

# Technical Due Diligence as a Methodology for Assessing Risks in Start-up Ecosystems

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**Abstract:** The dynamics of transformations that the world is experiencing at global dimensions due to the intensity of technological changes demand sophisticated management tools to assess risks in the business and industrial sectors, aimed at ensuring investment security. The objective of this article is to analyse and propose the technical Due Diligence as a methodology to assess risks in Start-up ecosystems. The method used was mixed; a quantitative approach, and the qualitative approach, supported by a literature review with bibliographic arches. The sample was composed of thirty (30) experts, to whom a survey was applied, and to (10) of them, an interview that was subjected to a process of triangulation of the information, which was supported by documentary arches. The results showed the need to identify technological risks (product, service and process); commercial risks regarding the scalability of the business; and financial, legal, fiscal and environmental risks as part of a comprehensive and integral procedure.


## 1 INTRODUCTION


In the Due Diligence process, it has been used as part of a set of good practices when developing assessment procedures on the behaviour of marketing activities in the markets, where entrepreneurs, investors, suppliers, customers and competitors are involved and who are about to sign purchase and sale contracts, here these operations are evaluated in terms of legality, requirements, financial management and physical conditions of the property before executing the transactions, which are subject to regulatory compliance.


For example, many organizations engaged in foreign trade must be reviewed with the rigorosity of the case with a detailed analysis, to rule out the existence of sanctions and penalties by any of the international bodies with the capacity to catalog fraudulent operations, which constitutes a significant risk, which must be weighed at the time of making a decision by the investor; the objective is to limit the risks at all costs to protect it from unforeseen costs.

For its part, the technical Due Diligence in Kiziniwicz's speech quoted by (Kutera and Anysz, 2016) "comprises three detailed analyses of the property: legal, technical, financial". It is usually associated with the valuation of a property (land, infrastructure, buildings, machinery, equipment, systems, products, services or processes), but also emphasizes patents, trademarks, intellectual property, reservation of title, among others, it is an essential methodology for making business and industrial decisions, which involves the detection of risks in the present and future before a possible transaction or commercial operation involving large capitals.

Now, this technical due diligence methodology plays a relevant role in the Start-ups ecosystems, business model that from the industry and globalization 4.0 as phenomena in full effervescence "focused on artificial intelligence, nanotechnologies, the internet of things, digital skills, creativity (...)" (Arévalo and Fuenmayor, 2020), are built from the acceleration in the technological and digital revolution for transformation, which can reuse technologies, this is precisely what entrepreneurs take

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advantage of, they take the current trends, study them rigorously, measure the impact it will have, the evolution, projection and the way the product or service is adapted to the changes to come, Here investors capture these initiatives to obtain great economic benefits, for this, they must make sure of the business opportunities, physical characteristics, property, code, systems, the risks that surround it and other aspects to avoid defects that lead to financial losses.

This article focuses its efforts on analyzing and proposing the technical Due Diligence as a methodology to assess risks in Start-up ecosystems, since these business initiatives are loaded with exponential digital technologies represented in a set of technical specifications that require to be detailed with the rigorosity of the case by a multidisciplinary and interdisciplinary team of experts in various areas to know the operation of the product, services or processes that will be offered in the market by investors, hence the importance of the methodology within the transaction process to materialize a purchase-sale contract, this tool provides good management practices that provide reliability and impartiality.

This paper is structured as follows. Section 2 describes the existing literature on Technical Due Diligences and Start-ups. Section 3 is oriented to explain the research method used to obtain the results. Section 4 shows the results and the proposed methodology (TDD). Last, section 5 explains the conclusions reached after carrying out the research.

## 2 TECHNICAL DUE DILIGENCE AND START-UPS

The *Technical Due Diligence*, methodology oriented to a verification or audit on a property or asset, whether tangible or intangible, the conditions in which they are (state in physical terms and operation), the market price after determining the depreciation if any, in short, all the attributes that characterize it. *Technical Due Diligence* is a "process of analyzing the technical aspects of a product or service. It usually takes place before fundraising rounds and mergers and acquisitions. These complex transactions require strict due diligence investigation (...)" (Gilmanov, 2019).

From another point of view, this methodology is used when a process of buying and selling any real estate is underway, where it is essential for the investor to know, unravel and manage in advance the

different technical risks that could influence the commercial operation (Aguirre and Baeza, 2019).

The purpose of this method is basically to know from a technical point of view the entire life cycle through which the property has gone through (design, maintenance and operation), to ensure the investor that the possible risks that are being generated are detected in time, which for the purposes of this article is based on the *Start-ups* ecosystems, loaded with technological platforms (servers) and systems (software), from here will focus on this type of assets with tangible and intangible qualities, which require specifications, source code, patent, originality in the production of software and many other features, which will provide sufficient guarantees to make a decision on the business.

The *Technical Due Diligence* must contain the following aspects: identify in sufficient detail the tangible or intangible asset, general description and where it is located within the company, location (equipment, machinery, platform, server, software or system); check the physical conditions of the asset (state of preservation, useful life); verify the conditions of updating (applies to intangible assets); reports on maintenance, rehabilitation and/or updating that have been practiced during the useful life; verify the necessary technical documentation (compliance with regulations): patents, licenses, source codes, permits, rights, approvals, homologations, accessibility, insurance, backup, etc. determine the value, bearing in mind the quantification of costs for repairs or improvements, if any; identify and assess the potential risks that could arise from technical defects, in order to reduce them as much as possible in the event of a possible investment.

The objective of this methodology is to have a technical inspection report executed by a team of specialized professionals, who have the task of performing a detailed diagnosis and prognosis on the current conditions of a given asset, product, service or process promoted by *Start-ups* ecosystems, identifying existing weaknesses, leading to a proposal for readjustment, repair or improvements to obtain the real value in the market. Next, the phases or stages of the usual *Technical Due Diligence* process were analyzed from the perspective of (Gilmanov, 2019):

1. *Kick-off Call*: the starting point for a technical process, usually resulting from a preliminary contact between the interested parties, with the purpose of specifying the scheduling (work schedule / roadmap) of the time to materialize each of the activities, tasks, requirements and steps to be addressed by an independent team of subject matter experts.

2. *Documentation Review*: before performing an on-site verification of the asset, product, service or process, the team of experts is given the task of backing up all existing documentation correctly (architecture, design, processes, backup and recovery, monitoring, servers), which will serve as input to develop the respective analyses.
3. *On-site Due Diligence / Remote Call*: in this opportunity, investors require a live meeting to take place in the facilities where the property is located, it is a *sine qua non* condition to know primary sources, all the technical parts of the asset, product, service or process, especially the operation of each component that integrates it, usually occurs in a session of 1-2 days.
4. *Follow-up*: this research stage starts with a number of questions related to the conditions, functioning and technical operation of the property: originality, patents, licenses, programming codes, etc., which must be clarified in different sessions and interactions between the parties involved in the process *per se*.
5. *Report*: the team of independent experts proceeds to set out in a final document all the advantages and disadvantages that were obtained from the technical verifications of the property under verification, with the objective that investors have enough data in a report at a rigorous level of detail to make a decision with reliable and trustworthy information.

With these steps is that a technical investigation is achieved, which starts with an *initial contact* between the interested parties and the independent team of professionals that is hired, at this stage the general guidelines of the study are addressed, in addition to the particularities that the investor demands about the current state of the property that is being subjected to technical verification, all doubts are dispelled in a preliminary time about any factor that the experts consider relevant.

Start-ups, as a new concept that emerges from the recurrent advances achieved by the computer and technological era, which has been able to mutate in a dizzying way from one invention to another, but this has multiplied in the first two decades of this century, to an unimaginable level of evolution, where all those areas and sectors that act in the markets were adapting according to the possibilities, acquiring advanced equipment to manage organizational processes, began a culture of innovation from the trends of the so-

called technological revolution, elements that improve productivity and competitiveness.

Harvard professor and Silicon Valley American entrepreneur Steve Blank defined start-ups as a "temporary organization that aims to pursue a repeatable and scalable business model" (Blank, 2010). This type of entrepreneurship as a business model can adopt a transitional condition for the development of a product or service that has the quality of remaining in operation in the market as many times as necessary, and whose characteristic is to achieve profitability and constant benefit, making it capable of progressing over time by generating added economic and social value, an idea that can be replicated in other niches by making tropicalizations and adjustments on the culture of a locality until it is strengthened as a solid company.

They are temporary organizations as they are focused on a necessary stage of transaction, peremptory period to accommodate within the segment where it operates, while achieving the objectives of the business model, performing for this the execution of a number of processes and actions so that it can evolve to another level (scaling), which avoids stagnation or stagnation on these products and services that will be repeatable and may also have a level of unmatched acceptance to the influence of digital technologies, being profitable for the market that has been arranged.

In this regard argues (Reis, 2012), that it is an organization of people with different expertise in different areas that merge to exploit creativity and explore the intentionality of developing a new product or service in an environment of maximum risk, volatility and uncertainty, as exogenous variables that entrepreneurs must manage information about the market segment to manage these natural distorting agents.

The concept of Start-ups is built as a venture in an ecosystem based on technological advances and knowledge management as two components that provide the foundations for a new business to emerge, it is an articulated symbiosis that combines know-how with new digital technologies to develop exponentially competitive initiatives from the transformation of intellectual and digital capital, creating useful products and services for consumers.

However, this approach necessarily involves knowing and managing information about the variables and dimensions that act within the complex environment (market volatility), since this model requires fusion activities between the knowledge of the different visions of the team, creativity combined with technologies to obtain originality in the idea as

an innovative and often renovating venture, since it is also possible to reinvent a product, service or area of a large company that seeks greater competitiveness and profitability.

This new business trend has been able to update and modernize the components of the different schools of entrepreneurship, the Chicago (Frank Knight, 1885-1972 / Theory of the entrepreneur's profit, risk assumption), Schumpeterian (Joseph Schumpeter 1883-1950 / Innovation and creative destruction) and Austrian (Israel Kirzner 1930-present / Theory of opportunity and profit) (Somarriba, 2015), who had already mentioned creative destruction, knowledge, risk and uncertainty, then, the contributions have been significant, the millennium authors have undoubtedly incorporated digital technologies as differentiating, comparative and competitive advantages to accelerate the successful operation of this model.

These innovative business initiatives, to a significant extent are derived from training and education processes in organizations specialized in many areas (science, technology, management sciences, among others) of knowledge, through the support of research centers and agencies attached to universities and other agencies, which are engaged in collaborative scientific work on a range of topics in different sciences and disciplines, taking into account the digital technology trends to ensure solid projects that provide consistent knowledge to design new products and/or services, which represent utility and innovation (Peris, 2014).

A conceptual approach to Start-ups, is situated as an emerging business proposal with a temporary space, which is able to combine the technical and scientific knowledge of a multidisciplinary team, which exceeds the comfort zone of an entrepreneur or businessman, taking advantage of the benefits offered by current trends in digital technologies to develop an innovative business idea in an increasingly volatile and risky environment, projecting opportunities, profitability and growth.

Start-ups, are contributing significantly to the markets and global economic systems are dynamic, the behavior of the creation of new business ideas take boom in the global context, which has allowed to determine that the actions linked to entrepreneurship have become key initiatives for the supply and demand of innovative goods and services to acquire other dimensions much more competitive, there companies classified as startups have a dizzying level of growth, which places them as an important engine for economic development. (Arenal, Armuña, Ramos and Feijóo, 2016).

### 3 METHOD

The quantitative approach of deductive logic and based on the positivist paradigm, provided the data as a quality to verify and check the validity of the article, as referred (Martinez, 2002), privileges the objectivity of knowledge through quantification, this was achieved by applying a survey to (30) expert subjects on the subject. These experts were selected based on their experience in start-up environments, investment funds and large international consulting firms, which gives the interviews an added value due to their practical orientation.

While the interpretative paradigm was the complementary model used for the treatment of information, which in the discourse of (Sandin, 2003) rejects the idea that social science methods should be identical to the natural sciences, requiring overcoming rigidity and unilateralism [4]. Thus, the multiple realities of *technical Due Diligence* were understood and interpreted from an intersubjective perspective through an interview with (10) specialists. Hence, it is based on the qualitative approach, as stated by (Yuni and Urbano, 2005) it is not a mechanical procedure with formal stages, but requires the assumption of decisions, assessments and conceptual and procedural alternatives, contrasted with the systematic review of the literature.

From the interview, fundamental categories and subcategories emerged to nurture the *technical Due Diligence* methodology within the *Start-up* ecosystems, managed with a triangulation process. All this derived in the results that allowed to build the contribution and contribution with new knowledge about the usefulness of this verification mechanism, good practices, reliable and impartial.

### 4 RESULTS

#### 4.1 Technical Due Diligence: Methodology for Assessing Risks in Start-ups

As part of the contribution of this article, Figure 1 proposes a methodology aligned with the needs identified from the results obtained from the surveys and interviews on the Technical Due Diligence to assess the risks in the Start-up ecosystems, which involves a checklist comprising three major components, the first related to technology, covering all the technical specifications of the product, service or process; the second is the commercial, whose north

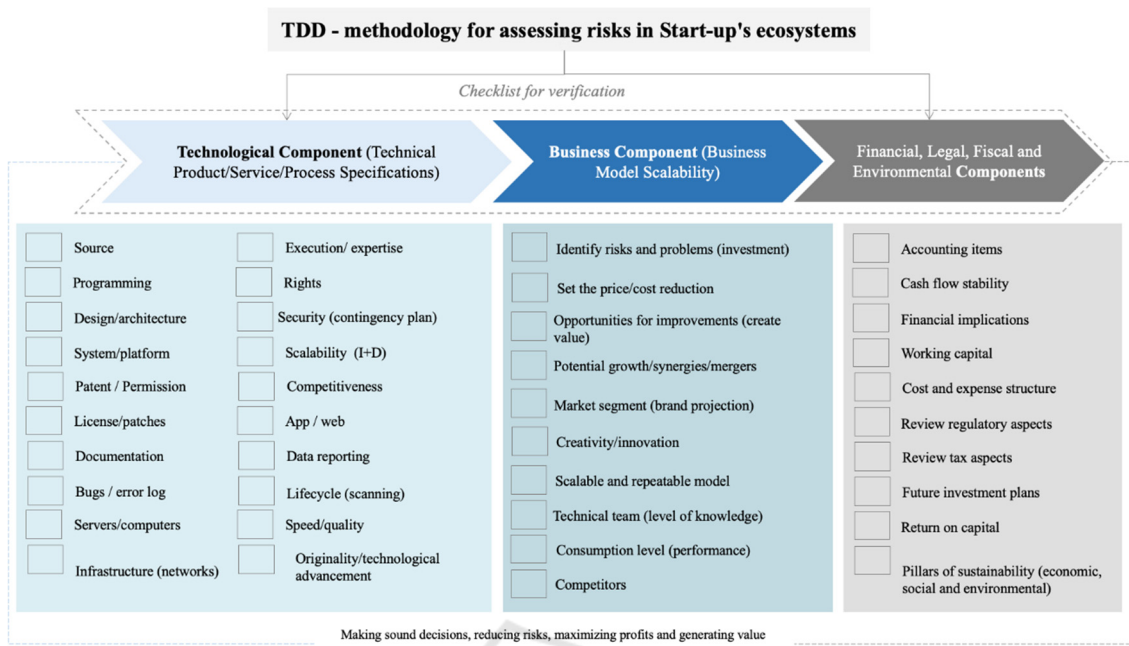


Figure 1: Technical Due Diligence Methodology applied to Start-up ecosystem.

is to delve into the scalability of the business model and finally, the financial, legal, fiscal and environmental component, which is limited to a full and comprehensive examination, providing reliability, security, data and useful information for investors, which are in line with the approaches of (Gilmanov, 2019).

In the technological component, a detailed investigation of the entire life cycle of the start-up is developed, from the origin, the operation, the generation of errors as a factor present in this type of platforms based on computerized and intangible computer codes, the idea is to identify every detail however small, which is susceptible to risks and incompatibilities with the environment where the product has been developed, as stated by (Aguirre and Baeza, 2019).

This consistent and coherent proposal aims to offer a global procedural vision of the need to make the right decisions when investing in start-up ecosystems in order to minimize risks, uncertainties and incompatibilities, with a view to maximizing profits and generating value.

So far, the few existing works have been oriented to Technical Due Diligences within the office, residential and industrial buildings sector (Kutera and Anysz, 2016), which describes in a sequential way the process to be carried out to study the feasibility of a real estate purchase.

#### 4.2 Technical Due Diligence: Analysis of Qualitative Research

Below are the most significant graphs on this methodology in the Start-up ecosystems to assess the risks, and that emerged from the surveys and interviews applied, results that provide credibility, validity and certification of this management tool to study the technical specifications in this type of users and customers in various market segments, where differentiation is a competitive constant to seize opportunities in segments of the markets.

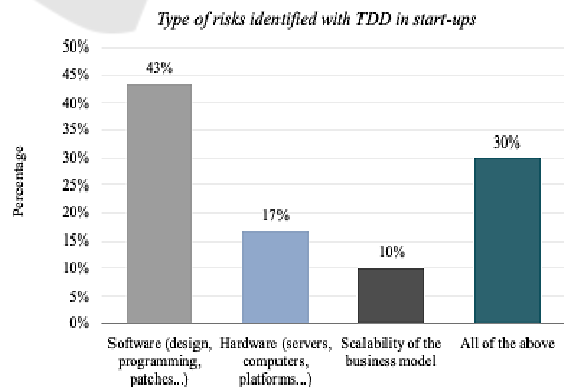


Figure 2: Risk identified.

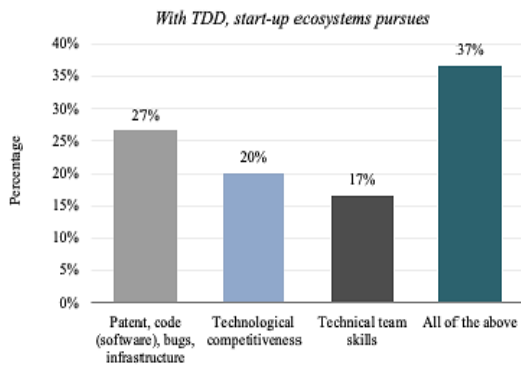


Figure 3: Approach to TDD methodology.

Figure 2 shows, with 43%, that the type of risk surrounding Start-ups is directly related to software development in this entrepreneurial initiative, where programming, language, design, patches, codes, bugs and patents (copyright) are essential for optimal operation to offer a quality product and service, in addition, with 17%, the hardware as a component (infrastructure) sine qua non that provides security, stability and technical support to ensure efficiency in the operations and transactions that may originate in this ecosystem, with a view to achieving technological competitiveness and scalability of the model in the market.

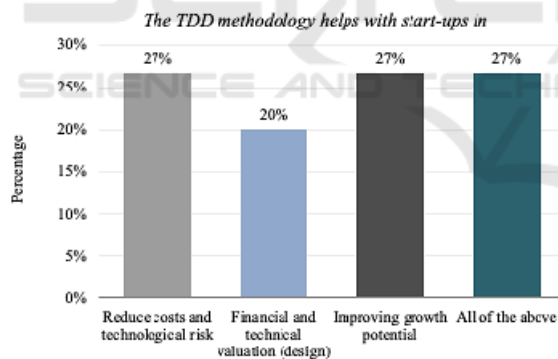


Figure 4: TDD helps with.

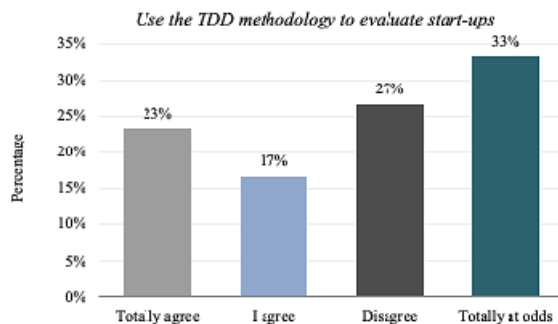


Figure 5: TDD to evaluate.

Likewise, in figure 4, 27% and 20%, respectively, show that this methodology helps emerging business models such as *start-ups* to reduce costs and technological risks to improve growth potential, while valuing the financial and technical structure, the latter based on the tangible and intangible components on which the model was built. The massification of this verification mechanism should be promoted, due to the moderate use it is having in the markets, beyond the circumstances, urgencies and conditions of negotiation by investors who mobilize capital in purchase and sale contracts, where it is key to know in depth the functioning of these ecosystems that generate value from exponential digital technologies.

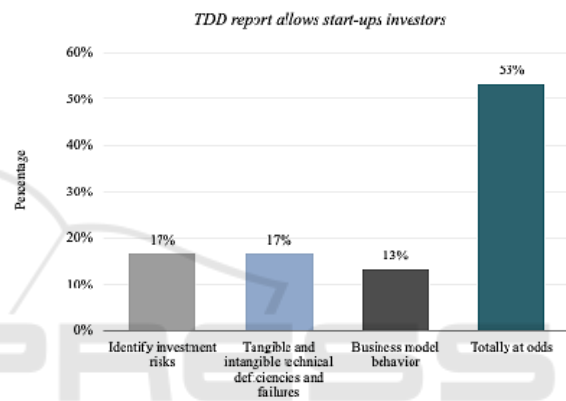


Figure 6: TDD allows stat-ups investors.

Figure 6 shows that the report derived from the application of the TDD methodology, with 17% and 13% respectively, allows investors to identify the risks in these Start-ups susceptible to evaluation and technical verification, detecting with the rigorosity of the case, the possible deficiencies and tangible and intangible technical failures as part of the behavior of this business model; which also cover with 17% and 10%, the operational, technical, environmental, human, commercial, technological, financial, fiscal and legal aspects.

The TDD in the world of emerging businesses such as Start-ups, are increasingly taking place in different markets, not only as innovative ventures, but also as a type of organization that offer services to large corporations to modernize and expand areas in them, in order to adapt to global trends that drive the smart industry and globalization 4.0, demonstrating potential, software implementation capacity, hardware, identifying technological risks, becoming scalability models for investors (see Table 1).

Table 1: Categories and subcategories that emerged from the interviews.

Categories for TDD methodology in <i>Start-ups</i>	Subcategories
Potential and ability to execute	Ownership, patent, expertise, code quality, technical equipment, similar competitors, infrastructure, maintenance, bugs
Technological risk, technical specifications	Reducing risk for unknown assets, knowing every detail of the product and service
Visibility and financial quality	Approximate value of an intangible business, return on capital investment, cost reduction
Global zones of operation	Legal, commercial, tax, environmental, financial, technological, operational, strategic, human and financial team.
Scalability of the emerging business model	Current global trends (digitization as an opportunity to create value), consumer preferences

## 5 CONCLUSIONS

The emergence of ventures built with the development of technologies are part of the global trends in this millennium, where the digitization of data and information, are booming in consumer preferences, which has stimulated the emergence of business models such as Start-ups, attractive initiatives that have attracted the attention of investors and entrepreneurs, who to boost capital seek to seize opportunities, consumer trends, and in these ecosystems have excellent opportunities.

For investors, adopting the TDD methodology is an important need that offers guarantees within a buying and selling process that is interested in a Start-up, in order to situate the fulfillment of a set of minimum conditions required to make decisions, knowing the technological components where it has been developed, analyzing the current state of the architecture and infrastructure of the product, service or process, the ownership of the code, which has maintainable, scalable and susceptible to changes for updates to suit the innovations that are emerging, the level of security, hosting of the application, software or system, all this is essential to ensure favorable results of the investment.

Another component is linked to the commercial behavior it has had or the estimates it will have to generate value in the market segment (history, level and preferences of consumption, profile of users / customers), if that model shares characteristics of scalability, repetition that provides the potential for growth with mergers and synergies strategies, as well as, the team of specialized collaborators, human capital, genuine expression of creative knowledge

that has the responsibility to perform the code development and other core aspects in the life cycle, since Start-ups are intellectual business initiatives and products, hence the relevance of intellectual property.

In the case of the legal component, which goes hand in hand with the others, it must include all the legal documents, in order and updated, that support the ownership of the start-up, in intellectual terms (creative idea, copyright), the patent as a categorical element that allows it to operate, and which will naturally certify the ownership at all levels, avoiding the risk of plagiarism, theft of source code, among other aspects of security and reliability in increasingly competitive markets.

As an innovative venture, the investor needs to evaluate the financial history of the business model so far and future projections (cost structure, expenses, working capital, cash flow, profits, etc.), this will show how feasible the final objective will be, which is the reproduction of capital, profitability, return and creation of economic value in the market, that is the purpose of having the financial resources to boost them, knowing the recovery period in which the investment will be returned.

The TDD methodology is a very useful tool to obtain data, figures and key information as a critical success factor in the investments to be executed in an emerging business model such as Start-up ecosystems, providing security, reliability and a broad overview of the conditions of risk, uncertainty, opportunities and growth possibilities (scalability).

Applying the TDD methodology provides cost savings due to the optimization of resources to carry out the Due Diligence, and a significant time saving of the whole process. On an experimental basis, this methodology has been tested in several start-ups by

analyzing the acquisition cost, progression and present value over 2 years, which provides extra information about the original deviation.

The projects on which the methodology has been applied have been varied, mainly oriented to software development and the data provided following the methodology show that the calculations obtained are closer to reality than the estimates that were made following traditional methods (Due Diligence, interviews, etc.).

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