**ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES**
ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2021 Volume 8 Number 4 (June)
http://doi.org/10.9770/jesi.2021.8.4(27)

ENTREPRENEURSHIP AND SUSTAINABILITY CENTER

**Publisher**
http://jssidoi.org/esc/home

# CRITICAL SUCCESS FACTORS THROUGHOUT THE LIFE CYCLE OF INFORMATION TECHNOLOGY START-UPS

**José Santisteban [1], Jorge Inche [2], David Mauricio [3*]**

[1,3] *Department of Computer Science, Universidad Nacional Mayor de San Marcos, Lima 01, Perú*
[2] *1551 Incubator, Universidad Nacional Mayor de San Marcos, Lima 01, Perú*

*E-mails:[1] jsantistebanp1@unmsm.edu.pe; [2] jinchem@unmsm.edu.pe;*
*[3*] dmauricios@unmsm.edu.pe (Corresponding Author)*

*Received 15 November 2020; accepted 10 April 2021; published 30 June 2021*

**Abstract.** Information technology start-ups (ITSs) contribute towards the rapid growth of society as well as encourage innovation, create technical jobs, and support the economic and technological development of countries. Despite their importance, however, ITSs have a high failure rate worldwide, making it important to identify the factors that influence their success throughout the life cycle. Moreover, studies of this topic are scarce. This study aims to identify the factors that influence the success of an ITS throughout its development stages to mitigate the risks of failure. We review the critical success factors that affect ITSs and their life cycle stages based on the literature and consider the relationship between these factors and stages. An empirical study is carried out to test the presented hypotheses about the perceptions of 125 CEOs of ITSs in Peru using a descriptive analysis, simple and multiple correspondence analysis, and the Student's t hypothesis test. Five stages of the life cycle of an ITS are established: seed, early, growth, expansion, and exit. Of the 93 hypotheses tested to assess the influence of 27 critical success factors, 77 are supported. This study proposes an ITS life cycle composed of five stages, defines the critical success factors for each of them, and establishes their influence in all stages.

**Keywords:** critical success factors; life cycle; stage; IT startups; entrepreneurship

**Reference** to this paper should be made as follows: Santisteban, J., Inche, J., Mauricio, D. 2021. Critical success factors throughout the life cycle of information technology start-ups. *Entrepreneurship and Sustainability Issues*, 8(4), 446-466. http://doi.org/10.9770/jesi.2021.8.4(27)

**JEL Classifications:** M13, L26

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## 1. Introduction

Companies go through different development stages (Abou-Moghli & Al-Kasasbeh, 2012). However, not all companies are the same, nor do they operate in the same sectors; thus, they do not require the same initial capital or investment, have the same levels of indebtedness, or need the same specific knowledge (Morteza et al., 2013). Hence, the different stages through which an organisation passes during its development vary by case (Kim & Heshmati, 2010).

Information technology start-ups (ITSs), also called technology-based entrepreneurship, are emerging companies with high innovative and technological potential (Colombo & Grilli, 2010). The managers of an ITS must understand their enterprise's development stages to contribute to the decision-making process (Thanh, 2015). In addition, they must know what procedures to establish for their business to have sustained growth over time (Balboni et al., 2014). In this way, an early-stage ITS that needs to grow can implement the relevant measures and strategies to make it possible. Van Gelderen et al. (2005) find that despite the positive impact of ITSs on the economies of developing countries, they also present a high failure rate worldwide (McAdam & McAdam, 2008).

In recent decades, research has discussed the main factors that influence the overall success of an ITS, among which the studies by Joshi (2021), Al-Fraihat et al., (2020, Roy et al. (2020), Anh et al. (2012), Banda & Lussier (2015), Kim et al. (2018), and Honorine & Emmanuelle (2019) are highlighted. Furthermore, Santisteban & Mauricio (2017) identify 21 critical success factors (CSFs) in the literature. However, only a few works identify the CSFs that influence the life cycle stages of an ITS. Therefore, research aim of this study is identify the CSFs that influence the development stages of an ITS (seed, early, growth, expansion, and exit) to mitigate the risks of an ITS failing. Which is summarized in the following research question: What are the CSFs that influence the success of the development stages of an ITS?. In particular, numerically tested CSFs are identified from the literature and hypotheses about the influence of these factors are established for these five stages.

The rest of the study is divided into the following sections. Section 2 describes ITSs, their development stages, and their CSFs. In Section 3, the relationships between these CSFs and development stages are conceptualised through a model. In Section 4, the research methodology used in this study is presented. The statistical results and their discussion are presented in Sections 5 and 6, respectively. Finally, Section 7 concludes.

## 2. Liierature Review

### *Introducing ITSs*

According to Díaz-Santamaría & Bulchand-Gidumal (2021) ITS are important engines for regional job creation. Gimmon & Levie (2010), an ITS is essentially agile and flexible, and it also evolves in line with the market. Similarly, Petru et al. (2019) state that an ITS is created with the expectation of high growth in the near future. Finally, Santisteban et al. (2021) define an ITS as a start-up that provides innovative IT-based products and/or services. In essence, an ITS is always searching for an action model that, once tested, can transform it into a solid and mature company (Chen et al., 2019).

### *Development Stages*

Different phases constitute the life cycle of a start-up (Strehle et al., 2010). Wing-Ki et al. (2005) propose six stages: Preparation for start-up, where an assessment of incubation programme applicants is performed; Incubation process, where services and resources are channelled for the creation, consolidation, and acceleration of the business in the market; Incubatee performance measures, which help them understand where their start-ups are incubated and how to improve their performance; Exit policies, an experienced business incubator must be able to provide knowledge and professional experience to help the start-up advance; Parental care, not all

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incubated start-ups may have gained sufficient maturity to operate their business independently, in which case an extended period of care can make them competitive; and Disconnect incubator, when incubated start-ups are ready to become an independent company to enter the competitive world.

Yoon-Jun (2010) identifies three stages: Incubation, where companies identify practical business ideas, review and evaluate the possibility of commercialisation, and produce the first products; Growing, where companies begin to produce, launch, and sell their products and/or services as a result of technological development; and Maturing, when they focus on maintaining the growth rate and developing additional products.

However, Pirolo & Presutti (2010) only identify two stages: Emergence (also called appearance), when there is normally a small team and when the prototype is started and shaped; and Early growth, when entrepreneurs typically seek the largest venture capital financing from angel investors. Similarly, Mueller et al. (2012) describe two stages: Start-up, where entrepreneurs focus their attention on the business opportunity they hope to take advantage of as well as on specific start-up activities such as the development of a prototype, organisation of a founding team, and purchase of equipment; and Growth, when there is a search for resources to finance rapid growth (e.g. the entrepreneur's focus could be on strategic alliances).

Ng et al. (2014) identify three stages: Early, when the company builds its initial business team; Growth and development, when it is affected by the management of resources; and Expansion, when human capital is the driving force for companies to scale up and the technological infrastructure helps improve the development of critical assets and innovation of products and/or services. Alternatively, in Bocken's (2015) study, four stages are identified: Seed, a stage influenced by family, friends, the entrepreneur's own capital, and government support; Young, a stage in which products and/or services are in production and the first customers appear; Growing, where sales and customers are increasing and competition intensifies; and Mature, with sales and profits tending to be stable. However, competition is still fierce and a decision on whether to expand or sell the company is needed. Almakenzi et al. (2015) describe two stages: Incubation, where the leading entrepreneur evaluates the team's commitment and validates the business model; and Post-incubation, where the evolution of the market and appearance of substitute and competitive products are evaluated. Finally, Konsek-Ciechonska (2019) also identifies two stages: Seed, when the entrepreneur initiates actions that will transform the idea into a profitable activity (characterised by teamwork, prototype development, market entry, and the search for support mechanisms such as business accelerators and incubators); and Creation, when the organisation is created, employs its first employees, and sells its products. These studies show that there is no defined standard for the life cycle stages of a start-up. Some authors consider two stages, others six stages, and some consider stages that other authors do not, such as Bocken (2015) who considers the 'young' stage that is not contemplated by Ng et al. (2014). Furthermore, there are no standard terms for the stages, with the work by Konsek-Ciechonska (2019), for example, naming the stage in which the innovative idea begins as 'seed', while Mueller et al. (2012) call it 'start-up'. Hence, it is necessary to establish a standard for the development stages of an ITS.

***CSFs***

For the purposes of the present investigation, CSFs can condition the success or failure of a start-up (Ko & An, 2019). A large number of researchers have attempted to identify the CSFs of a start-up. From the selected publications, 27 statistically proven CSFs were identified (see Table 1). In the literature there are several studies that attempt to define a startup and its success and it is concluded that there is no standard definition. In addition, several studies identified CSFs for TBSs. However, there is no consensus on factors influence success.

## 3. Relationship between the CSFs and Development Stages

***CSFs***

To identify the influence of the CSFs of the life cycle stages, the factors shown in Table 1, are used. The influence of these factors on the overall success of an ITS; all these factors are important because they influence the success

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of ITSs and must be considered to define the strategies and/or actions aimed at accelerating the development of an ITS.

**Table 1.** CSFs

| ID | Factor | Source |
|---|---|---|
| F1 | Customer satisfaction | Santisteban et al. (2021) |
| F2 | Stage financing | Santisteban et al. (2021) |
| F3 | Support of a business incubator | Santisteban et al. (2021) |
| F4 | Developed innovation and entrepreneurship ecosystem | Santisteban et al. (2021) |
| F5 | Dynamic capacity | Santisteban et al. (2021) |
| F6 | Innovative and entrepreneurial culture | Santisteban et al. (2021) |
| F7 | Industry experience | Hyder & Lussier (2016), Rojas & Huergo (2016) |
| F8 | Previous start-up experience | Mueller et al. (2012), Pugliese et al. (2016) |
| F9 | Academic training | Pugliese et al. (2016), Rojas & Huergo (2016) |
| F10 | Technology/business capabilities | Yoo et al. (2012) |
| F11 | R&D experience | Baum & Silverman (2004) |
| F12 | Business management experience | Arruda et al. (2013), Thiranagama & Edirisinghe (2015) |
| F13 | Entrepreneurial leadership | Schneider et al. (2007), Wei-Wen (2009) |
| F14 | Entrepreneurial leader’s gender | Friar & Meyer (2003) |
| F15 | Entrepreneurial leader’s age | Diochon et al. (2007) |
| F16 | Motivation | Greve & Salaff (2003), Ganotakis (2012) |
| F17 | Government support | Arruda et al. (2013), Pugliese et al. (2016) |
| F18 | Venture capital | Almakenzi et al. (2015), Prohorovs et al. (2018) |
| F19 | Competing market | Song et al. (2008), Arruda et al. (2013) |
| F20 | Organisational size | Thiranagama & Edirisinghe (2015), Rojas & Huergo (2016) |
| F21 | Business age | Haltiwanger et al. (2012) |
| F22 | Product and/or service innovation | Ardito et al. (2015) |
| F23 | Location | Hormiga et al. (2011) |
| F24 | Environmental dynamism | Timmons & Spinelli (2004) |
| F25 | Science and technology policies | Scarborough & Zimmerer (2003) |
| F26 | Clustering | Yoon-Jun (2010), Mueller et al. (2012) |
| F27 | Partners | Sefiani & Bown (2013) |

The selected studies show that few authors link a CSF with the life cycle stage of a start-up. Figure 1 shows that of the 27 CSFs identified in the selected studies (see Table 1), only five (F8, F10, F17, F18, F28) have been linked to a development stage.

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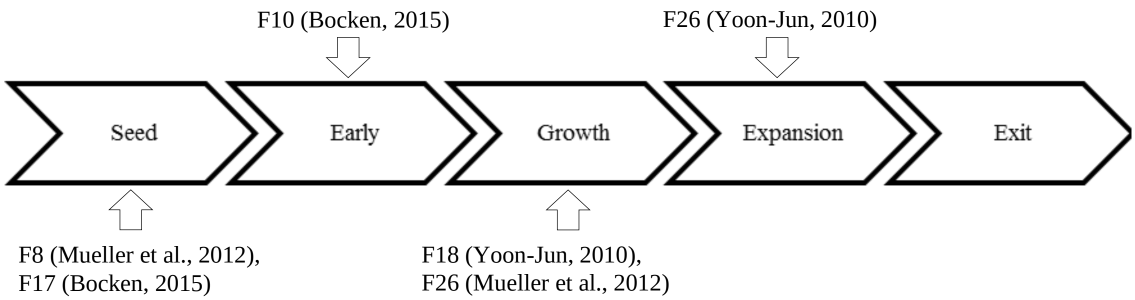


**Figure 1.** Development Stages and CSFs
*Source*: the authors

A total of 93 hypotheses linking the CSFs to each development stage of an ITS were formulated, as described below.

***Development Stage 'Seed' (S1)***

H1.1: The 'customer satisfaction' influences the 'success of the seed stage'.
H2.1: The 'stage financing' influences the 'success of the seed stage'.
H3.1: The 'support of a business incubator' influences the 'success of the seed stage'.
H4.1: The 'developed innovation and entrepreneurship ecosystem' influences the 'success of the seed stage'.
H5.1: The 'dynamic capacity' influences the 'success of the seed stage'.
H6.1: The 'innovative and entrepreneurial culture' influences the 'success of the seed stage'.
H7.1: The 'industry experience' influences the 'success of the seed stage'.
H8.1: The 'previous start-up experience' influences the 'success of the seed stage'.
H9.1: The 'academic training' influences the 'success of the seed stage'.
H10.1: The 'technology/business capabilities' influences the 'success of the seed stage'.
H11.1: The 'R&D experience' influences the 'success of the seed stage'.
H12.1: The 'business management experience' influences the 'success of the seed stage'.
H13.1: The 'entrepreneurial leadership' influences the 'success of the seed stage'.
H16.1: The 'motivation' influences the 'success of the seed stage'.
H17.1: The 'government support' influences the 'success of the seed stage'.
H19.1: The 'competing market' influences the 'success of the seed stage'.
H22.1: The 'product and/or service innovation' influences the 'success of the seed stage'.
H24.1: The 'environmental dynamism' influences the 'success of the seed stage'.

***Development Stage 'Early' (S2)***

H1.2: The 'customer satisfaction' influences the 'success of the early stage'.
H2.2: The 'stage financing' influences the 'success of the early stage'.
H3.2: The 'support of a business incubator' influences the 'success of the early stage'.
H4.2: The 'developed innovation and entrepreneurship ecosystem' influences the 'success of the early stage'.
H5.2: The 'dynamic capacity' influences the 'success of the early stage'.
H6.2: The 'innovative and entrepreneurial culture' influences the 'success of the early stage'.
H7.2: The 'industry experience' influences the 'success of the early stage'.

H8.2: The 'previous start-up experience' influences the 'success of the early stage'.
H9.2: The 'academic training' influences the 'success of the early stage'.
H10.2: The 'technology/business capabilities' influences the 'success of the early stage'.
H11.2: The 'R&D experience' influences the 'success of the early stage'.
H12.2: The 'business management experience' influences the 'success of the early stage'.
H13.2: The 'entrepreneurial leadership' influences the 'success of the early stage'.
H14.2: The 'entrepreneurial leader's gender' influences the 'success of the early stage'.
H16.2: The 'motivation' influences the 'success of the early stage'.
H17.2: The 'government support' influences the 'success of the early stage'.
H22.2: The 'product and/or service innovation' influences the 'success of the early stage'.
H23.2: The 'location' influences the 'success of the early stage'.
H25.2: The 'science and technology policies' influences the 'success of the early stage'.

***Development Stage 'Growth' (S3)***

H1.3: The 'customer satisfaction' influences the 'success of the growth stage'.
H2.3: The 'stage financing' influences the 'success of the growth stage'.
H3.3: The 'support of a business incubator' influences the 'success of the growth stage'.
H4.3: The 'developed innovation and entrepreneurship ecosystem' influences the 'success of the growth stage'.
H5.3: The 'dynamic capacity' influences the 'success of the growth stage'.
H6.3: The 'innovative and entrepreneurial culture' influences the 'success of the growth stage'.
H7.3: The 'industry experience' influences the 'success of the growth stage'.
H9.3: The 'academic training' influences the 'success of the growth stage'.
H10.3: The 'technology/business capabilities' influences the 'success of the growth stage'.
H11.3: The 'R&D experience' influences the 'success of the growth stage'.
H12.3: The 'business management experience' influences the 'success of the growth stage'.
H15.3: The 'entrepreneurial leader's age' influences the 'success of the growth stage'.
H16.3: The 'motivation' influences the 'success of the growth stage'.
H17.3: The 'government support' influences the 'success of the growth stage'.
H18.3: The 'venture capital' influences the 'success of the growth stage'.
H19.3: The 'competing market' influences the 'success of the growth stage'.
H21.3: The 'business age' influences the 'success of the growth stage'.
H22.3: The 'product and/or service innovation' influences the 'success of the growth stage'.
H23.3: The 'location' influences the 'success of the growth stage'.
H24.3: The 'environmental dynamism' influences the 'success of the growth stage'.
H25.3: The 'science and technology policies' influences the 'success of the growth stage'.
H26.3: The 'clustering' influences the 'success of the growth stage'.
H27.3: The 'partners' influences the 'success of the growth stage'.

***Development Stage 'Expansion' (S4)***

H1.4: The 'customer satisfaction' influences the 'success of the expansion stage'.
H2.4: The 'stage financing' influences the 'success of the expansion stage'.
H4.4: The 'developed innovation and entrepreneurship ecosystem' influences the 'success of the expansion stage'.
H5.4: The 'dynamic capacity' influences the 'success of the expansion stage'.
H6.4: The 'innovative and entrepreneurial culture' influences the 'success of the expansion stage'.

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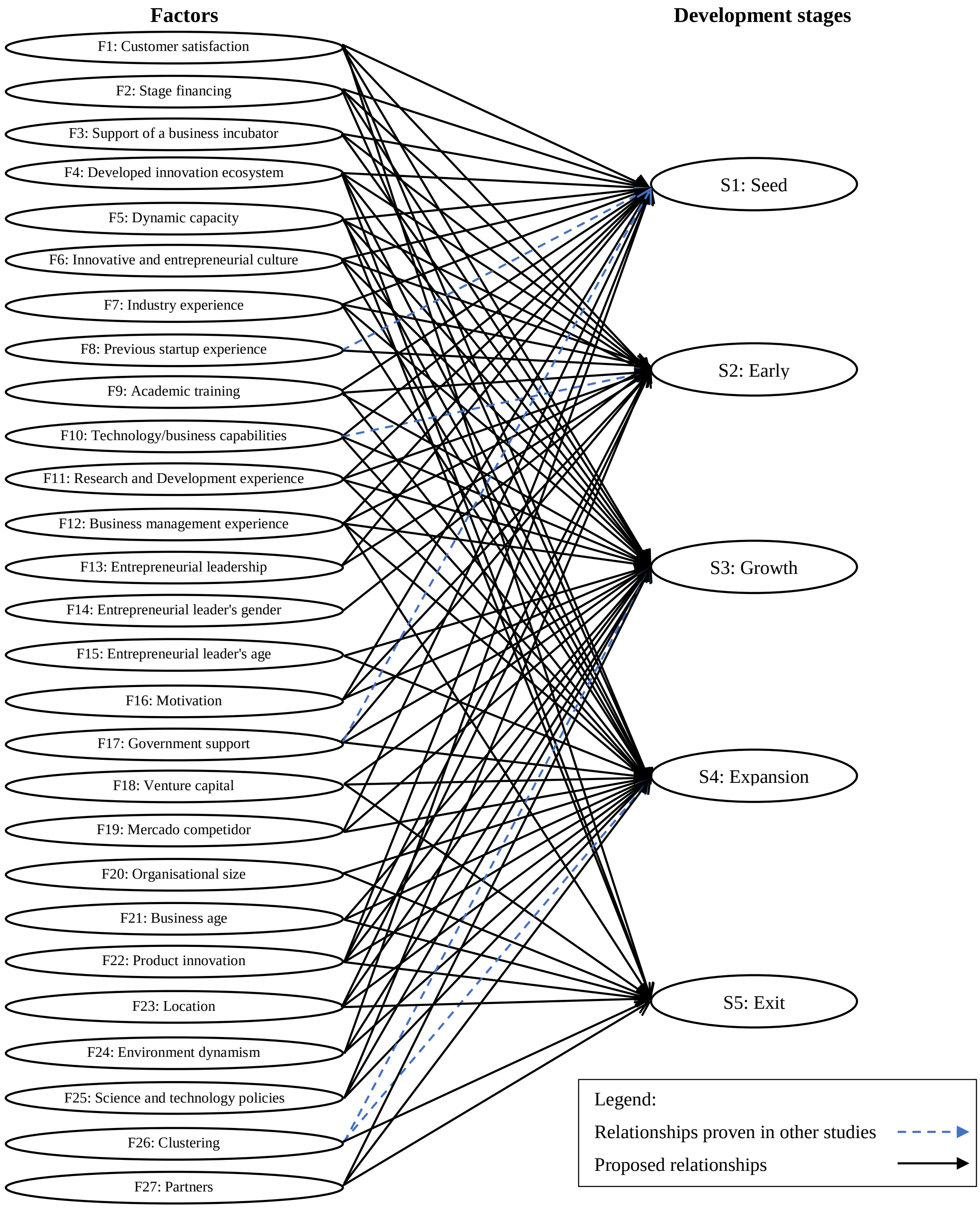
H7.4: The ‘industry experience’ influences the ‘success of the expansion stage’.
H9.4: The ‘academic training’ influences the ‘success of the expansion stage’.
H10.4: The ‘technology/business capabilities’ influences the ‘success of the expansion stage’.
H11.4: The ‘R&D experience’ influences the ‘success of the expansion stage’.
H12.4: The ‘business management experience’ influences the ‘success of the expansion stage’.
H15.4: The ‘entrepreneurial leader’s age’ influences the ‘success of the expansion stage’.
H17.4: The ‘government support’ influences the ‘success of the expansion stage’.
H18.4: The ‘venture capital’ influences the ‘success of the expansion stage’.
H19.4: The ‘competing market’ influences the ‘success of the expansion stage’.
H20.4: The ‘organisational size’ influences the ‘success of the expansion stage’.
H21.4: The ‘business age’ influences the ‘success of the expansion stage’.
H22.4: The ‘product and/or service innovation’ influences the ‘success of the expansion stage’.
H23.4: The ‘location’ influences the ‘success of the expansion stage’.
H24.4: The ‘environmental dynamism’ influences the ‘success of the expansion stage’.
H25.4: The ‘science and technology policies’ influences the ‘success of the expansion stage’.
H26.4: The ‘clustering’ influences the ‘success of the expansion stage’.
H27.4: The ‘partners’ influences the ‘success of the expansion stage’.

***Development Stage ‘Exit’ (S5)***

H1.5: The ‘customer satisfaction’ influences the ‘success of the exit stage’.
H4.5: The ‘developed innovation and entrepreneurship ecosystem’ influences the ‘success of the exit stage’.
H5.5: The ‘dynamic capacity’ influences the ‘success of the exit stage’.
H12.5: The ‘business management experience’ influences the ‘success of the exit stage’.
H18.5: The ‘venture capital’ influences the ‘success of the exit stage’.
H20.5: The ‘organisational size’ influences the ‘success of the exit stage’.
H21.5: The ‘business age’ influences the ‘success of the exit stage’.
H22.5: The ‘product innovation’ influences the ‘success of the exit stage’.
H23.5: The ‘location’ influences the ‘success of the exit stage’.
H26.5: The ‘clustering’ influences the ‘success of the exit stage’.
H27.5: The ‘partners’ influences the ‘success of the exit stage’.

Figure 2 conceptualises the relationships between the 27 CSFs and five life cycle stages of an ITS, through its 93 hypotheses.




93 Hypothesis

**Figure 2.** Conceptual Model

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## 4. Methodology

The sample was selected by (i) reviewing ITSs in Peru financed by the National Program of Innovation for Competitiveness and Productivity (Innóvate Perú), (ii) sending an online survey to the CEOs of ITSs, and (iii) applying snowball sampling (Chirino et al., 2016), asking each CEO who receives the survey to forward it to another ITS executive. An online survey was developed with Google Forms (Survey Google Form, 2018) based on the proposed model. The survey was carried out from May 2018 to July 2019 with the CEOs of the six generations of ITSs sponsored with non-reimbursable funds from Innóvate Perú.

Once the survey was prepared, a pilot test was conducted to validate the questions. This pilot test was carried out on 15 CEOs of ITSs in Peru, who verified whether the questions were adequately related to the hypotheses. Based on this, the wording of the questions was corrected and the use of appropriate language was reviewed.

A total of 130 responses were obtained, of which five were discarded because they presented incomplete and inconsistent responses; thus, 125 valid surveys were collected.

To determine the reliability of the measurement instrument, the Cronbach's alpha method was used. According to Streiner (2003), the closer the alpha value is to 1, the greater is the internal consistency of the analysed elements; the validity of an instrument is acceptable if it has a value above 0.70.

## 5. Results

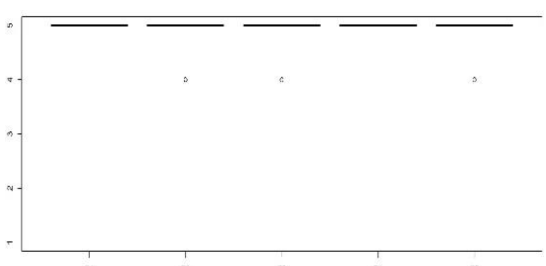
According to the results obtained with the R tool, a Cronbach's alpha of 0.91 was obtained, as shown in Figure 3.

```
Reliability analysis
 raw_alpha std.alpha G6(smc) average_r S/N    ase mean   sd median_r
      0.91       0.9       1     0.051 9.3 0.0098  3.6 0.15    0.021
```

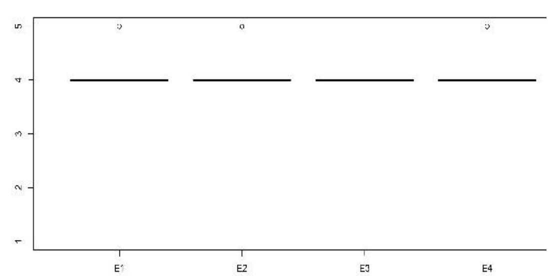
**Figure 3.** Results with 'R Studio' on the Reliability of the Survey Data

### *Descriptive analysis*

Figure 4 presents the boxplots created from the responses of the surveyed entrepreneurs. As shown in Figure 4(a), the influence of customer satisfaction (F1) on S1, S2, S3, S4, and S5 has a median value of 5 (very high). The black line represents those values almost entirely around a degree of influence, and hence its box shape is flat. In addition, some outliers are observed in the influence levels of S2, S3, and S5.



(a) F1 ➔ S1, S2, S3, S4, S5



(b) F2 ➔ S1, S2, S3, S4

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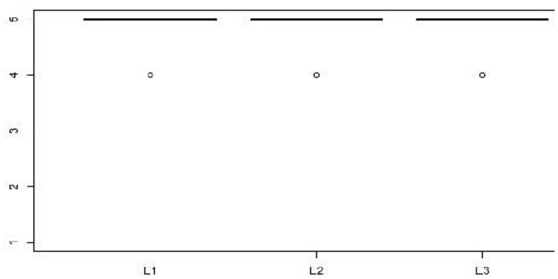
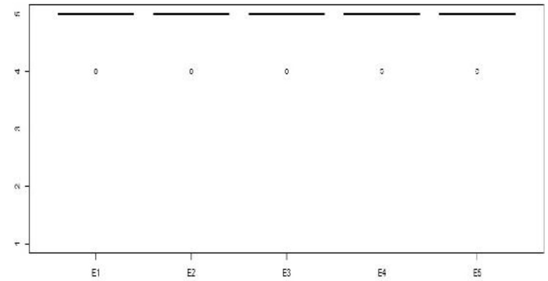
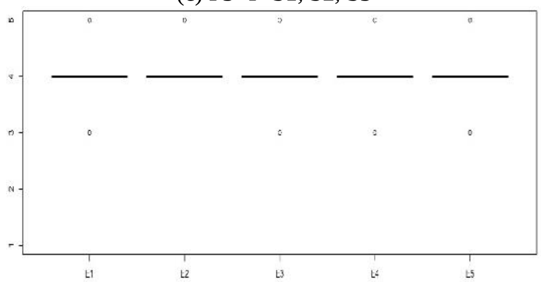


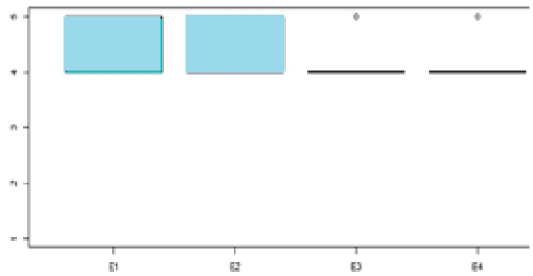

(c) F3 ➔ S1, S2, S3



(d) F4 ➔ S1, S2, S3, S4, S5



(e) F5 ➔ S1, S2, S3, S4, 55



(f) F6 ➔ S1, S2, S3, S4

**Figure 4.** Boxplots Between the Factors and Stages

***SCA***

SCA is used to determine the level at which a CSF is related to a life cycle stage (Factor → Stage). Table 2 presents the eigenvalues for the SCA between the factors and stages, showing that the first two components explain 97.2% of the data in the sample (87.5% + 9.7%). Therefore, components 1 and 2 (Dim1 and Dim2) were used and inertia tables were constructed with these values, as shown in Tables 3 and 4.

**Table 2.** Eigenvalues for the SCA Between the Factors and Stages

| Component | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Value | 0.277 | 0.031 | 0.006 | 0.003 |
| Percentage | 87.50% | 9.7% | 1.8% | 1.0% |

In Tables 3 and 4, the rows show the factors and the columns show the stages. Table 3 shows the contribution of each factor to Dim1 and Dim2 as well as which component each factor is most related to, the total frequency of each point (Mass), the value of the Chi-square distribution (ChiDist), and the inertia value (inertia). Similarly, Table 4 shows the contribution of each stage to each component and which component is most related to each stage.

**Table 3.** Factor Inertia Table

| Factor | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 |
|---|---|---|---|---|---|---|---|---|---|
| Mass | 0.1127 | 0.0009 | 0.0780 | 0.1048 | 0.0024 | 0.0265 | 0.0794 | 0.0248 | 0.0007 |
| ChiDist | 0.1566 | 0.6103 | 0.4141 | 0.2210 | 0.6101 | 0.7304 | 0.2388 | 1.1231 | 1.1557 |
| Inertia | 0.0028 | 0.0003 | 0.0134 | 0.0051 | 0.0009 | 0.0141 | 0.0045 | 0.0313 | 0.0010 |
| Dim. 1 | -0.178 | 0.4864 | 0.6034 | -0.345 | 0.9656 | 1.3690 | 0.2690 | 2.0760 | -1.014 |
| Dim. 2 | 0.6864 | 2.6262 | -1.496 | 0.6952 | 0.8970 | -0.137 | -0.916 | 1.0797 | 5.6019 |
| Factor | F10 | F11 | F12 | F13 | F14 | F15 | F16 | F17 | F18 |
| Mass | 0.0283 | 0.0510 | 0.0617 | 0.0548 | 0.0002 | 0.0002 | 0.0416 | 0.0184 | 0.0672 |
| ChiDist | 0.4075 | 0.5193 | 0.1608 | 0.6402 | 1.8638 | 1.8638 | 1.0069 | 0.4435 | 0.9055 |
| Inertia | 0.0047 | 0.0137 | 0.0016 | 0.0225 | 0.0006 | 0.0006 | 0.0422 | 0.0036 | 0.0551 |
| Dim. 1 | 0.3412 | 0.8624 | 0.2689 | 1.1890 | -1.102 | -1.102 | 1.8763 | 0.7720 | -1.703 |
| Dim. 2 | -1.665 | -1.230 | 0.3204 | 0.7568 | -7.366 | -7.366 | 0.9238 | -0.845 | 0.6518 |
| Factor | F19 | F20 | F21 | F22 | F23 | F24 | F25 | F26 | F27 |
| Mass | 0.0002 | 0.0003 | 0.0002 | 0.1132 | 0.0248 | 0.0002 | 0.0097 | 0.0438 | 0.0542 |
| ChiDist | 1.8638 | 1.4220 | 2.4445 | 0.1656 | 0.9012 | 1.8638 | 0.1853 | 0.8915 | 0.8358 |
| Inertia | 0.0006 | 0.0007 | 0.0011 | 0.0031 | 0.0202 | 0.0006 | 0.0003 | 0.0348 | 0.0379 |
| Dim. 1 | -2.287 | -2.036 | -2.287 | -0.187 | -1.696 | -2.287 | 0.1768 | -1.510 | -1.583 |
| Dim. 2 | -7.366 | 4.509 | 11.348 | 0.7299 | -0.275 | -7.366 | -0.801 | -2.142 | 0.2599 |

**Table 4.** Stage Inertia Table

| Stage | S1 | S2 | S3 | S4 | S5 |
|---|---|---|---|---|---|
| Mass | 0.22973 | 0.20782 | 0.22352 | 0.19558 | 0.14335 |
| ChiDist | 0.64810 | 0.53845 | 0.38612 | 0.51093 | 0.72418 |
| Inertia | 0.09650 | 0.06025 | 0.03332 | 0.05106 | 0.07518 |
| Dim. 1 | 1.21231 | 0.99792 | -0.57989 | -0.93955 | -1.20342 |
| Dim. 2 | 0.35741 | 0.00543 | -1.28987 | -0.40809 | -1.98736 |

From the data in Tables 3 and 4, Figure 5 was constructed to explain how the components are related to the stages and CSFs. This two-dimensional graph visualises which factors (blue points) are most related to the stages (red triangles); in other words, the closer the CSFs are to a stage, the more these are related.

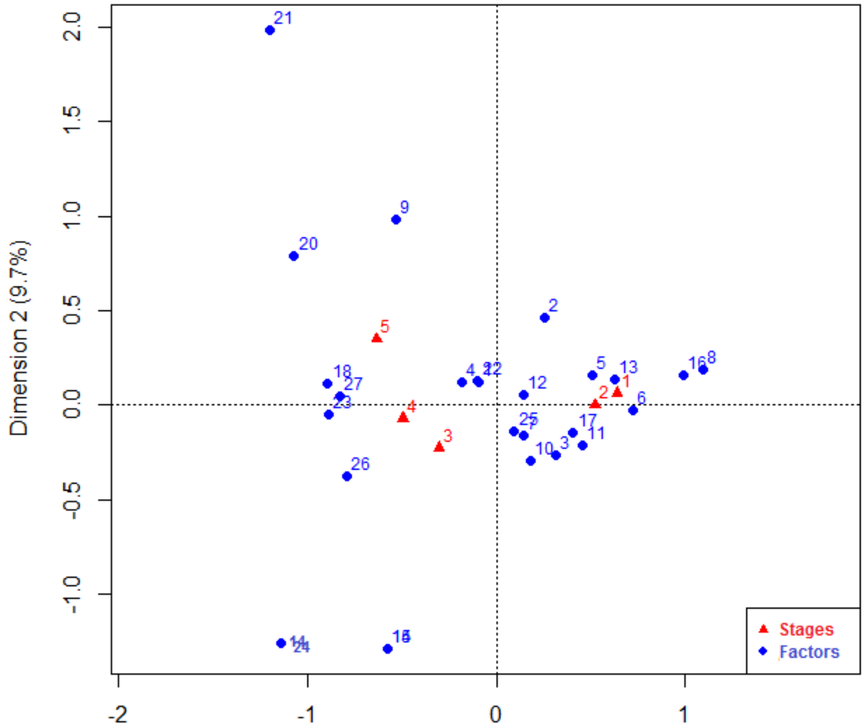



**Figure 5.** SCA Between the Factors and Stages

In Figure 5, the following simple relationships are observed for each factor. This technique describes the first relationships between the stages and CSFs; however, to determine the degree of influence of the factors on the stages, an MCA was carried out. MCA can determine the degree of influence between a CSF with more than one stage (Factor → Stage) (Johnson & Wichern, 2007).

***MCA***

*MCA relationship for customer satisfaction (F1→ S1, S2, S3, S4, S5)*

Figure 6 shows the distribution of the ratings provided by the entrepreneurs surveyed on the perception of the relationship between customer satisfaction (F1) and all the stages (S1–S5). This graph demonstrates that F1 has a very high influence on all the stages and a high influence on S5 (see also Table 5).

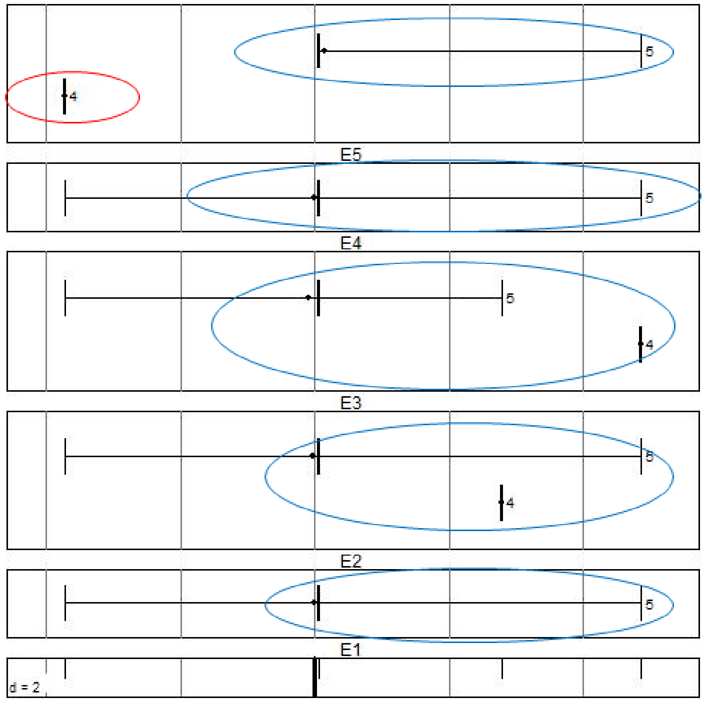



**Figure 6.** Distribution of the Relationship Rating (F1 → S1, S2, S3, S4, S5)

**Table 5.** Respondents' Perception of the Level of Influence (F1 → S1, S2, S3, S4, S5)

| Hypothesis | Score | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| H1.1 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| H1.2 | 0.00 | 0.00 | 0.00 | 0.01 | 0.99 |
| H1.3 | 0.00 | 0.00 | 0.00 | 0.02 | 0.98 |
| H1.4 | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 |
| H1.5 | 0.00 | 0.00 | 0.00 | 0.04 | 0.96 |

In addition, Figure 7 shows the high and very high levels of influence of customer satisfaction (F1) for each of the stages are associated (top left). Respondents indicate that F1 influences the stages (bottom left); finally, the experience time and level that influences F1 are strongly associated (bottom right).

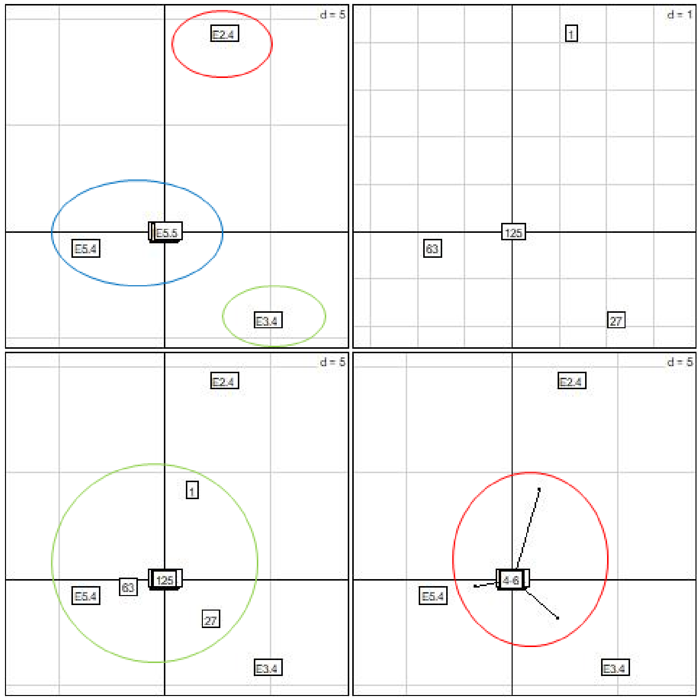



**Figure 7.** MCA Factor Map (F1 → S1, S2, S3, S4, S5)

***Hypothesis testing***

In this section, the Student's *t* distribution (Streiner, 2003) is applied to verify the hypotheses proposed in Section 3. To this end, the null hypothesis $(H_0)$ and alternative hypothesis $(H_a)$ are first formulated. $H_a$ is accepted if $H_0$ is rejected and vice versa. $H_0$ and $H_a$ are defined with the following decision rules:

- $H_0 = \mu <= 3.7$ (the entrepreneurs surveyed believe that the degree of influence between a factor and a stage is less than or equal to 3.7).
- $H_a = \mu > 3.7$ (the entrepreneurs surveyed believe that the degree of influence between a factor and a stage is greater than 3.7).

To accept or reject $H_0$, the p-value is calculated using equation (1) proposed by Monroy and Rivera (2012). The significance level value ($\alpha$) for this study is 0.05. If the p-value is greater than the significance level ($\alpha$), $H_0$ is accepted and $H_a$ is rejected. If the p-value is lower than the significance level ($\alpha$), $H_0$ is rejected and $H_a$ is accepted:

$$t = (\bar{X} - \mu) / (s / \sqrt{n}) \qquad (1)$$

Where $\bar{X}$ is the sample mean, $\mu$ is the mean specified in the null hypothesis to be analysed, s is the standard deviation of the sample, and n is the sample size.

Table 6 shows the results of the Student's *t* hypothesis test carried out on the 93 hypotheses according to equation (1).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/jesi.2021.8.4(27)

**Table 6.** Summary of the Student's *t* Hypothesis Testing

| # | Hypothesis | *t* | df | p-value | Confidence interval (%) | Estimated mean Min | Estimated mean Max | Result |
|---|---|---|---|---|---|---|---|---|
| 1 | H1.1 | 161.500 | 124 | 2.543E-15 | 95 | 5.00630 | 5.00783 | Supported |
| 2 | H1.2 | 161.500 | 124 | 2.543E-15 | 95 | 4.97617 | 5.00783 | Supported |
| 3 | H1.3 | 113.951 | 124 | 1.144E-13 | 95 | 4.96170 | 5.00630 | Supported |
| 4 | H1.4 | 161.500 | 124 | 2.543E-15 | 95 | 5.00630 | 5.00783 | Supported |
| 5 | H1.5 | 71.601 | 124 | 4.983E-10 | 95 | 4.92517 | 4.99483 | Supported |
| 6 | H2.1 | 28.044 | 124 | 7.986E-56 | 95 | 3.99370 | 4.03830 | Supported |
| 7 | H2.2 | 38.500 | 124 | 4.001E-71 | 95 | 3.99217 | 4.02383 | Supported |
| 8 | H2.3 | 13.769 | 124 | 4.765E-27 | 95 | 3.92948 | 4.00652 | Supported |
| 9 | H2.4 | 38.500 | 124 | 4.001E-71 | 95 | 3.99217 | 4.02383 | Supported |
| 10 | H3.1 | 80.226 | 124 | 5.016E-11 | 95 | 4.93672 | 4.99928 | Supported |
| 11 | H3.2 | 113.951 | 124 | 1.144E-13 | 95 | 4.96170 | 5.00630 | Supported |
| 12 | H3.3 | 41.948 | 124 | 2.042E-75 | 95 | 4.83195 | 4.94406 | Supported |
| 13 | H4.1 | 32.827 | 124 | 2-316E-63 | 95 | 4.75631 | 4.89169 | Supported |
| 14 | H4.2 | 33.716 | 124 | 1.342E-64 | 95 | 4.76555 | 4.89845 | Supported |
| 15 | H4.3 | 92.839 | 124 | 9.231E-12 | 95 | 4.94880 | 5.00320 | Supported |
| 16 | H4.4 | 161.500 | 124 | 2.543E-15 | 95 | 4.97617 | 5.00783 | Supported |
| 17 | H4.5 | 80.226 | 124 | 5.016E-11 | 95 | 4.93672 | 4.99928 | Supported |
| 18 | H5.1 | 14.732 | 124 | 2.561E-29 | 95 | 3.98740 | 4.07661 | Supported |
| 19 | H5.2 | 23.574 | 124 | 6.085E-48 | 95 | 3.99680 | 4.05120 | Supported |
| 20 | H5.3 | 26.410 | 124 | 4.728E-53 | 95 | 3.97752 | 4.02248 | Supported |
| 21 | H5.4 | 18.675 | 124 | 3.830E-38 | 95 | 3.96820 | 4.03180 | Supported |
| 22 | H5.5 | 13.769 | 124 | 4.765E-27 | 95 | 3.92948 | 4.00652 | Supported |
| 23 | H6.1 | 18.667 | 124 | 3.979E-38 | 95 | 4.44736 | 4.62464 | Supported |
| 24 | H6.2 | 15.424 | 124 | 6.334E-31 | 95 | 4.28228 | 4.45372 | Supported |
| 25 | H6.3 | 13.919 | 124 | 2-105E-27 | 95 | 4.10831 | 4.24369 | Supported |
| 26 | H6.4 | 16.561 | 124 | 1.638E-33 | 95 | 4.02050 | 4.10750 | Supported |
| 27 | H7.1 | 30.623 | 124 | 5.736E-60 | 95 | 4.72890 | 4.87110 | Supported |
| 28 | H7.2 | 56.234 | 124 | 2.079E-90 | 95 | 4.89250 | 4.97950 | Supported |
| 29 | H7.3 | 31.325 | 124 | 4.741E-61 | 95 | 4.73799 | 4.87801 | Supported |
| 30 | H7.4 | 18.543 | 124 | 7.323E-38 | 95 | 4.54681 | 4.74919 | Supported |
| 31 | H8.1 | 8.895 | 124 | 2.918E-15 | 95 | 4.24423 | 4.55577 | Supported |
| 32 | H8.2 | 6.792 | 124 | 2.048E-10 | 95 | 4.03729 | 4.31471 | Supported |
| 33 | H9.1 | -6.407 | 124 | 1.000E+00 | 95 | 3.31780 | 3.49820 | Not supported |
| 34 | H9.2 | -22.831 | 124 | 1.000E+00 | 95 | 3.04364 | 3.14836 | Not supported |
| 35 | H9.3 | -21.741 | 124 | 1.000E+00 | 95 | 3.04974 | 3.15826 | Not supported |
| 36 | H9.4 | -21.966 | 124 | 1.000E+00 | 95 | 3.03285 | 3.14315 | Not supported |
| 37 | H10.1 | 15.911 | 124 | 4.845E-32 | 95 | 4.31292 | 4.48708 | Supported |
| 38 | H10.2 | 13.937 | 124 | 1.901E-27 | 95 | 4.13586 | 4.28014 | Supported |
| 39 | H10.3 | 15.424 | 124 | 6.334E-31 | 95 | 4.28228 | 4.45372 | Supported |
| 40 | H10.4 | 14.035 | 124 | 1.119E-27 | 95 | 4.15697 | 4.30703 | Supported |
| 41 | H11.1 | 25.297 | 124 | 4.305E-51 | 95 | 4.64019 | 4.79981 | Supported |
| 42 | H11.2 | 24.491 | 124 | 1-225E-49 | 95 | 4.62286 | 4.78514 | Supported |
| 43 | H11.3 | 19.739 | 124 | 2.211E-40 | 95 | 4.48816 | 4.66384 | Supported |
| 44 | H11.4 | 13.910 | 124 | 2.209E-27 | 95 | 4.12199 | 4.26201 | Supported |
| 45 | H12.1 | 24.491 | 124 | 1.225E-49 | 95 | 4.62286 | 4.78514 | Supported |
| 46 | H12.2 | 23.394 | 124 | 1.320E-47 | 95 | 4.59709 | 4.76291 | Supported |
| 47 | H12.3 | 18.469 | 124 | 1-053E-37 | 95 | 4.43927 | 4.61673 | Supported |
| 49 | H12.4 | 16.176 | 124 | 1.211E-32 | 95 | 4.32839 | 4.50361 | Supported |
| 49 | H12.5 | 5.187 | 124 | 4.229E-07 | 95 | 3.93499 | 4.22501 | Supported |
| 50 | H13.1 | 161.500 | 124 | 2.543E-15 | 95 | 5.00630 | 5.00783 | Supported |
| 51 | H13.2 | 31.325 | 124 | 4.741E-61 | 95 | 4.73799 | 4.87801 | Supported |
| 52 | H14.2 | -86.500 | 124 | 1.000E+00 | 95 | 2.99217 | 3.00385 | Not supported |
| 53 | H15.3 | -31.511 | 124 | 1.000E+00 | 95 | 2.99854 | 3.08146 | Not supported |
| 54 | H15.4 | -5.270 | 124 | 1.000E+00 | 95 | 3.37536 | 3.55264 | Not supported |
| 55 | H16.1 | 161.500 | 124 | 2.543E-15 | 95 | 4.97617 | 5.00783 | Supported |
| 56 | H16.2 | 24.491 | 124 | 1.225E-49 | 95 | 4.62286 | 4.78514 | Supported |

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
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http://doi.org/10.9770/jesi.2021.8.4(27)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 57 | H16.3 | 17.242 | 124 | 4.972E-35 | 95 | 4.01513 | 4.09687 | Supported |
| 58 | H17.1 | -0.473 | 124 | 6.814E-01 | 95 | 3.51327 | 3.81473 | Supported |
| 59 | H17.2 | -0.673 | 124 | 7.489E-01 | 95 | 3.49509 | 3.80091 | Supported |
| 60 | H17.3 | -0.291 | 124 | 6.142E-01 | 95 | 3.54398 | 3.81602 | Supported |
| 61 | H17.4 | -3.072 | 124 | 9.987E-01 | 95 | 3.40404 | 3.63596 | Supported |
| 62 | H18.3 | 30.620 | 124 | 5.800E-60 | 95 | 4.81869 | 4.97331 | Supported |
| 63 | H18.4 | 161.500 | 124 | 2.543E-15 | 95 | 4.97617 | 5.00783 | Supported |
| 64 | H18.5 | 113.951 | 124 | 1.144E-13 | 95 | 4.96170 | 5.00630 | Supported |
| 65 | H19.1 | -86.500 | 124 | 1.000E+00 | 95 | 2.99217 | 3.00385 | Not supported |
| 66 | H19.3 | -86.500 | 124 | 1.000E+00 | 95 | 2.99217 | 3.00385 | Not supported |
| 67 | H19.4 | -86.500 | 124 | 1.000E+00 | 95 | 2.99217 | 3.00385 | Not supported |
| 68 | H20.4 | 2.654 | 124 | 4.494E-03 | 95 | 3.72543 | 3.87457 | Supported |
| 69 | H20.5 | 4.655 | 124 | 4.099E-06 | 95 | 3.78967 | 3.92233 | Supported |
| 70 | H21.3 | -49.184 | 124 | 1.000E+00 | 95 | 2.99680 | 3.05120 | Not supported |
| 71 | H21.4 | -4.723 | 124 | 1.000E+00 | 95 | 3.39915 | 3.57685 | Not supported |
| 72 | H21.5 | -4.405 | 124 | 1.000E+00 | 95 | 3.40433 | 3.58767 | Not supported |
| 73 | H22.1 | 161.500 | 124 | 2.543E-15 | 95 | 5.00630 | 5.00783 | Supported |
| 74 | H22.2 | 161.500 | 124 | 2.543E-15 | 95 | 4.97617 | 5.00783 | Supported |
| 75 | H22.3 | 161.500 | 124 | 2.543E-15 | 95 | 4.97617 | 5.00783 | Supported |
| 76 | H22.4 | 161.500 | 124 | 2.543E-15 | 95 | 4.97617 | 5.00783 | Supported |
| 77 | H22.5 | 113.951 | 124 | 1.144E-13 | 95 | 4.96170 | 5.00630 | Supported |
| 78 | H23.2 | 13.769 | 124 | 4.765E-27 | 95 | 3.92948 | 4.00652 | Supported |
| 79 | H23.3 | 15.311 | 124 | 1.154E-30 | 95 | 4.27468 | 4.44532 | Supported |
| 80 | H23.4 | 16.455 | 124 | 2.831E-33 | 95 | 4.34395 | 4.52005 | Supported |
| 81 | H23.5 | 9.691 | 124 | 3.549E-17 | 95 | 4.10425 | 4.31175 | Supported |
| 82 | H24.1 | -20.762 | 124 | 1.000E+00 | 95 | 3.05595 | 3.16806 | Not supported |
| 83 | H24.3 | -86.500 | 124 | 1.000E+00 | 95 | 2.99217 | 3.00385 | Not supported |
| 84 | H24.4 | -86.500 | 124 | 1.000E+00 | 95 | 2.99217 | 3.00385 | Not supported |
| 85 | H25.2 | 14.737 | 124 | 2.487E-29 | 95 | 4.04974 | 4.15826 | Supported |
| 86 | H25.3 | 14.548 | 124 | 6.917E-29 | 95 | 4.05595 | 4.16806 | Supported |
| 87 | H25.4 | 16.026 | 124 | 2.660E-32 | 95 | 4.02606 | 4.11795 | Supported |
| 88 | H26.3 | 17.602 | 124 | 7.991E-36 | 95 | 4.57691 | 4.79910 | Supported |
| 89 | H26.4 | 20.321 | 124 | 1.402E-41 | 95 | 4.63509 | 4.83691 | Supported |
| 90 | H26.5 | 13.448 | 124 | 2.773E-26 | 95 | 4.20146 | 4.37454 | Supported |
| 91 | H27.3 | 18.420 | 124 | 1.343E-37 | 95 | 4.59612 | 4.81188 | Supported |
| 92 | H27.4 | 20.845 | 124 | 1.212E-42 | 95 | 4.63763 | 4.83437 | Supported |
| 93 | H27.5 | 22.803 | 124 | 1.742E-46 | 95 | 4.61685 | 4.79115 | Supported |

As shown in Table 6, in most cases (77 relationships), the p-value is less than 0.05 and $H_a$ is accepted. Thus, the average perception of surveyed entrepreneurs is that the CSFs have a high influence on the life cycle stages of an ITS. Moreover, 16 hypotheses are not supported (p>0.05).

## 6. Discussion and future research

The results of the descriptive analysis indicate high and very high relationships between the various CSFs and stages (factor → stage). For instance, the 'developed innovation and entrepreneurship ecosystem' (F4) factor is essential for the success of an ITS in all stages, as shown in Figure 4(d).

The SCA results provide evidence of the high and very high relationships between the various factors and development stages, explaining 97.2% of the sample data. The MCA results show that several CSFs have high and very high relationships with the stages, with an average of 98% of the responses. One of the strongest relationships is between customer satisfaction and it's the stages (100%).

ISSN 2345-0282 (online) http://jssidoi.org/jesi/
2021 Volume 8 Number 4 (June)
http://doi.org/10.9770/jesi.2021.8.4(27)

Finally, the results obtained in the Student's t hypothesis test confirm that 77 of the 93 hypotheses are supported. H9.1, H9.2, H9.3, and H9.4 were not supported, perhaps because most technological ventures in Peru are not sophisticated (i.e. they do not require specialists). In addition, 68% of respondents indicate that they have not completed higher education and consider previous experience in managing and starting a business to be more important than academic training despite studies showing a positive relationship between the academic training of the entrepreneurial team and success of a start-up (Bou-Wen et al., 2006; Baptista et al., 2007). H14.2 was not supported, perhaps because the entrepreneurial leader's gender may be affected by another variable such as his/her experience, which according to Anh et al. (2012) & Arruda et al. (2013) influences ITS success. In addition, 94% of those surveyed have started a business before, and consider that experience to be the most influential on success, even more than gender.

Age could affect the growth and expansion of an ITS because an older entrepreneur generally has greater security and responsibility; however, H15.3 and H15.4 were not supported because the entrepreneurial leader's age (F15) presents a medium influence on the growth (S3) and expansion (S4) stages. This could be explained by the fact that age, similar to the entrepreneurial leader's gender, is also affected by his/her experience. This result disputes that of Oakey (2003), who finds that age has an influence. H19.1, H19.3 and H19.4 were not supported; this could be due to the nature of the Peruvian market. An ITS in Peru is generally characterised by the previous acquired experience of its collaborators, some innovation, and little research. Moreover, the market is not competitive contrary to ITSs in developed countries. Pugliese et al. (2016) point out that the pressure exerted by competition is decisive for the success of a start-up and that this pressure also provides ITSs with a means to improve their products through advanced research, innovation, and technological progress.

H21.3, H21.4 and H21.5 were not supported, perhaps because of the unawareness of respondents given that no Peruvian ITS has been listed on the stock market (S5), which requires companies to have been operating for a certain number of years and to have expanded to other markets (S4); further, few are in the growth stage (S3). Finally, H24.1, H24.3 and H24.4 were not supported; this could be explained by the Peruvian environment not advancing at the speed of technological ventures. According to Timmons & Spinelli (2004), environmental dynamism means having a high rate of change in the external environment of the company. Unfortunately, in the Peruvian case, several actors of the innovation and entrepreneurship ecosystem have not yet managed to support the development of ITSs.

## Conclusions

In this study, 93 relationships between the CSFs and life cycle stages of an ITS were identified through a conceptual model.

There is no defined standard for the life cycle stages of an ITS. Some authors consider three stages, whereas others adopt four; some consider stages that other authors do not and others use different names for the stages. For this reason, a life cycle consisting of five stages was proposed: seed, early, growth, expansion and exit. All these stages are important since achieving success in each one of them contributes towards the overall success of the ITS. Most studies of the factors that influence the success of an ITS do not indicate which development stage is particularly affected; hence, in this study, 15 factors that influence the seed stage (S1), 17 factors that influence the early stage (S2), 18 factors that influence the growth stage (S3), 17 factors that influence the expansion stage (S5), and 10 factors that influence the exit stage (S5) were identified.

From an academic point of view, this research contributes to the literature of technological entrepreneurship proposes an ITS life cycle composed of five stages, develop an integrated model of the critical success factors for each of them, and establishes their influence in all stages by  that influence the success.

The results of our analysis with 125 ITSs in Peru showed that several CSFs have high and very high relationships with the stages. Furthermore, the Student's t hypothesis test confirmed, with 95% confidence, that 77 relationships of the 93 hypotheses are supported. Hence, the final conceptual model is constituted by 21 factors and 77 relationships.

F9, F14, F15, F19, F21, and F24 that are important factors in developed countries are not valid for Peru, and probably for developing countries in the current context, although this is set to change in the medium or long term because of the development of policies to promote ITSs and acceleration of technology globalisation. F14 and F15 on success, proven in various studies, are not supported in the Peruvian case, perhaps because their effect is linked to another variable such as experience, regardless of the country of study.

This empirical study was limited to Peruvian ITSs; hence, to expand the experiment, the study could be conducted in other countries of the region. Future work could also aim to identify the requirements and activities to be performed within each life cycle stage of an ITS to move from one stage to another, considering the factors analysed in this study.

## References

Abou-Moghli, A. and Al-Kasasbeh, M. (2012) 'Social network and the success of business startup', *International Journal of Business and Management*, Vol. 7, No. 9, pp.134–140. http://dx.doi.org/10.5539/ijbm.v7n9p134

Al-Fraihat, D., Joy, M. and Sinclair, J. (2020) 'Evaluating e-learning systems success: an empirical study', Computers in Human Behavior, January, Vol. 102, pp.67–86

Almakenzi, S., Bramantoro, A. and Rashideh, W. (2015) 'A survivability model for Saudi ICT startups', *International Journal of Computer Science and Information Technology*, Vol. 7, No. 2, pp.145–157. http://dx.doi.org/10.5121/ijcsit.2015.7213

Anh, D., Hoa, Q. and Quoc, T. (2012) 'Critical success factors for Vietnamese software companies: a framework for investigation', *Journal of Sociological Research*, Vol. 3, No. 2, pp.160–169.

Ardito, L., Messeni Petruzelli, A. and Albino, V. (2015) 'From technological inventions to new products: a systematic review and research agenda of the main enabling factors', *European Management Review*, Vol. 12, No. 3, pp.113–147. http://dx.doi.org/10.1111/emre.12047

Arruda, C., Silva, V. and Costa, V. (2013) 'The Brazilian entrepreneurial ecosystem of startups: an analysis of entrepreneurship determinants in Brazil as seen from the OECD pillars', *Journal of Entrepreneurship and Innovation Management*, Vol. 2, No. 3, pp.17–57.

Balboni, B., Bortoluzzi, G., Tivan, M., Tracogna, A. and Venier, F. (2014) 'The growth drivers of startup firms and business modelling: a first step toward a desirable convergence', *Management*, Vol. 9, No. 2, pp.131–154.

Banda, J. and Lussier, R. (2015) 'Success factors for small businesses in Guanajuato, Mexico', *International Journal of Business and Social Science*, Vol. 6, No. 11, pp.1–17.

Baptista, R., Karaoz, M., & Mendonca, J. (2007). Entrepreneurial backgrounds, human capital and start-up success. *Jena Economic Research Papers*, 45(2007), 1-39.

Baum, J.A.C. and Silverman, B.S. (2004) 'Picking winners or building them? Alliance, intellectual, and human capital as selection criteria in venture financing and performance of biotechnology startups', *Journal of Business Venturing*, Vol. 19, No. 3, pp.411–436. http://dx.doi.org/10.1016/S0883-9026(03)00038-7

Bocken, N. (2015) 'Sustainable venture capital – catalyst for sustainable startup success?', *Journal of Cleaner Production*, Vol. 108, Part A, pp.647–658. http://dx.doi.org/10.1016/j.jclepro.2015.05.079

Bou-Wen, L., Po-Chien, L., & Ja-Shen, C. (2006). Social capital, capabilities, and entrepreneurial strategies: a study of Taiwanese high-tech new ventures. *Technological Forecasting and Social Change*, 73(2), 168-181.

Chen, Y.F., Tsai, C.W. and Liu, H.J. (2019) Applying the AHP model to explore key success factors for high-tech startups entering international markets', *International Journal of E-Adoption (IJEA)*, Vol. 11, No. 1, pp.45–63. http://dx.doi.org/10.4018/IJEA.2019010104

Colombo, M. and Grilli, L. (2010) 'On growth drivers of high-tech startups: exploring the role of founders' human capital and venture capital', *Journal of Business Venturing*, Vol. 25, No. 6, pp.610–626. http://dx.doi.org/10.1016/j.jbusvent.2009.01.005

Díaz-Santamaría, C., & Bulchand-Gidumal, J. (2021). Econometric Estimation of the Factors that Influence Startup Success. *Sustainability*, 13(4), 2242. https://doi.org/10.3390/su13042242

Diochon, M., Menzies, T., & Gasse, Y. (2007). Attributions and success in new venture creation among Canadian nascent entrepreneurs. *Journal of Small Business & Entrepreneurship*, 20(4), 335-350. http://dx.doi.org/10.1080/08276331.2007.10593404

Friar, J. and Meyer, M. (2003) 'Entrepreneurship and startups in the Boston region: factors differentiating high-growth ventures from micro-ventures', *Small Business Economics*, Vol. 21, No. 2, pp.145–152. http://dx.doi.org/10.1023/A:1025045828202

Ganotakis, P. (2012) 'Founders' human capital and the performance of UK new technology based firms', *Small Business Economics*, Vol. 39, No. 2, pp.495–515. http://dx.doi.org/10.1007/s11187-010-9309-0

Gimmon, E. and Levie, J. (2010) 'Founder's human capital, external investment, and the survival of new high-technology ventures', *Research Policy*, Vol. 39, No. 9, pp.1214–1226. http://dx.doi.org/10.1016/j.respol.2010.05.017

Greve, A. and Salaff, J.W. (2003) 'Social networks and entrepreneurship', *Entrepreneurship Theory and Practice*, Vol. 28, No. 1, pp.1–20. http://dx.doi.org/10.1111/1540-8520.00029

Haltiwanger, J., Jarmin, R., & Miranda, J. (2012). Who creates jobs? Small versus. large versus. Young. *Review of Economics and Statistics*, 95(2), 347-361. http://dx.doi.org/10.1162/REST_a_00288

Honorine, A.N.D. and Emmanuelle, D. (2019) 'Stage financing and syndication in the IPO underpricing of venture-backed firms: venture capital and IPO underpricing', *The International Journal of Entrepreneurship and Innovation*, Vol. 20, No. 4, pp.289–300. http://dx.doi.org/10.1177/1465750318795083

Hormiga, E., Batista-Canino, R. and Sánchez-Medina, A. (2011) 'The impact of relational capital on the success of new business startups', *Journal of Small Business Management*, Vol. 49, No. 4, pp.617–638. http://dx.doi.org/10.1111/j.1540-627X.2011.00339.x

Hyder, S. and Lussier, R. (2016) 'Why businesses succeed or fail: A study on small businesses in Pakistan', *Journal of Entrepreneurship in Emerging Economics*, Vol. 8, No. 1, pp.82–100. http://dx.doi.org/10.1108/JEEE-03-2015-0020

Johnson, R.A., & Wichern, D.W. (2007). *Applied multivariate statistical analysis (6th ed.)*, Pearson Education, Upper Saddle River, New Jersey.

Joshi, D. (2021). Role of Culture in Success of Global High-Tech Startup Businesses from India. *In Culture in Global Businesses* (pp. 133-182). Palgrave Macmillan, Cham

Kim, B., Kim, H. and Jeon, Y. (2018) 'Critical success factors of a design startup business', *Sustainability*, Vol. 10, No. 9, p.2981. http://dx.doi.org/10.3390/su10092981

Kim, Y. and Heshmati, A. (2010) 'Analysis of Korean IT startups' initial public offering and their post-IPO performance', *Journal of Productivity Analysis*, Vol. 34, No. 2, pp.133–149. http://dx.doi.org/10.1007/s11123-010-0176-0

Ko, C.R. and An, J.I. (2019) 'Success factors of student startups in Korea: from employment measures to market success', *Asian Journal of Innovation and Policy*, Vol. 8, No. 1, pp.097–121.

Konsek-Ciechonska, J. (2019) 'Startup companies challenges in Poland', *Knowledge International Journal*, Vol. 30, No. 6, pp.1621–1626 http://dx.doi.org/10.35120/kij30061621K

McAdam, M. and McAdam, R. (2008) 'High tech startups in university science park incubators: the relationship between the startup's lifecycle progression and use of the incubator's resources', *Technovation*, Vol. 28, No. 5, pp.277–290. http://dx.doi.org/10.1016/j.technovation.2007.07.012

Monroy, L.G.D. and Rivera, M.A.M. (2012) Estadística multivariada: Inferencia y métodos, Editorial Universidad Nacional de Colombia, Bogota, Columbia.

Morteza, S., Pitts, B., Ehsani, M. and Kordnaeij, A. (2013) 'The vital factors for small and medium sized sport enterprises startups', *Asian Social Science*, Vol. 9, No. 5, pp.243–253.

Mueller, S., Volery, T. and Von, B. (2012) 'What do entrepreneurs actually do? An observational study of entrepreneurs' everyday behavior in the start-up and growth stages', *Entrepreneurship Theory and Practice*, Vol. 36, No. 5, pp.995–1017. http://dx.doi.org/10.1111/j.1540-6520.2012.00538.x

Ng, A., Macbeth, D., & Southern, G. (2014). Entrepreneurial performance of early-stage ventures: Dynamic resource management for development and growth. *International Entrepreneurship Management Journal*, 10(3), 503-521. http://dx.doi.org/10.1007/s11365-014-0303-x

Oakey, R. (2003) 'Technical entrepreneurship in high technology small firms: some observations on the implications for management', *Technovation*, Vol. 23, No. 8, pp.679–688. http://dx.doi.org/10.1016/S0166-4972(03)00045-2

Petru, N., Pavlák, M. and Polák, J. (2019) 'Factors impacting startup sustainability in the Czech Republic', *Innovative Marketing*, Vol. 15, No. 3, pp.1–15. http://dx.doi.org/10.21511/im.15(3).2019.01

Pirolo, L. and Presutti, M. (2010) 'The impact of social capital on the startups' performance growth', *Journal of Small Business Management*, Vol. 48, No. 2, pp.197–227. http://dx.doi.org/10.1111/j.1540-627X.2010.00292.x

Prohorovs, A., Bistrova, J. and Ten, D. (2018) 'Startup success factors in the capital attraction stage: founders' perspective', *Journal of East-West Business*. http://dx.doi.org/10.1080/10669868.2018.1503211

Pugliese, R., Bortoluzzi, G. and Zupic, I. (2016) 'Putting process on track: empirical research on start-ups' growth drivers', *Management Decision*, Vol. 54, No. 7, pp.1633–1648. http://dx.doi.org/10.1108/MD-10-2015-0444

Rojas, F. and Huergo, E. (2016) 'Characteristics of entrepreneurs and public support for NTBFs', *Small Business Economics*, Vol. 47, No. 2, pp.1–20. http://dx.doi.org/10.1007/s11187-016-9718-9

Roy, S., Modak, N. and Dan, P.K. (2020) 'Managerial support to control entrepreneurial culture in integrating environmental impacts for sustainable new product development', Sustainable Waste Management: Policies and Case Studies, pp. 637–646, Springer, Singapore

Santisteban, J. and Mauricio, D. (2017) 'Systematic literature review of critical success factors of information technology startup', *Academy of Entrepreneurship*, Vol. 23, No. 2, pp. 1-23

Santisteban, J., Mauricio, D., & Cachay, O. (2021). 'Critical factors success for technology-based startups'. *International Journal of Entrepreneurship and Small Business*. Vol. 42. No. 4, pp. 397-421. http://dx.doi.org/10.1504/IJESB.2021.114266

Scarborough, N. and Zimmerer, T. (2003) Effective Small Business Management: *An Entrepreneurial Approach*, Prentice Hall Publishing, New Jersey

Schneider, J., Dowling, M. and Raghuram, S. (2007) 'Empowerment as a success factor in startup companies', *RMS*, Vol. 1, No. 2, pp.167–184 http://dx.doi.org/10.1007/s11846-007-0001-y

Sefiani, Y. and Bown, R. (2013) 'What influences the success of manufacturing SMEs? A perspective from tangier', *International Journal of Business and Social Science*, Vol. 4, No. 7, pp. 297–309.

Song, M., Podoynitsyna, K., Van der Bij, H. and Halman, J. (2008) 'Success factors in new ventures: a meta-analysis', *The Journal of Product Innovation Management*, Vol. 25, No. 1, pp. 7–27. http://dx.doi.org/10.1111/j.1540-5885.2007.00280.x

Strehle, F., Katzy, B. and Davila, T. (2010) 'Learning capabilities and the growth of technology-based new ventures', *International Journal Technology Management*, Vol. 52, Nos. 1/2, pp. 26–45.. http://dx.doi.org/10.1504/IJTM.2010.035854

Streiner, D. (2003) 'Starting at the beginning: an introduction to coefficient alpha and internal consistency', *Journal of Personality Assessment*, Vol. 80, No. 1, pp. 99–103. http://dx.doi.org/10.1207/S15327752JPA8001_18

Survey Google Form (2018) [online] is available at the following address: https://docs.google.com/forms/d/e/1FAIpQLSdkDDVaj4ito1Gux0Z3vKYVOJEe_lBy0vYPeSlP-wus4gjE9w/viewform (accessed 1 March 2018)

Thanh, P. (2015). The policy factors affecting the small and medium enterprises' business success in Dong Nai province Vietnam. *KAAV International Journal of Arts, Humanities*, 2(4), 67-78.

Thiranagama, R. and Edirisinghe, K. (2015) 'Factors affecting small business startup of engineers and accountants in Sri Lanka', *NSBM Business and Management Journal*, Vol. 6, No. 1, pp. 84–107.

Timmons, J. and Spinelli, S. (2004) New Venture Creation: Entrepreneurship for the 21st Century, McGraw-Hill/Irwin, New York.

Van Gelderen, M., Thurik, R. and Bosma, N. (2005) 'Success and risk factors in the pre-startup phase', *Small Business Economics*, Vol. 24, No. 4, pp. 365–3. http://dx.doi.org/10.1007/s11187-004-6994-6

Wei-Wen, W. (2009) 'A competency-based model for the success of an entrepreneurial startup', *WSEAS Transactions on Business and Economics*, Vol. 6, No. 6, pp. 279–291.

Wing-Ki, W., Hong-Man, C., & Venuvinod, P. (2005). Assessing the growth potential of high-technology startups: An exploratory study from Hong Kong. *Journal of Small Business and Entrepreneurship*, Vol. 18, No. 4, pp. 453-470.

Yoo, C., Yang, D., Kim, H. and Heo, E. (2012) 'Key value drivers of startup companies in the new media industry – the case of online games in Korea', *Journal of Media Economics*, Vol. 25, No. 4, pp.2 44–260. http://dx.doi.org/10.1080/08997764.2012.729546

Yoon-Jun, L. (2010) 'Technology strategy by growth stage of technology-based venture companies', *International Review of Business Research Papers*, Vol. 6, No. 6, pp. 216–234.

***Acknowledgements***
*We thank reviewers for their recommendations and opinions on this paper. Their insights and experiences added considerable valuable. Finally, we are gratefull to Universidad Nacional Mayor de San Marcos (UNMSM), for the partial funding of this research.*

**José SANTISTEBAN** is a System Engineer, he received his Magister in Systems Engineering and currently is a doctoral candidate at the Faculty of System Engineering and Informatics, Universidad Nacional Mayor de San Marcos (UNMSM), Peru. He has more than 10 years of experience in implementing information systems in different business sectors. Research interests: artificial intelligence, entrepreneurship and regional development; innovation and small firms; small firm internationalization; sustainability.
**ORCID ID**: orcid.org/0000-0003-4526-642X

**Jorge INCHE** is a Doctor In Administrative Sciences, at the Universidad Nacional Mayor de San Marcos (UNMSM) (2005-2007), with a specialization in research and development at the Karlsruhe Institute of Technology (1990-1992) in Germany. Since 1996 he is Professor at the UNMSM. His areas of interest are: innovation, environment, security and technological management.
**ORCID ID**: orcid.org/0000-0002-5887-8591

**David MAURICIO** is is a Doctor of Science in Systems Engineering and Computer Science and Master of Science in Applied Mathematics by the Federal University of Rio de Janeiro, Brazil. He had taught at the State University of North Fluminense Brazil in the years 1994 to 1998; and since 1998, he is a Professor at the Universidad Nacional Mayor de San Marcos (UNMSM). His areas of interest area: Mathematical programming, Artificial intelligence, Software engineering and Entrepreneurship.
**ORCID ID**: orcid.org/0000-0001-9262-626X