 5-9

Note: IPR = intellectual property rights

the appropriate rankings by dimension, company and the distance from the reference threshold values.

3.5 The overall evaluation matrix

The application of the methodology ends with a joint analysis of the qualitative and quantitative aspects, and therefore, it is possible the ranking of companies.

In particular, the principle adopted was that the two different types of evaluation converge to the same final objective and mutually reinforce each other with their differentiated values and repercussions (Figure 10).

The qualitative first part of the proposed methodology refers to the potential of the business model the quantitative second part validates the results obtained by the considered startup.

Cross-referencing these two dimensions (qualitative-potential evaluation and quantitative-validation evaluation) we can define an overall evaluation matrix (Figure 11) that allows us to get important suggestions on how to support the growth and how to eventually correct the startup's choices.

Figure 10 The mutual relation among the two part of the LAC methodology

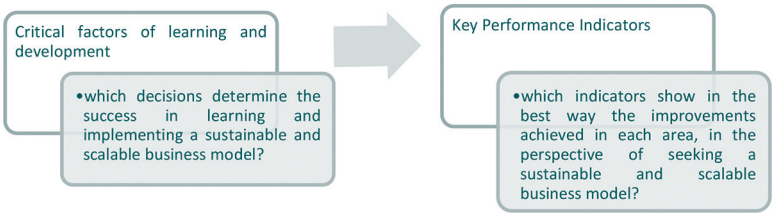
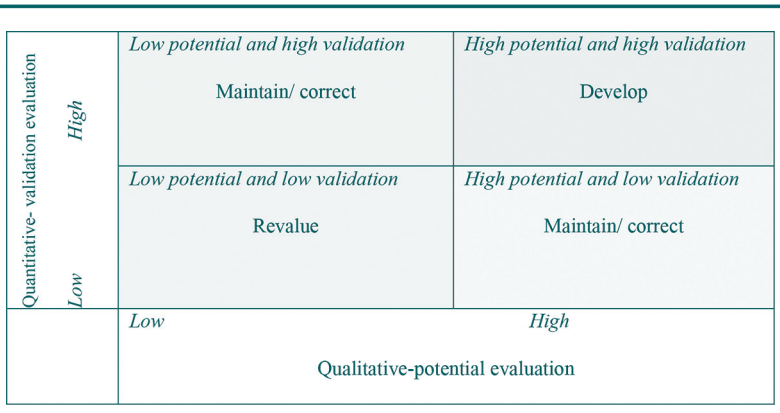


Figure 11 The overall evaluation matrix



4. An application of the proposed methodology on spin-offs at the University of Calabria: first results

The University of Calabria, in the south of Italy, is a medium university with near 30,000 students and 800 research assistants and professors. A TTO coordinates the technology transfer activities, and various startups can be hosted in an incubator. This methodology has been proposed to a sample represented by 37 spin-offs from the University of Calabria (of which 35 per cent in the 0-3 years of age range, 19 per cent in the 4-6 years of age range and the remaining 46 per cent in the upper-end group at 6 years of age). Following the proposed methodology these startups have been subjected to a questionnaire aimed at investigating the data related to 2015 and a series of in-depth interviews voluntarily.

The ASOs completing all the processes are eight and Table VII summarizes their characteristics.

Table VIII summarizes the results obtained within the two phases of the proposed methodology (company names are hidden for confidentiality reasons).

The data have been appropriately normalized so as to make them comparable by area and for an overall evaluation (Table IX).

These values can be positioned on a graph, as shown in Figure 12 by positioning the axes along with the value of the medians, it can be observed that the analyzed sample of ASOs is distributed among the four quadrants identified by the proposed overall evaluation matrix. The suggestions deriving from the application of the matrix are consistent with the qualitative evaluations emerged during the analysis phase.

Table VII The sample of startups analyzed

Startup	*Main activity*
Case A	Big data analysis on the cloud
Case B	Food processing technologies
Case C	Construction of industrial chemical additives
Case D	Cosmetic and pharmaceutical
Case E	Processing of anticancer therapies
Case F	Software innovation engin. modeling analysis
Case G	Design of sensors for structural failure monitoring
Case H	Food safety testing services

Table VIII The results obtained for each area

KPI analyzed	*Case 1*	*Case 2*	*Case 3*	*Case 4*	*Case 5*	*Case 6*	*Case 7*	*Case 8*
Qualitative evaluation								
Product-market FIT	0.89	0.65	0.99	0.96	1.00	1.00	0.81	0.82
Innovation FIT	0.76	0.54	0.91	0.99	1.00	1.00	0.56	0.65
Operations FIT	0.41	0.63	0.84	1.00	0.99	0.93	0.61	0.66
Stakeholders FIT	0.44	0.63	0.54	0.87	0.95	0.84	0.61	0.59
Economics FIT	0.03	0.51	0.80	0.82	1.00	0.86	0.58	0.70
Quantitative evaluation								
Product-market FIT	0.12	0.31	0.29	0.30	0.09	0.22	0.46	0.72
Innovation FIT	0.42	0.30	0.28	0.37	0.80	1.00	0.49	0.24
Operations FIT	0.36	0.48	0.24	0.54	0.42	0.29	1.00	0.70
Stakeholders FIT	0.47	0.87	0.15	0.72	1.00	0.79	0.80	0.93
ECO FIT	0.05	1.00	0.30	0.58	0.74	0.30	0.24	0.20

Note: KPI = Key performance indicator

Table IX The overall evaluation

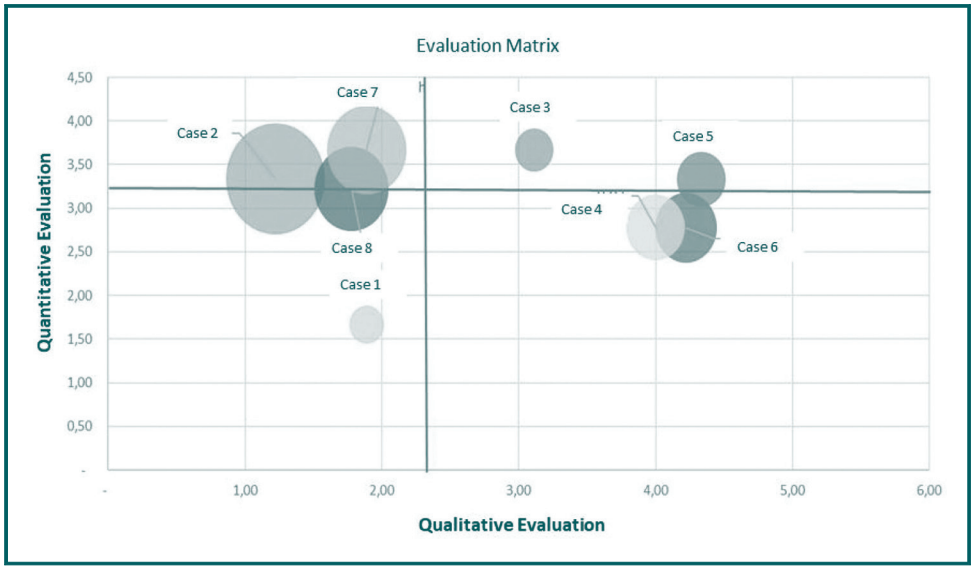
Cases analyzed	*Qual. score*	*Quant. score*	*Suggestion*	*Notes*
Case 2	3.11	3.67	Develop	Convergent assessments
Case 5	4.33	3.33		High potential and good validations
Case 2	1.22	3.33	Maintain- correct	Prospective business model not clearly defined
Case 7	1.89	3.67		
Case 8	1.78	3.22		
Case 6	4.22	2.78	Maintain- correct	Market validations to be improved
Case 4	4	2.78		
Case 1	1.89	1.67	Revalue	Stalemate

5. Discussion

As stated, the arrival point of the methodology involves the integration between the qualitative assessments produced through the LEAN sessions and the quantitative ones of a monitoring system. This integration should lead to a very complete rating system, in which the different and synergetic properties of the two different types of evaluations are exploited as follows:

1. quantitative assessments refer to historical data and can be defined *ex post*, highlighting the progress that in a given period produces spin-offs in terms of validation of the business model. Being based on a reading of the data, they strongly reduce the subjective component with respect to qualitative evaluations; and

Figure 12 The matrix evaluation



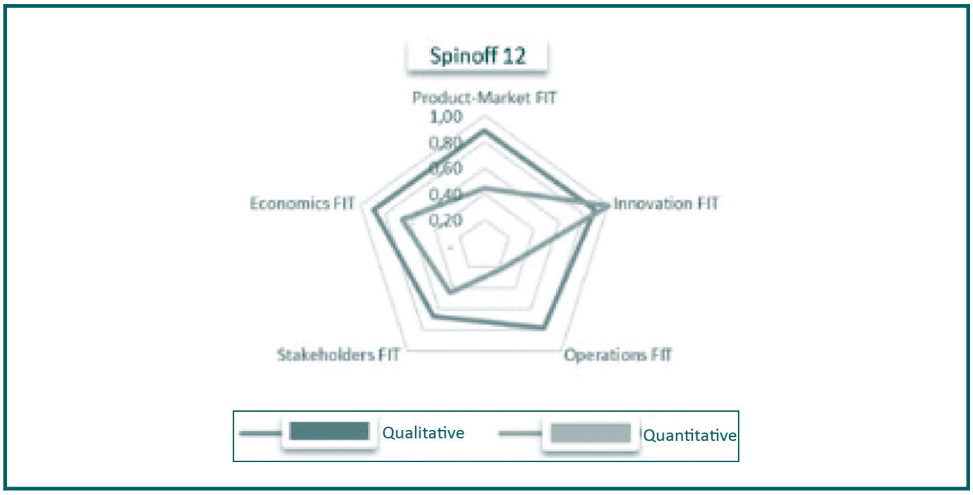
2. qualitative assessments refer to perceptions and information that evaluators can draw from a lean session and refer more than anything to *ex ante* evaluations, i.e. based on the prospects of the business model. In this case, the subjective component is very high (although mitigated by the use of methodologies that improve over time), although they allow us to grasp aspects that certainly escape the quantitative evaluations.

Every good rating system has a mix of both assessments so that the integration of these two approaches has also been envisaged in the SOLA evaluation protocol, functional to the acceleration processes, as illustrated below (Figure 13).

Comparing the scores obtained by each spin-off in the two phases and for each area of investigation, it is possible to recognize different situations: there may be, for example, cases of spin-offs that have poor performances but that can be judged differently depending on whether they have great potential or depending on the years of life. In Figure 14 an example of graphical representation of performance is shown.

Figure 13 The steps required by the methodology for supporting ASOs

Figure 14 A possible graphical representation of the evaluation for an ASO



Finally, the application of the large-scale methodology and the definition of a rating system can lead to numerous advantages, at different levels as follows:

- at the university level, the TTO: can provide an important service to its spin-off companies, accompanying them, with assessments and precise indications, in their process of growth and acceleration; and can represent an overall framework of their spin-off portfolio, giving them the possibility of defining intervention actions; and
- at a general level, moreover, there could be a system for comparing the spin-offs of universities in a specific territory, region, nation that is potentially usable by many stakeholders of the innovation system, from investors to policymakers.

6. Conclusions

A new canvas model (LAC) was developed and tested, more specific and suited to the context of ASOs.

Moreover, the methodology was applied to the spin-offs at the University of Calabria (Italy), and the paper reports the first results obtained.

The proposed methodology tries to face the typical problems that characterize the growth of an ASO as follows:

- the excessive attention to the technological aspects with respect to the commercial and managerial ones; and
- the need for evaluation systems that try to evaluate all risk areas and to highlight any misalignment, in particular, between the market and academic research.

A problematic approach to the market, in fact, leads to limited turnover, which consequently limits the balanced development and the resources for becoming autonomous from the "protective" context of a university environment.

The methodology proposes to monitor the main risk areas (market, technological, implementation, governance and economic-financial risk). For each of these areas, a framework and a checklist are proposed that first helps the qualitative assessment of the potential and of any areas not properly managed. In the second part, a set of metrics is proposed that help to monitor the performances and to understand if the spinoff is developing in the right direction.

In this context, the crucial role of TTOs emerges: they can help spinoffs in assessing the major risk areas and focus the strategic priorities to be faced. Moreover, they can offer services and advice in typically weaker areas for this type of company.

All this is accomplished with the primary objective to support the spin-offs growth, but more deeply contributing to the economic and social growth of the territory, thus concretizing the "third mission" of the university (Brown, 2016).

One of the main limitations of this work is the limited size of the analyzed sample. The objectives are certainly challenging and to be able to obtain the necessary assumption is that of a wider possible application of the spin-off methodology of various universities and in various countries, to be able to summarize the common elements of this particular category of startup.

This limited size of the considered sample is due also because of the difficulty to collect homogeneous quantitative data, above all with companies at the first stage of their lifecycle, when the development path is often very specific.

Another critical point is the decision about the weights to give on different areas and to the different class ages: to have an overall evaluation and ranking is very useful but the results strongly depend on these weights.

Further, future development is the extent the results testing the methodology on ASOs coming from other universities or on sample homogeneous for industry and technology.

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Further reading

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