

Individual's Core Competences in the Innovation Process: A Proposal of Personality Profiles Required in Each Innovation Stage

Mariela Martínez^{1}, Manon Enjorlas², Laure Morel²*

Abstract

Models of the innovation process, such as open innovation, lean innovation, disruptive innovation, and others, have been developed these last years to improve organizational innovation. However, limited studies exist focused on identifying the individual's competences related to the stages of the innovation process, even though, they (the individual competences) have been considered the starting point of the innovation process and are part of the different factors that could impact favourable outcome of those models. This study aims then to identify the individual's core competences of the leaders of the innovation process, required to efficiently handle the specificities of each innovation stage. The importance of this proposal is strengthened by the fact that by understanding its competences (skills, traits, and behaviors) within the innovation process, the human capital could be strategically placed, trained, and optimize its impact. It has the potential to significantly enhance the innovation performance of an organization.

An exploratory multiple cases study with Costa Rican SMEs companies is developed. Integrating the ideal competences based on a theoretical model, complementing it with an empirical approach, and by using a personality profiling instrument, a holistic contribution was obtained. As a result, a proposal including six personality profiles with the individual's core competences for each innovation stage is proposed. Those results represent both a theoretical and a managerial contribution. Moreover, they could provide a helpful, practical, and efficient guide enabling the innovation team composition, an accurate distributions of the innovation's team roles, the right possible fit between personal competences and positions, a favorable human resources strategy, and the implementation of effective training plans.

Keywords: innovation roles, innovation teams, innovation skills, innovation behaviour, entrepreneurial behavior, profile, innovation stage.

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Introduction

Recent innovation studies have focused on the creation of models such as open innovation, lean innovation, incremental innovation, and others, to improve the way the organizations implement innovation. However, few have focused on the persons behind the innovation process and in their individual competences, even if those competences can be an important factor to efficiently achieve what is proposed in the innovation models. The more the individual competences could be enhanced, the more the company's capability to develop and coordinate the innovation process could be improved (Adams et al., 2006; Boly et al., 2014; Gehani, 2011; Hiltunen & Henttonen, 2016). This study aims then to identify the individual's core competences profile(s) of the leaders of the innovation process, required to efficiently handle the specificities of each innovation stage. The importance of individual competences is supported by the fact that people are at the origin of the enterprise's innovation process. Given that the foundation of innovation is ignited by a group of ideas, it is people who ultimately, develop, carry, react, and modify them (Annieke et al., 2007; Nham et al., 2020; Setia Margana et al., n.d.; Wiktorsson & Groth, 2011).

Some theoretical constructs have been developed with the intent of identifying the profile of the person behind the innovation process,

some of them are Innovative Behavior (IB) (Lepoutre et al., 2013; Scott & Bruce, 1994; Stauffer, 2015; Welbourne et al., 1998; F. Yuan & Woodman, 2010), Entrepreneurial Behavior (EB) (Liñán & Santos, 2021; Mandysová, 2018; Pietersen & Botha, 2021; Riyanti et al., 2022), Psychological Models (Gao et al., 2020; Luthans et al., 2011; Y. Yuan & Chai, 2020) (Psy), and Managers' innovation profiles (de Visser & Faems, 2015; Engle et al., 2017; Martínez-Ros & Orfila-Sintes, 2012). Despite the multiple uses of those theoretical constructs, there exist gaps in their own bases. Also, there exist increasing discrepancies between the competences and variables each construct used (Martinez et al., 2022). It leads to a difficult, non-uniformed, or non-common path to analyze and respond to what are the required individual competences within the innovation process, to enhance innovation performance results. The relevance and impact of this gap also implies that some of the industry's current practices such as recruiting, conforming teams, delegating roles, training, and motivating within the innovation processes could be badly focused and not efficient as it could be. In the way of closing the gap in which are the individual competences for innovation, this study aims to identify a core competences profile(s) of the individual, required to hold the innovation process. This research uses an exploratory multiple-case study with Costa Rican SMEs companies. It used as a background a theoretical model called Model of Individual Competences (Martinez, 2023), and an empirical approach by utilizing semi-structured interviews and

(1) Business Administration School, University of Costa Rica & Univeristé de Lorraine, Nancy, France

(2) ERPI, Univeristé de Lorraine, Nancy, France

*Corresponding author: mariela-de-los-angel.martinez-chacon@univ-lorraine.fr

content analysis. This integrates a theoretical and empirical approaches of individual competences for the innovation process in one unified set of competences. To find the competences individual profile(s), an identification and matching of an instrument for profiling the person's personality called Big Five with the set of competences was made.

As a result, a model composed of six personality profiles within the individuals' core competences for each innovation stage is proposed. It highlighted that all the stages of the innovation process do not require the same individual "competences".

This resulting model reflects integral but different competences that need to be mobilized for a person at each stage of the process. Some of them require a creative profile, moving them to an organized or structured profile throughout the process, and concluding with a social profile.

Those results become significant and relevant for both the industry and also the academy. In the industry, it could impact positively at different levels such as; the improvement of each innovation stage outcomes, innovation teams' configuration, roles for the innovation process, individual performance, management of human resources, recruitment process, training programs and motivation of employees. Those benefits will improve and impact consequently the innovation performance (Nham et al., 2020). It could also have an impact on the company's resources optimization when a beneficial adaptation of the individuals in the innovation role is held. In the academy, the contribution of confronting and integrating the empirical or company approach is relevant, and in this study, both were managed. The results are holistic and provide a supported model that can be used by different subjects such as innovation, entrepreneurship, innovative ecosystems, and also in behavioral perspectives. The extension of this model' uses could be supported in other studies when an integrative, contrasted model of a person's competences would be required.

Theoretical Background

Theoretical constructs of individual innovation competences

Individual competencies are defined as the ability to integrate and apply contextually-appropriate knowledge, skills, and psychosocial factors (beliefs, attitudes, motivations, etc.) to provide successful outcomes (Bartram, 2005; Vitello et al., 2021). In this study, we are based on those individual's competences that help to have successful outcomes in innovation.

There exist some theoretical constructs commonly used by the authors in the way to define individual innovation competencies. Based on literature review, experts opinion and professionals in this subject, some of the most relevant theoretical constructs are:

- Innovative Behavior (IB) (Lepoutre et al., 2013; Scott & Bruce, 1994; Stauffer, 2015; Welbourne et al., 1998; F. Yuan & Woodman, 2010) is defined as "all individual actions directed at the generation, introduction and or application of beneficial novelty at any organizational level" (ISO 56000, 2020).

- Entrepreneurial Behavior (EB) (Liñán & Santos, 2021; Mandysová, 2018; Pietersen & Botha, 2021; Riyanti et al., 2022), is defined as a "behavior in response to a judgmental decision under uncertainty about a possible opportunity for profit" (Gómez-Solórzano et al., 2019)
- Psychological Model (Gao et al., 2020; Luthans et al., 2011; Y. Yuan & Chai, 2020) (Psy) Psychological models integrate individual or Psychological variables. Are all the models and theoretical proposal from a psychological perspective, related with innovation.
- Managers' innovation profiles (de Visser & Faems, 2015; Engle et al., 2017; Martínez-Ros & Orfila-Sintes, 2012). We consider as a manager's innovation profile those characteristics, individuality, and specifics behaviors required for innovation managers to and enlisted for different authors, and founding in SCOPUS database.

However, Martinez et al.(2022) in recent research identified some contradictions and differences within each construct; that's why, based on a systematic literature review they integrated the common variables of those constructs in one variable's categorization framework of the individual innovation competences. Using content analysis and a comparison of those theoretical constructs, an integration of the indispensables variables categories for defining individual innovation competences was developed. The main variables categories of this framework according to (Martinez et al., 2022) are described below:

- Environmental/Work/social variables: related to the support of the company or social aspects. Example: innovative work environment, horizontal support, institutional trust.
- Psychological factors: related to natural or personality characteristics. Example: flexibility, detail-oriented, risk-taking.
- Innovative or Entrepreneurial Behavior: specifically, variables or behaviors related to, or for, innovation or entrepreneurship. Example: entrepreneurial activity, entrepreneurial innovativeness, innovative behavior.
- Management/Leadership: related to the kind of leadership or those variables developed in a charge of leadership. Examples: leadership efficacy, communication, and management skills.
- Education: related to the educational process. For example, engineering education, empirical studies, and high school studies.
- Innovation stage actions. More than behavior, they are the expected actions. For example, implementation, action, exploitation, etc.

Those categories of variables of the model is consistent with the ISO 56000:2019 (Innovation Management – Fundamentals and Vocabulary).

This norm integrates holistic and integral aspects of the innovation and its management (ISO 56000, 2020). It proposes the areas of the organization for the innovation. That's why this proposal of this Framework represent a sufficiently supported model.

Theoretical Individual Competences for stages of the innovation process

The stages for innovation process are associated with a unique set of task and so with a specific skills and roles. It means specific set of competences may be needed in each stage as Yeboah (2023) argues. An only set of competences could not be enough to supply all the necessities in the different stages. Moreover, it could avoid the bias of generalizing one person's set of competences for the whole process, omitting the differences between the stages.

There exist some theoretical and empirical approaches that suggest different stages in the innovation process. Some of them include from four innovation stages to six (Cooper, 1990; ISO 56000, 2020; Rogers, 2003; Tidd & Bessant, n.d.). (Hansen & Birkinshaw, 2007)

Martinez et al (2023), held a research using the variables' categorization framework detailed in the last section (Martinez et al., 2022) and realized a systematic literature review to identify the most common innovation process stages, and a co-occurrence analysis to identify individual competence's variables in each stage using that framework as a base. As a result, the Model of Individual Competences was developed. In that model, it has been identified a proposal of six innovation process stages. Those stages are:

- Stage 1. Identify opportunities: knowledge of a necessity or problem to be solved and where the innovation initiative started (Hansen & Birkinshaw, 2007; ISO 56000, 2020; Rogers, 2003).
- Stage 2. Create concepts: idea generation, initial screen, and concept generation. The potential solutions are handled in this stage (Cooper, 1990; Hansen & Birkinshaw, 2007; ISO 56000, 2020; Rogers, 2003; Tidd & Bessant, n.d.).
- Stage 3. Validate: the project or solution selection is carried on, as well as the following process to decrease the uncertainty of technical, financial, marketing, and organizational aspects. The viability and validation of the risk are reviewed in this stage (Cooper, 1990; ISO 56000, 2020; Rogers, 2003; Tidd & Bessant, n.d.).
- Stage 4. Develop the materialization of the concept and convert ideas into a real solution in held in this process. The participation of stakeholders is preferred to help the creation process and validate its acceptability (Cooper, 1990; Hansen & Birkinshaw, 2007; ISO 56000, 2020; Tidd & Bessant, n.d.).
- Stage 5. Deploy: diffusing and communicating the idea is realized. It is also called implementation, and here the commercialization of the solution is executed, could integrate some stakeholders and organizational departments to integrate the solution (Cooper, 1990; Hansen & Birkinshaw, 2007; ISO 56000, 2020; Rogers, 2003; Tidd & Bessant, n.d.).
- Stage 6. Review: the right function of the solution reviewed, and also the identification of new opportunities to be solved in future innovation processes (Cooper, 1990; Rogers, 2003; Tidd & Bessant, n.d.).

This Model integrates in each stage a set of specific competence for the individual innovation. An extract of the theoretical Model (Stage 1) is presented in the following figures. (See the Complete Model in Annex 1)

Table 1

Stage 1. Model individual innovation competences: from theoretical approach.

Innovation Stage: 1. Identify opportunities	
Category	Individual Competences
Educational profile or studies:	Project management Engineering education
Environmental/Work/Social factors that could impact:	Organizational culture
Innovation stage actions required:	Exploitation Exploration Planning
Innovative/Entrepreneur. Behavior expected:	Innovation capability or innovativeness Collaborative innovation
Leadership and Manag. Skills required:	Communication Problem solving Risk assessment Leadership Dynamic capabilities
Psychological factors expected:	Absorptive capacity, Abstraction capacity Creativity, Cooperative

It can be deduced that an innovative person could not be considered as one element and separated from other variables, and also the competences required in the innovation process are specific in each stage.

The detailed theoretical model represents a kind of profile of specific competences required to accomplish the aims in each innovation stage process.

It is important to highlight that this model is based on the literature review of the authors, and an empirical approach could be effective to verify its implication and comparability in industry.

Personality Traits and set of competences

Personal knowledge, perceptions, experiences, and behaviors shaped personality traits (Hwee Nga & Shamuganathan, 2010a). In other words, the personality traits or personality profiles integrate specific behaviors, experiences, and features. Those traits are known as predictable and persistent features in the adoption of individual behavior that could help to explain actions and decision-making in some scenarios (Devaraj et al., 2008; Kor et al., 2007; Llewellyn & Wilson, 2003).

Considering that individual competences integrated also specific features, behaviors, knowledge, etc. (Bartram, 2005; Vitello et al., 2021) some authors related the personality traits or personality profile features with the competences (Bäckström et al., 2020; Bartram, 2005; Rammstedt et al., 2017). It means that a set of competences in a generalized way could reflect some aspects of psychological profile or trait. Considering that this research aims to propose a profile of the individual's core competencies, by using a personality trait instrument this aim could be supported.

A literature review was held to verify the most used instrument for measuring individual characteristics or personality in relation to innovation. For this aim, based on a Scopus with the following detail: ABS(((personality W/5 (measure OR dimension OR instrument OR test OR model))) AND (innovation))), was held.

By selecting the 15 most cited papers, and analyzing the instrument used in each study, the Big Five Traits Personality Measurement Instrument was the model most used by previous authors (Abrahams et al., 2019; Heidenreich & Handrich, 2015; Howell et al., 2005; Hwee Nga & Shamuganathan, 2010a; Kirton & De Ciantis, 1986; Lightfoot et al., 2014; Madrid et al., 2014a; Marcati et al., 2008a; Punnoose, 2012; Reader et al., 2016; Uher, 2013) (Rauschnabel et al., 2015; Seibert et al., 2001) to evaluate personal or individual characteristics in innovation studies. Also, this instrument is well recognized for different authors as primary tool for capturing the essence of an individual's personality (Zhou & Tang, 2022), as robustness model

that compelling evidence in the literature (Stock et al., 2016) and also this instrument has been used before for different authors when study innovation and psychological aspects (Goldberg, 1990; Madrid et al., 2014b; Runst & Thomä, 2022; Sassenberg et al., 2023).

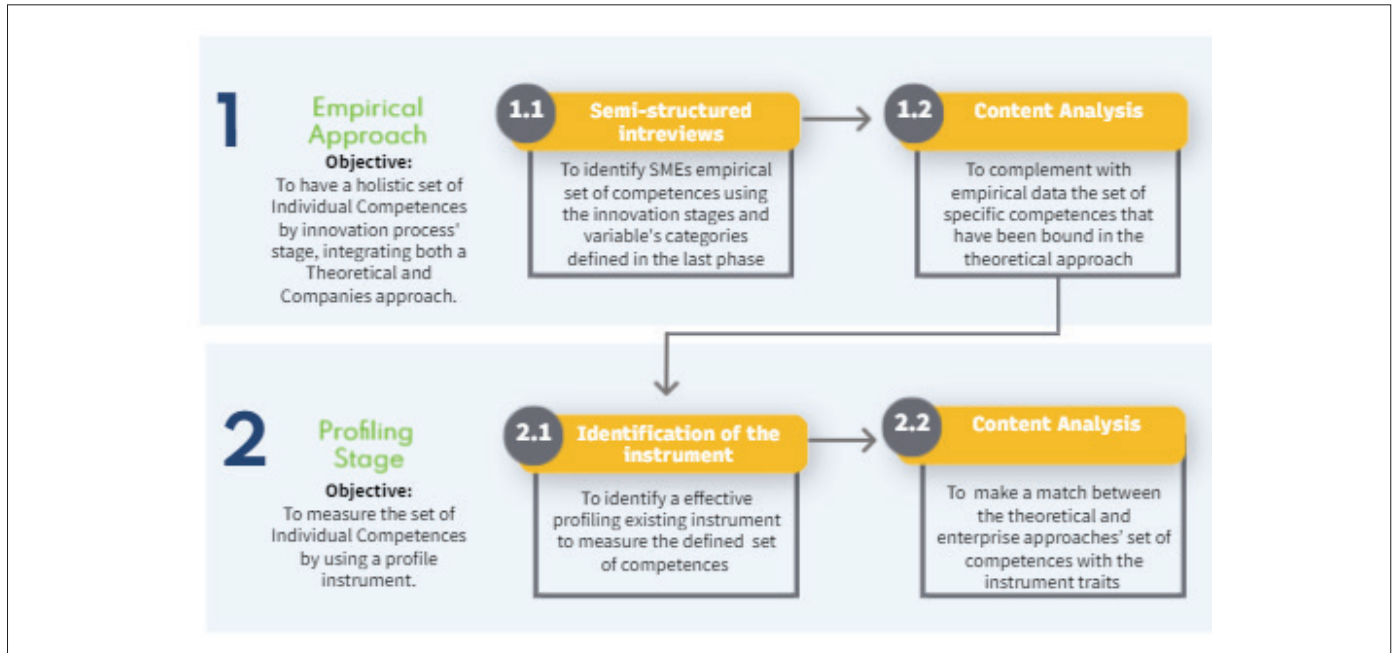
This instrument considers the following aspects: openness, extroversion, conscientiousness, agreeableness, and neuroticism. Some different characteristics have been classified into five dimensions, known as the Big Five (Costa & McCrae, 1980; Digman, 1990). The Five dimensions are called: Agreeableness, Openness, Extroversion, Conscientiousness, and Neuroticism. Each dimension has specific traits or behaviors, that shape and differentiate that dimension from others. Some features in each dimension are described as follows: Agreeableness is a feature of social, altruistic, cooperative, and trusting behavior (Major et al., 2006). Conscientiousness refers to a preference for goal-oriented activity, meticulousness, responsibility, and organization (Hwee Nga & Shamuganathan, 2010a; Judge & Zapata, 2015). Extroversion represents social interaction and activity, also enjoy social attention, outgoing attitude, and assertiveness (Hwee Nga & Shamuganathan, 2010a; Judge & Zapata, 2015) (Devaraj et al., 2008; Major et al., 2006); Openness involves the tolerance for new ideas and new ways of doing things (Hwee Nga & Shamuganathan, 2010a; Judge & Zapata, 2015; Major et al., 2006; Marcati et al., 2008b); and Neuroticism, which denotes the inability to respond to external stimuli through charge emotions and impulses under control, impulsiveness, and low self-esteem (Hwee Nga & Shamuganathan, 2010a; Judge & Zapata, 2015; Marcati et al., 2008a).

Methodological Procedures

The objective of this paper is to identify a core competences profile(s) of the individual, required for the leaders of the innovation process to efficiently handle the specificities of each innovation stage.

Based on the information developed in the theoretical background section of this article, a Theoretical Model of Individual Competences already exists and is well supported. Due the relation of the competences and psychological profiles described in the previous section, our aim in this point is that each set of competences proposed by stage of this model could be compared with a defined and existing personality instrument to identify the personality profile in each stage. As an outcome, a psychological profile could be suggested for each innovation stage, and this suggestion could be measured by a verified psychological profile's measure instrument.

However, the model is a theoretical model. So, to reflect closer results to the enterprises context, a complement of this theoretical model with its empirical version could result from an exploratory multiple-case. That's why, to accomplish this process, a two steps methodology was implemented. The methodology subsections are described next:

Figure 1. Methodology steps. *Note.* Source: Own creation**Step 1. Exploratory Multiple-case**

Since a Theoretical Model of Individual Competences is based on the literature, this methodological step aims to have the individual's core competences profiles from both theoretical and the company's approach unified, for each innovation stage.

The Theoretical Model of Individual Competences proposed in this study as a methodological background, and for the company's approach, an exploratory multiple-case approach was developed (Yin, 2014).

Semi-structured interview. To complement the Theoretical Model, it was required to have the point of view of the empirical or companies reality. Using the interviews allows us to collect data from independent sources (both the theory and the company's approach), is preferred in terms of further theory development and increases the generalizability of qualitative studies (Cunningham et al., 2016).

-Sample. A target sample includes an interview with ten owners and managers of SMEs operating in Costa Rica. The data were collected between October and December 2023. The selection process for the businesses to be surveyed depended on two criteria. First, businesses should belong to one of four sectors: Energy, telecommunication, and manufacturing, or services SMEs. These sectors have the most quantity of innovative processes held in Costa Rica, based on a comparative analysis held for this study based on the Science and Technology Index of the years 2013 to 2016 and 2018 (*Indicadores de Ciencia y Tecnología – Ministerio de Ciencia, Innovación, Tecnología y Telecomunicaciones*, n.d.). Comparing the results of those years, in 2013 at least 93.2% of the sectors of manufacturing, energy, and telecommunications handled an innovative process; in 2014, 60%

of the agricultural sector held an innovative process; in 2015-2016, 88.7% of the service sector held an innovative process; and in 2018, an 36.2% of the agricultural sector realized an innovative process. Averaging and comparing those results, in those years the sector with the highest percentage of kind of implemented innovation processes were manufacturing, energy, and telecommunications, followed by the service sector. This is the reason only the three first sector was selected. The second criterion was to have the experience of at least three innovation processes realized in the last three years. Once these businesses were selected, an exhaustive semi-structured interview

Table 2

SMEs selected

SMEs	Industry
7 companies	Services Sector: 6 from IT 1 from consulting services
3 companies	Manufacturing

Note. Source: Own creation

was conducted. The next table resumes the ten SMEs selected:

-Interview instrument. For the interview, a semi-structured interview instrument was developed. This kind of instrument guarantees the interviewer flexibility to track queries and to adapt to unpredicted directions (Williams et al., 2013). In total, ten semi-structured interviews were conducted in private sessions, in a video communication channel with the camera of both the interviewer and interviewed. This method has been studied and carried out considering recommendations to make it as useful as a face-to-face interview (de Villiers et al., 2021). The interview followed a guideline built based on the scheme of the theoretical individual competences. The guideline as a

base the structure of the theoretical Model of Individual Competences (Martinez, 2023). The personal competences requirements were focused on the person in charge of each stage procedure. This person is not necessarily a manager, due to the nature of the SMEs; but is the person supervising, or the team leader that is, in the end, responsible for this stage's success. In some cases, this person is not defined in the organizational structure but, is in practice the person leading the stage process. It's important to clarify it is not the profile of the whole innovation process, but each stage's in-charge person. At the end of each stage section, once the interviewee's intervention is finished, if some category from the framework was not considered, a sub-question was realized mentioning the missing category. This is done to identify the most critical variable or attribute if it exists for the interviewee.

Content analysis. A content analysis was made for the data treatment, to compare and unify the Theoretical Model with the new information from the companies. With the company's information, the content analysis allows us to unify the competences from the theory and the company's approach, for each stage. The major benefit of using content analysis is that each rater follows a systematic, replicable technique (Stemler, 2019). In the first step of the content analysis, the researcher identified keywords, examples, or concepts related to individual innovation competences in each innovation stage, resulting from the interviews. Then, a deductive procedure to rename or identify the attribute described by the interviewee, but not mentioned as a specific name of a variable or attribute. It also unifies those repeated or synonymous variables into the same variable. The third step of analysis consists of an open coding phase where the researcher allocates those keywords into the variables' categories framework used in this study, at each stage.

Step 2. Instrument to define profiles

The second part has as a goal to establish a profile instrument for the set of competences from the theoretical and companies approach proposed. By using a co-occurrence analysis, we make a match between the theoretical and enterprise approach with a measuring instrument. As a result, a set of profiles based on personality traits was established. **Identification of the instrument.** For this study, the Big Five was used

as an instrument for profiling the competences identified in each stage, due to its frequent use in innovation studies (see section Personality Traits and set of competences). The Five dimensions are called: Agreeableness, Openness, Extroversion, Conscientiousness, and Neuroticism.

The variables in each dimension, according to the studies selected, were similar. However, to identify the indispensable and specific variables in each aspect, a co-occurrence literature analysis was made. It was based on the papers resulting of the literature review of the instrument detailed in the last section. From the 15 papers, the ones that used the Big Five were strictly analyzed. For each dimension, a list of variables that the author used were grouped in a unified list. Obtaining as a result, a list with basic variables for each aspect of the instrument.

Content Analysis.

Now a content analysis was held, and each competence proposed in each innovation stage of the Model was matched with one of the respective lists of the Big Five dimensions, according to the similitude in the meaning of the variables and significance. It means, that each innovation stage considered in the model, has already a Big Five trait or attribute identified. For example, in stage 1. Identification of Opportunities. One of the competences is creativity according to the model. Also, in the list of variables of the Openness most of them are related with creativity. So, when we make the match between competence and the variables of the dimension, most of the variables of Openness match with the competence creativity. In the end the summary or count of those matches are reflected in the result of the profiles, in this case openness is stronger than another dimension. The more matches in one of the dimensions the stronger this dimension is in that stage. As a result, a proposal of personality profiles required in each innovation stage was identified.

Results

Proposal of personality profiles required in each innovation stage

As a result of the first part of the methodology, the following model of individual innovation competences: theoretical and empirical approach:

Table 3

Stage 1. Model individual innovation competences: from theoretical and empirical approach.

Innovation Stage: 1. Identify opportunities	
Category	Individual Competences
Educational profile or studies:	Project management Engineering education
Environmental/Work/Social factors that could impact:	Organizational culture Exploitation, new functionalities
Innovation stage actions required:	Identifying problem, exploration Planning, Prioritization, risk assessment
Innovative/Entrepreneur. Behavior expected:	Innovation capability or innovativeness Communication
Leadership and Manag. Skills required:	Problem-solving, Solution researcher, decision maker Risk assessment Dynamic capabilities: Capacity building or adoption, Materialize ideas Proactive
Psychological factors expected:	Absorptive capacity, Abstraction capacity Creativity, Structured, Persistent

Note. Source : Own creation

The competences integrated from the variable's coincidences between the theoretical and empirical approach displays the ideal set of competences for SME innovation supervisor for the innovation processes' stage 1: Identifying opportunities. The innovation actions required for this stage are compatible with the nature of the stage, being the first step of identifying knowledge and visualizing problems and possible solutions (Hansen & Birkinshaw, 2007; ISO 56000, 2020; Rogers, 2003).

The innovative behaviors, skills, and, psychological factors expected from an innovative manager in this stage are well-matched with the actions required. The constant communications, the materializing and absorptive capacity to understand an issue, and enough innovation capability and creativity to search solutions options. The organizational culture has an impact on innovation performance (Souto,

2015; Tan et al., 2008); at least in this stage, the organizational culture reaffirms its participation.

For the stage 2. Create Concepts, the **Table 4** characterize the variables for it stage. The educational profile should include technical knowledge or profile, it can integrate project manager studies or some other empirical studies that facilitate technical knowledge. This stage is centered in finding solutions, that's why the innovation stages are related with exploitation referring the solution creation and action plan, it is consisted with the evaluation initial for the future development proposed by ISO 56000 (2020). Similarly, the innovative behavior, skills and psychological factors are correlated with those tasks, suggesting the creativity, innovativeness, and solution thinking the base of the concept's creation.

Table 4

Stage 2. Model individual innovation competences: from theoretical and empirical approach.

Innovation Stage: 2. Create Concepts	
Category	Individual Competences
Educational profile or studies:	Technical knowledge, Technical profile, project manager studies, empirical
Environmental/Work/Social factors that could impact:	Teamwork, Collaboration, team's collaboration
Innovation stage actions required:	Planning, Action plan Exploitation, solution creation
Innovative/Entrepreneur. Behavior expected:	Innovativeness
Leadership and Manag. Skills required:	Leadership Dynamic capabilities, Solution thinking
Psychological factors expected:	Creativity, Trust

Note. Source : Own creation

Into the stage 3. Validation, the 5 represents the ideal set of competences.

Table 5

Stage 3. Model individual innovation competences: from theoretical and empirical approach.

Innovation Stage: 3 Validate	
Category	Individual Competences
Educational profile or studies:	Technical knowledge, Technical profile, Education computing, Educational innovation, Engineering education, Project management, Interdisciplinary
Environmental/Work/Social factors that could impact:	Organizational factors: corporate entrepreneurship, organizational learning, organizational change, organizational strategy Social factors: social innovation, social influence, social change, market behavior and acceptance
Innovation stage actions required:	Innovation management, confirmation of the innovation process, research and development management Specific Management: Financier and Analysis study (strategic, change, industrial, energy, human resource, risk, and technology management)
Innovative/Entrepreneur. Behavior expected:	Cocreation, collaborative innovation
Leadership and Manag. Skills required:	Strategic thinking, problem solving Proactive, Prediction, expectation
Psychological factors expected:	Analytic, risk perception, perceived risk, risk-taking

Note. Source : Own creation

Considering Validation stage as moment of analysis to decrease the uncertainty linked with the acceptance, resources needed, reliability (ISO 56000, 2020) by developing business cases, assessments, and selection of the project (Cooper, 1990; Tidd & Bessant, n.d.) The interdisciplinary and different technical and engineering knowledge are associated with the aim of the stage. Correspondingly, other organizational factors as the presented could present a key element for this process because according to the organizational capability and availability to learning, strategy and change, the resources required for the stage should be confirmed or not. Additionally, the management actions required are completely related with validation process as the finance and analysis study, for example.

The psychological factors and skills required are essential capabilities for the success of this stage, being not that creative or innovative, but more detail focusing, analytic and risk validation. For the innovation behavior, cocreation or collaboration are expected, as cocreation implies the collaboration between organization and participants that generates benefits for all an creates value (Jaakkola & Hakanen, 2013) offering benefits as: more relevant ideas, better insights, cost efficiencies, speed to marketing or reduced risk (Hatch & Schultz, 2010; Ind et al., 2017; Kazadi et al., 2016; Ramaswamy, 2010) All of those elements considered in the validation process to select the ideal project.

Table 7 represents the set of competences for the Stage 4. Development.

Innovation Stage: 4 Develop	
Category	Individual Competences
Educational profile or studies:	Technical knowledge, Technical profile, Education computing, Educational innovation, Engineering education, Project management, Specialization or training, Business formation, Engineering education, Information, programmer engineering
Environmental/Work/Social factors that could impact:	Teamwork, Collaboration Stakeholder participation, client's participation, social networking (online), stakeholder engagement and participation, social networking, networking
Innovation stage actions required:	Exploration General management, Strategic planification Research and development management, develop
Innovative/Entrepreneur. Behavior expected:	Cocreation, collaborative innovation
Leadership and Manag. Skills required:	Communication Analysis capacity, Strategic Planning Thinking Leadership Building capacity, effectivity
Psychological factors expected:	Creativity Resilience

Note. Source : Own creation

In stage 4. Development, converting ideas in an operational solution and value creation is demanded (Hansen & Birkinshaw, 2007; ISO 56000, 2020). The results found harmonizes with the description of the stage. Starting with the environmental or organizational factors, the development stage requires collaboration, teamwork, and also the stakeholder participation. It coincides with the collaborative innovation and cocreation definition that considers innovation partnerships and interorganizational efforts for collaborative innovation, and collective intelligence for co-creation. Therefore, the psychological factors and skills required agrees with those elements, requiring creativity, building capacity, leadership, resilience, communication, and analysis capacity.

For stage 5. Deploy, as some authors proposed, is the stage in which the pre/commercialization or diffusing of the idea starts (Cooper, 1990; Hansen & Birkinshaw, 2007; Rogers, 2003; Tidd & Bessant, n.d.). ISO 56000 (2020), highlights the integration with marketing, communication, sells, and the engagement with users and all the interested parts, and the adoption and information back from them. Subsequently, the set of competences presented in table 8 is according to this process. The educational profile in marketing or engineering, the participation of the stakeholders and engagement, the communication skills are also required. Finally, the responsibility, resilience, or adaption and adoption for final settings are expected as psychological factors.

Table 8

Stage 6. Model individual innovation competences: from theoretical and empirical approach.

Innovation Stage: 6 Review	
Category	Individual Competences
Educational profile or studies:	Project Manager Education 4.0, Customer center services studies
Environmental/Work/Social factors that could impact:	Stakeholder engagement, Client relationship
Innovation stage actions required:	Exploration, ideation
Innovative/Entrepreneur. Behavior expected:	Innovation capability or innovativeness
Leadership and Manag. Skills required:	Communication Feedback acceptance capacity, adoption Leadership, transformational leadership, Care of others necessities
Psychological factors expected:	Creativity Safety, Trust, Confident or trustful person Resilience, Adaptation, adoption

Note. Source : Own creation

For stage 6 some authors (Cooper, 1990; Rogers, 2003; Tidd & Bessant, n.d.), the final review and post implementation process and following should be handled. However, as some SMEs mentioned is also the opportunity to see what others needs or problems does the enterprises has to start again the innovation process. Moreover, this stage is the end of the innovation process, to making final settings or adjustment to satisfy the client; but also represent as well beginning of new one, by the searching new issues to start the innovation.

That's why some theoretical and empirical approach are consistent at some elements used for the two focuses described, and it shapes this profile. For the following of the implementation and final adjustment, the educational profile proposal includes a customer center focus, it emphasizes the relevance of the stakeholder awareness that a person

managing this stage should have. The skill of feedback acceptance capacity can represent the entrance to improve and adapt some specification, requested from the stakeholder, of the product or services deployed. It is also related with resilience, adaptation, and adaptation capacity detailed by the psychological factors. The importance of the safety and confident person according to the SMEs approach relies on the importance of care of other necessities, adjust the necessary time to satisfy the client and is the base of this relationship and communication.

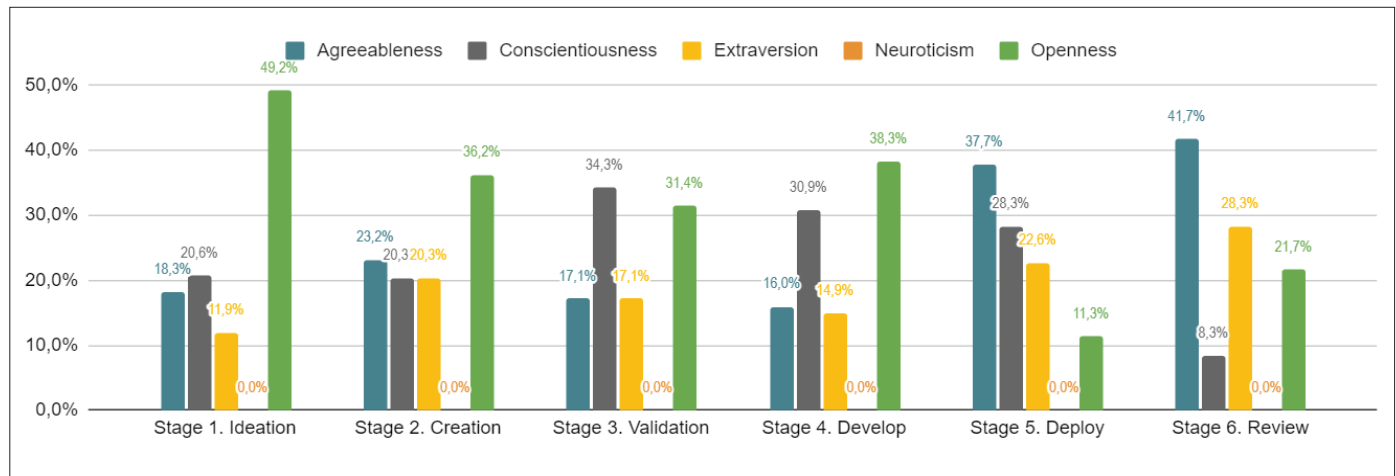
For the new problem searching that could eventually again start the innovation process, the innovation stage action required in the exploration or ideation, it emerges once more due to the new opportunity to identify problems. Afresh, the innovative behavior is expected and also the creativity.

Proposal of personality profiles required in each innovation stage

The result of the second part of the methodology, is described as follows. After the process of correspondence between the result of the

previous part with the Big Five variables, the following profiles of a person's competences in each innovation process stage are presented:

Figure 1. Profile for Stage



Note. Source : Own creation

Profile for Stage 1.

Between the variables of the Big Five (47) and the variables of stage 1 (14), 126 matches were established, reflecting the concordance of meanings in those variables. According to **Figure 3**, the majority of variables are in Stage 1. Identify Opportunities, and match them with the variables of Openness (49.2%). Following by Agreeableness and Conscientiousness, aspects that suggest 18.2% and 20.6% respectively. Extraversion was represented just at 11.9%.

Profile for Stage 2.

In Stage 2. Create, a total of 69 matches were developed. Compared with the results in Stage 1, as **¡Error! No se encuentra el origen de la referencia.** indicates, this Stage expresses a more balanced distribution between the aspects of the Big Five. From those, Openness got the 36,2% of the total, followed by Agreeableness (23,2%), Conscientiousness (20,3%), and Extraversion (20,3%). Neuroticism has not been represented in this stage according to the obtained results. According to the results presented, the aspect of Conscientiousness has been increasing while the innovation process advance. In the first stage, it represents just 19.8, then for Stage 2 it was 20.3% but in Stage 3, it attains 34.3%.

Profile for Stage 3.

In this Stage 3, a total of 35 matches were realized, and the second major trait in this stage is Openness, followed by Agreeableness and Extraversion, both with the same percentage. Once again, Neuroticism was not present in this stage.

Profile for Stage 4.

Based on a total of 94 matches in Stage 4. Develop, Openness leads the results with 38,3%, then the 30,9% for Conscientiousness, and similar results for Agreeableness and Extraversion, both of them with a fewer percentage than its results in Stage 3.

Profile for Stage 5.

For this Stage, it has an increment in Agreeableness, in comparison with results it has had in the previous stages. From a total of 53 matches, this trait represents 37.7%. In the case of Openness, it has a decrease in this stage and just represents the 11.3%. While Extraversion has a 22.6%, higher than its results in Stage 4.

Profile for Stage 6.

In the last Stage, from a total of 60 matches executed, Agreeableness stay leading with 41.7%. While Extraversion increases its percentage (28.3%), and Conscientiousness as well. In the case of Openness, it duplicates the percentage in Stage 5 and expresses a 21.7% in this last stage of their innovation process.

Discussion

The innovation process stages are dynamic, and each stage has different aims and outcomes. That's why those require also different and adjustable competences for each stage for success. As the results show, the change within each stage was evident and, in some stages, shows contrary results between them. For the SME's due to their changeable context and internal conformation it is crucial to be supported with knowledge on team composition and competences management to optimize their resources.

Beginning with Stage 1. Identify Opportunities, having almost 50% Openness and according to the definition of this trait, the proposed profile for a person in charge to attend the first stage should present profile characteristics as a high level of creativity, imagination, and exploratory tendency. Correspondingly, it would include versatile, divergent thinking and not being afraid of new challenges, and affinity towards the novelty of new experiences. For this Stage, the results suggest a lower percentage of Agreeableness and Conscientiousness.

It means a person with some characteristics of good listening, patience, empathy, and also characteristics of goal-oriented or necessity of achievement, industriousness, and a methodical way to work (Hwee Nga & Shamuganathan, 2010b). Extraversion features are not as important as those mentioned before. It represents 11.9% and would include some features such as assertiveness, social and emotional control, and communication skills.

It is congruently to the Stage's aims, where the innovation initiative started, and the knowledge of a necessity or problem to be solved is presented (Rogers, 2003); thus, open thinking, creativity, and affinity toward new solutions are needed. To achieve this, it is also important to be a good listener to infer the demands and necessities.

Passing to Stage 2, the profile suffers some changes. The highlight of Openness is equilibrated with the other's personality traits; however, Openness maintains the highest percentage. It means that some characteristics such as creativity, imagination, curiosity, and divergent thinking still been imperative; nevertheless, this time it has almost the same importance as others belonging to extraversion, agreeableness, and conscientiousness. For example, Extraversion has the aspect that most growth from stage 1 to stage 2. It involves some features: social interactions, assertiveness, social skills, etc. Some Agreeableness characteristics, such as good listening, social skills, and cooperative behavior (Hwee Nga & Shamuganathan, 2010b), share almost the same importance. As well as Conscientiousness features; for example, rules/processes thinking way, industriousness, achievement thoughts, etc.

Considering Stage 2 as the stage of the proposal of the potential solutions, concepts, or ideas generation, is expected to need managers with high levels of Openness, as a propulsor of new ideas (Hwee Nga & Shamuganathan, 2010b); nonetheless, this person should also manage leadership skills which are related mainly to Agreeableness, Openness, and equilibrium with Conscientiousness and Extraversion; because, it should allow the person, not just to draw the solution, but establish an action plan as well. It also involves working with a team and collaboration; consistently, it supposes a reinforced relation with Agreeableness and Extraversion features, reflecting also a perfect stage for co-creation, co-innovation, and also open innovation.

The profile found for Stage 3. Validate, suggesting for this stage an increase in Conscientiousness, it gathers a profile most focused on meticulousness, well organization, industriousness, and conformance with rules/procedures, compared with the first stages (Hwee Nga & Shamuganathan, 2010b). Given this Stage, it assumes the selection of the idea, and processes to decrease the uncertainty of technical, financial, marketing, and organizational aspects, and the risk considerations (Cooper, 1990; ISO 56000, 2020; Rogers, 2003; Tidd & Bessant, n.d.). Therefore, it implies a profile with more facilitation for the method, organization, and focus, than a profile more projected as Agreeableness. For example, because it is not always a stage that requires vast social skills or social interaction to take the solution. Nevertheless, it still has been interesting a requirement for a high level of Openness at this stage. It could be related to the fact that it is

needed an affinity towards novelty, tolerance for new ideas, or divergent thinking (Marcati et al., 2008c), to realize the necessary path to decrease uncertainty.

At Stage 4. Develop. Not strong differences from the last stage, however Openness leads the percentage, suggesting an affinity towards novelty of new experiences, versatile thinking, creativity and exploratory tendency and similar (Marcati et al., 2008c). Nonetheless, maintaining some Conscientiousness aspects such as industriousness, or need for achievement (Hwee Nga & Shamuganathan, 2010b), for example.

In addition, on a fewer but significant level, some features of Agreeableness and Extraversion are proposed. This profile harmonizes the aim of this stage, as the materialization of the concept and converting ideas into a real solution (Cooper, 1990; ISO 56000, 2020; Rogers, 2003; Tidd & Bessant, n.d.) and considering the participation of stakeholders to help the creative process and validate its acceptability. It means not only a creative and exploitation process but also a social one to execute leadership, assertive communication, and a sociable and positively affective approach (Costa & McCrae, 1980) as the extraversion referees, in the process, reflected by the proposed profile (Hwee Nga & Shamuganathan, 2010a; Judge & Zapata, 2015).

For Stage 5. Deploy, a significant decrease of 27% in Openness is noticeable. It gives more importance to Agreeableness, and it features related to patience, thrusting, kindness, harmoniousness in social relations, etc. (Judge & Zapata, 2014).

As the second attribute for this Stage, Conscientiousness is presented highlighting the responsibility feature, industriousness, and some related as the need for achievement. Extraversion features are present, suggesting assertive, positive, and outgoing performance.

Correspond with Stage 5. Deploy goal of implementing and communicating the idea realized, and it required stakeholder relations. It resembled the proposed profile though, considering the important relationship with the client when the product is in the implementation process (Cooper, 1990; ISO 56000, 2020; Rogers, 2003; Tidd & Bessant, n.d.), and the trust, resilience, adaptability, and responsibility to assure a great implementation of the product. In the meantime, the aspects of Conscientiousness are present, it could be related to the necessity to achieve an upright understanding but also the best implementation in a hastily manner.

Given the results of the last innovation Stage 6: Review, the Conscientiousness aspect decreased and now represents just 8.3%. While Openness grows from Stage 5 to Stage 6, focusing now on an affinity towards new ideas, versatile thinking, creativity, etc. (Marcati et al., 2008c) Besides, in some Extraversion features grow meaning that now the profile is more outgoing, social, and assertive.

Considering that Stage 6 involves the revision of the right function of the product as well as the identification of new opportunities is consistent with the proposal of a more extroverted profile. Those

characteristics are congruent because, in this stage, active listening, client center attention, empathy, and flexibility are needed actions to succeed and look for new opportunities.

Conclusions

The main objective of this paper was to suggest the individual competences profiles essential in the person behind the innovation process. The different and contradictory directions of how the individual competences profiles for the innovation should be according to the different theoretical constructs analyzed in this research, give us the opportunity to propose a supported, unified, integrative and accurate model with the set of competences and profiles required for the innovation process.

We present evidence and a model that contrast that perception by supporting and specifying essential competences profiles, considering each stage's requirements and aims.

By applying theoretical and empirical approaches, a model of personal competences' profiles in each innovation process stage results as a principal outcome of this study.

To assuring not just a theoretical profile but also an operationally-oriented profile, the following methodology was carried on:

- An exploratory multiple-case companies' approach was realized. For background, a theoretical model was identified. It presented the most relevant and required competences of the person in each innovation stage, according to the literature.
- After that, SME's interviews were generated, having as an outcome the competences requirements identification of the person in each innovation stage from empiric results.
- Consequently, it was developed a content analysis to make unification of the theoretical and enterprise approach.
- Finally, a profile instrument was selected: Big Five Traits Instrument. By using a new content analysis, the set of competences resulting from the previous step, were matched with each Big Five variables. So, a Model of personal competences' profiles per each innovation stage is generated.

Those profile descriptions, for each stage detailed in the last section, allow us to display it as a proposal for an in-charge person's profile according to the innovation process.

In this way, this profile could be contrasted with the current stage's in-charge person profile in companies with the desire to improve their innovation process. Here are recognized some predictors of profiles that thanks to their features make them fit with the requirements of each stage, so they can manage the best approach to the process.

We are aware that not all companies have the opportunity to include 6 different profiles in the innovation process. It would represent the majority. In those cases, we recommend evaluating the current profile they have and developing training programs, the conscience of each stage's requirements, and the flexibility to adapt to some point some behaviors that could help the process to be efficient.

The support of the team can be also crucial, even if there are no managers for each stage, some person on the team, according to their profile, could be assigned to manage the supervisor role of a determine stage.

The impact of this proposal could also precede a new conception of the innovation stages since some SMEs interviewed for this study had expressed that Stage 6 is the following for the innovation process of the determined project; despite this, they indicated that it represents also, most of the time, the beginning of innovation process. In certain cases, because a new adjustment or addition of the implemented innovation is required, a new project start. Or due to the closer contact with the stakeholders allows them to identify new innovation opportunities in this company. This description is precisely congruently with the first stage of the innovation process description, this time for a new project.

It is important to mention it because the authors all here mentioned (Cooper, 1990; Hansen & Birkinshaw, 2007; ISO 56000, 2020; Rogers, 2003; Tidd & Bessant, n.d.) to establish the 6 stages innovation process, talk about a closing of the process and just mention learnings for the future management of innovation projects. Nevertheless, supported by the kind of relation and profile suggested by the results in the last Stage, and the impression of the SMEs, it would be imperative to mention Stage 6 not as a closing, but as a platform or prelude that could open the path to a new project, specifically to a new Stage 1.

This proposal could be applied independently of the innovation structure of the SMEs. Even though the internal process in some enterprises, mostly SMEs, did not have a six stages innovation process structure. As some authors propose (Cooper, 1990) (Rogers, 2003), in there exist cases where some of these phases do not occur, or the time order of the phases may be changed. However, it could be a good practice to review the Six innovation stages of its process to assure there is not a missing step that could give an advantage to the innovation project.

This study represents an integration of some theoretical proposals known until now and applied in a practice instrument to be applied and contrasted in the enterprise. Its application could change the conceptualization of the structure of the innovation process, requirement procedures, training programs, motivations elements, teams' constitutions, and all for an improvement of the innovation performance.

The relevance of this important outcome is the positive impact that it uses implies on the industry and the academy. Since closing the gap

of the differences and discrepancies between constructs, and companies' perceptions to responding to how the person in the innovation process should be profiled for the best innovation performance results. For practitioners specifically, the SMEs considering that the sample used in this research, having a supported model that guides crucial aspects of the innovation starting points, results in key for the organization. This is due to the necessity of optimization of resources, including the human ones, in this kind of company because of the limited number of talent and financial resources to face the innovation process, compared to the bigger structures.

Also, organizational support is essential to trigger individual innovation (Lotz, 2018). Some uses and cares for the industry of the results of this study could be the delegation of the roles and tasks into the innovation teams. The conformation of the teams, the current practices to recruit personnel, the motivational strategies, and the training plans. Those aspects could directly and positively impact the individual performance, once the employee's competences fit with their assigned role requirements. Moreover, the optimization of their competences and the appropriate team composition team conformation could impact positively the team synergy and the project's outcomes (Bradley & Hebert, 1997).

The recruitment process could use this model as a guide to better results. Some motivational strategies as well as training plans could be adapted. Consequently, with all the elements described, an improvement of the innovation stage could result, and thus the innovation performance.

According to this, it could also have an impact on the efficiency and management of the resource's management (time, human capital, expenses), all for the optimization of the starting point of the innovation: the person (Bassey et al., 2012).

For the academy, due to the development of the model corresponding to the empirical and theoretical approaches, it represents a confident base to support other subjects such as innovation, entrepreneurship, innovative ecosystems, and also in behavioral perspectives.

The gap in information about the profile of the person behind the innovation process has been analyzed. With the results, those could be used as a base for looking forward to managers' profiles and other ranges of superior roles required. Also, the utilized method to contrast and integrate theoretical and empirical perspectives could help other fields with similar initiatives to reproduce the study.

Human capital has been considered the starting point of innovation and one of the recent trendy topics. It should be considered at the same importance level as another innovation aspect, since it results in a multidisciplinary concept (Jaroengarmsamer & Jermstittiparsert, n.d.). Once giving it the importance and relevance merited, it would reinforce the base of the innovation studies and its implications for organizational performance, competitiveness, and success: the person (Douglas & Douglas, n.d.).

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