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# EXAMINING THE FACTORS THAT INFLUENCE THE IT INNOVATION PROCESS

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## ABSTRACT

*Although there is a considerable literature about the factors that affect the innovation process, little is known concerning the factors that affect the IT innovation process. Thus, this exploratory study draws upon theories such as: Woodman's model, Bandura's self-efficacy theory, the goal orientation theory, Vroom's expectancy theory and the theory of trying to propose an integrative understanding of the factors that influence the IT innovation process. Theoretical predictions were empirically tested via a field study of 88 potential innovators. Results provide strong support for the research model. Theoretical implications for IT innovation process research are discussed.*

**Keywords:** *information technology innovation, creativity, technology self-efficacy, goal orientation theory, learning goal orientation, execution goal orientation and theory of trying.*

## INTRODUCTION

During the last decades the markets and economies' "game rules" have changed dramatically. Faced with the traditional factors of production, elements such as information, knowledge and new technologies have gained importance and have become the main pillars of the business fabric. That is why technological innovation has become an area of growing interest in the research field and one of the most critical management disciplines.

Despite the importance of understanding the elements and engines that influence the IT innovation process and the extensive literature devoted to this field, there is not a consensus about the factors and mechanisms influencing the process. In other words, there is not a consensus about the effective influence of internal factors such as creativity (Ahuja and Thatcher, 2005; Woodman et al., 1993), goal orientation (Dweck and Reppucci, 1973) and technology self-efficacy (Bandura, 1977; Friend, 1982); the influence of organizational factors such as management practices (Woodman et al., 1993; Amabile, 1988), work environment (Woodman et al., 1993; Gundry et al., 1994), innovation culture (Ekvall and Tangerberg-Anderson, 1986; Ekvall, 1997) and technological culture (Bijker, 2006), as well as the impact of the expectations about getting an expected result (Vroom, 1964). Thus, the objective of this research will be to define and empirically test a theoretically grounded model of factors influencing the IT innovation process. Specifically this study examines the following research question: What are the factors influencing IT innovation process?

This paper is structured into six sections including this introduction section. The second section concerns the theoretical background and framework. The third section, presents the model we have developed for the IT innovation process. We then present our research methodology, instrument development, data collection and data analysis. The fifth section shows the research results, and finally the last section includes the implications for theory and practice, the limitation and avenues for future research.

## THEORETICAL BACKGROUND AND FRAMEWORK

In this section we will introduce the IT innovation concept and the reason why it has become a critical function and a basic capability in organizations. Afterwards we will explain the different theories we have used to define our model, as well as the considerations through which we have selected these theories for our research.

Through trying to innovate, individuals identify successful applications of IT that may optimize task performance or organizational processes. Continual Information Technology innovation (i.e. converting technology use into innovative processes and applications) is essential for swift organizational responses to changing environment demands (Ahuja and Thatcher, 2005). That is why IT innovation has become a critical area of interest in recent research.

For the definition of our model, first we have included Woodman's model, a clear referent in this field (Ahuja and Thatcher, 2005), because its framework incorporates the two lenses that according to research should be considered to understand the factors influencing the innovation process: individuals and organization. Second, we have chosen Bandura's theory because self-efficacy has become a recognized influencer on computer-related behaviour, and Bandura a clear authority in this field (Biglan, 1987). Third, we have included the goal orientation theory, a contemporary line of research, due to its relevant contributions in the field of behaviour at the workplace (Dweck and Reppucci, 1973). Fourth, as we have already included in our model some of the factors integrated under the available and mostly-used motivation theories, in particular the impact of self-efficacy and work-environment, we have incorporated Vroom's expectancy theory to reflect three additional elements that might influence the process: utility/valence, instrumentality and expectations. Finally, bearing in mind that an individual controls his or her will to do something, not the end result, we have included the theory of trying. Table 1 shows our theoretical background - the theories used to create our research model.

Factor/Variable	Publications and Articles
Creativity (Woodman's model)	Woodman et al., 1993; Ahuja and Thatcher, 2005
Tech. Self-Efficacy (Bandura's Theory)	Bandura (1977 and 1997)
Learning G. O. (Goal Orientation Theory)	Dweck and Reppucci, 1973; VandeWalle, 2001
Execution G. O. (Goal Orientation Theory)	Dweck and Reppucci, 1973; VandeWalle, 2001
Management Practices Woodman's model)	Woodman et al., 1993; Amabile, 1988
Work Environment (Woodman's model)	Woodman et al., 1993; Ahuja and Thatcher, 2005
Innovation Culture (Woodman's model)	Ekvall and Tangerberg-Anderson, 1986; Ekvall, 1997
Technological Culture (Woodman's model)	La Rovere, 1996; Bijker, 2006
Utility/Valence (Vroom's Exp. Theory)	Vroom, 1964; Lewin, 1935; Tolman, 1932; Atkinson, 1964
Instrumentality (Vroom's Exp. Theory)	Vroom, 1964; Tolman, 1932; Atkinson, 1964
Expectations (Vroom's Exp. Theory)	Vroom, 1964; Tolman, 1932; Atkinson, 1964; Nasri, 2012
IT Innovation (Theory of Trying)	Bagozzi and Warshaw, 1990; Ahuja and Thatcher, 2005

*Table 1. Theoretical Background*

### Woodman's Model

The extensive literature devoted to innovation research at the workplace suggests two relevant lenses for studying the attitude towards innovation: individuals and organization (Ahuja and Thatcher, 2005). Regarding the first element, research points to the existence of a critical factor in the nature of each

individual -creativity- an element influencing the innovative capacity and the motivation towards innovation in all fields.

With respect to the elements that influence the development of the creative potential of professionals at the workplace, the model proposed by Woodman et al. (1993) is considered a comprehensive foundation. Woodman et al. (1993) suggest that the following organizational factors further influence innovation in organizations: management practices, company motivation to innovate and available resources.

### **Bandura's Theory**

On the other hand, researchers point out the necessity to complement these lenses with elements reflecting individual perceptions of these technologies (Friend, 1982). In this sense, they include the self-efficacy concept, which we will consider through Bandura's theory, a clear and recognized authority in this field. For Bandura (1977 and 1997), self-efficacy is the perception each individual has of his or her own capacities, a factor that influences actions directed to goals. This theory does not refer to the individual's resources, but to perceptions about what he or she can do with them. In Bandura's words, self-efficacy is defined as "the conviction that one can successfully execute the behaviour required to produce the outcomes" (Bandura, 1977).

Self-efficacy is a concept that explains behaviour in terms of cognitive constructs that explicitly deemphasizes the role of environment in determining behaviour. Bandura's theory, as remembered by Biglan (1987) has been applied to multiple aspects of human behaviour such as phobias, smoking cessation, smoking prevention, social skills, arithmetic skills, depression and pain tolerance.

### **Goal Orientation Theory**

Additionally, more recent research into individual behaviour at the workplace, and a lot of accumulated evidence, make necessary the introduction of new factors to close the model. That is why we include goal orientation theory. The role and impact of goal orientation is a contemporary line of research, with relevant contributions in the field of behaviour at the workplace. This theory was formulated by Dweck and Reppucci (1973) and emphasises the influence of behavioural goals at work. They argued that individuals have goal orientations, understood as "personal goal preferences in achievement situations". These goals can be classified as learning and execution goals.

Learning and performance goal orientations refer to different patterns of how individuals understand and react to achievement situations. It is important to highlight that these are not two different positions. Quite the contrary, recent research positions both orientations as different dimensions, existing at the same time - a tendency that we will adopt in this investigation.

### **Vroom's Expectancy Theory**

Motivation is the key factor influencing humans to work better. Understanding and having knowledge about motivation theories can help to create a motivational atmosphere and application of these theories can result in achieving higher productivity (Hassen, 2005). In other words, motivation is an engine that, given determined organizational and internal characteristics will move the person to act and to attempt to innovate.

In this sense, there are many different traditional theories and views to explain what motivates individuals at the workplace. In fact, in the last decades, motivation has been a highly important variable, as reflected in the fact that most of behaviour models implicitly or explicitly incorporate a theory of motivation (Maerh and Meyer, 1997) and, as a result, new theories have been developed and published. However, as we have already included some of the elements considered under those motivation theories in our model, in particular the impact of self-efficacy and work-environment, we

will incorporate Vroom's expectancy theory to explain the motivation of an individual towards innovation. Besides, expectancy theory is the most general theory of motivation (Nasri, 2012).

Vroom's expectancy theory (1964) suggests that motivation to do something, in our case innovate, is determined not only by external and internal characteristics, but also by the individual's expectation that his effort will be recompensed, as well as by the perceived valence or utility of the result of the action. In other words motivation to do something is determined by expectancy - understood as the conviction that the effort will bring the expected result. In our model this means that the effort to innovate will bring an innovation. Secondly, it is determined by the valence or utility element, a factor referring to the subjective value attributed to the result of an action. Finally, the model includes instrumentality, which refers to the relationship between the expected result and its performance. In this sense, the greater the result the better the performance, so he will be more motivated.

### **Theory of Trying**

Equally, we will make use of the theory of trying defined by Bagozzi and Warshaw (1990). This theory expands two previous models usually referenced in this field: the theory of planned behaviour (Ajzen, 1985) and the theory of goal pursuit (Bagozzi and Edwards, 1998). Further, the theory highlights the relevance of analysing the goals of decision makers as well as their psychological responses to those goals in the prediction of the acceptance of computers (Bagozzi and Warshaw, 1990). According to this theory, intentions reflect a state of mind that moves the individual to take action as opposed to trying, which reflects action as well as some parts of actual behaviour (Ahuja and Thatcher, 2005). This theory concentrates on the mental state that moves an individual to execute actions, arguing that an individual can control is his or her own will to do something, not the end result. At this stage we will understand the attempt to innovate as the concept representing the individual's trying to innovate, no matter what the results of his actions are.

## **RESEARCH MODEL**

Developing a model for the IT innovation process poses a challenge. To identify those elements that influence the process we used the following procedure. First, we considered as our basis that the extensive literature devoted to innovation research at the workplace suggests two relevant focuses for studying the individuals' attitude towards innovation: individuals and organization. Then, based on a review of available studies on the environmental factors that influence the innovation process we selected Woodman's theory (1993) and incorporated three external factors to our construct: management practices, work environment and innovation culture. Second, due to the special impact of new technologies on innovation culture and the generation of new competitive advantages, we incorporated the technological culture as an additional element in our model. Regarding internal characteristics, and according to the literature in this field, we incorporated creativity in our construct. Additionally, according to recent studies in behaviour research we incorporated the Bandura's self-efficacy concept and the goal orientation theory. Equally, to reflect the engine that moves individuals to try to innovate, we incorporate the expectations theory and its three constructs: utility/valence, instrumentality and expectations.

In other words, Figure 1 shows the proposed theoretical model that we have examined in our study.

The model includes three sets of variables, all related to the dependent variable, trying to innovate with IT. These include (1) internal factors (i.e., creativity, technology self-efficacy, learning goal orientation and execute goal orientation); (2) organizational factors (i.e., management practices, work environment, innovation culture, technological culture); (3) and motivational factors (i.e., utility/valence, instrumentality, expectations).

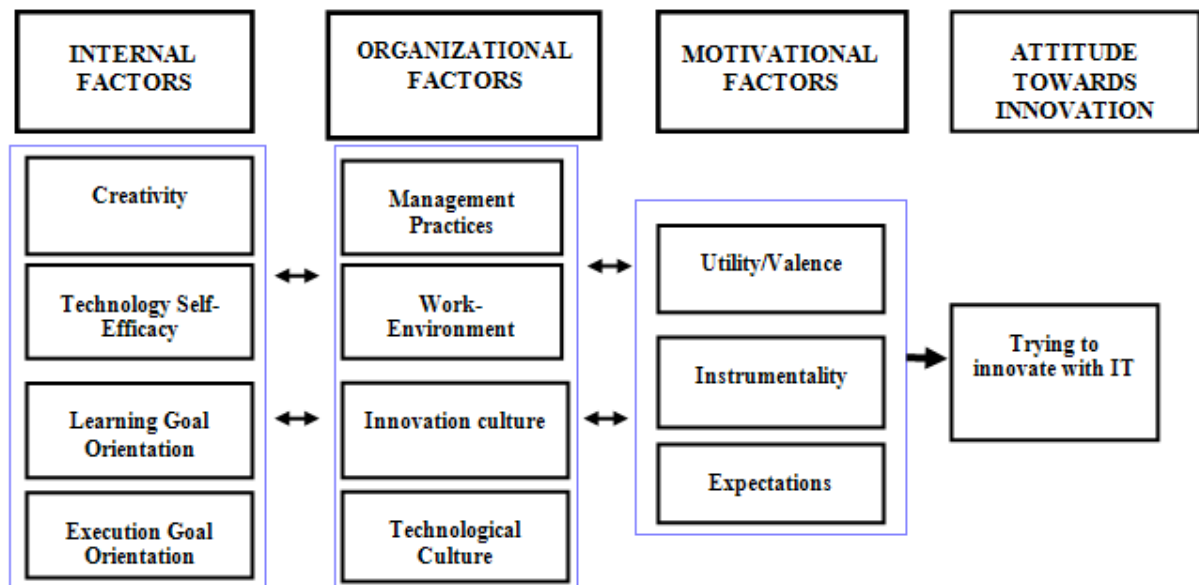


Figure 1. The Proposed Theoretical Model.

## RESEARCH METHODOLOGY

The current study was conducted at an international business school in Spain. Electronic questionnaires were used to collect the data.

### Instrument Development

Likert-type items measured the constructs. The questionnaire was constructed based largely on existing measures that were identified as suitable for this study, once properly adapted to the IT innovation context. Additionally the questionnaire was also validated using a testing sample and interviews to 10 individuals. Thus, creativity has been assessed using three items adapted from the Creativity Survey 2009 by Innovation Tools. Self-efficacy has been measured using three items adapted from Venkatesh et al. (2000). Learning goal orientation and execution goal orientation have been assessed using eight items adapted from VandeWalle (2001). Management practices, innovation culture and technological culture have been measured using three items in each case, items adapted from Blazquez Garcia-Ibarrola (2009). Work-environment has been assessed adapting three items from different resources: Martinez Guillen (2003), Marchant (2005) and Ahuja and Thatcher (2005). The expectations theory items have been assessed using six items adapted from Smith et al. (2008). Finally, the individuals' attitude towards technological innovation has been measured using an adapted item from Ahuja and Thatcher (2005).

### Data Collection

The research has been carried out with a survey given to students from management programs in a Spanish business school, which is highly ranked internationally. This business school was selected due to its high positions in the official rankings and because the students represent a valuable multicultural ecosystem. Besides, we consider that these students, while being experienced enough to take the pulse of the innovation process in a clear and accurate way, do not, by and large, occupy management positions that might bias their perception of this process, considered to be one of the main pillars of economy and business.

Different researchers such as Sears (1986) or Ahuja and Thatcher (2005) suggest that the use of students is a valid tool in the investigation of phenomena not crystallized in time, for instance, events in the sociology or politics. That is why researchers argue that the use of students with certain work experience can support investigations like ours, offering the advantage of limiting the number of potential statistical confusion variables, in other words, the external factors producing bias between the dependant and the independent variables (Joshi and Kuhn 2001). The survey was sent through a personalised e-mail. The survey tool forced individuals to complete the whole questionnaire and to select a single choice, so all the answers could be considered useable cases. As a result, we have worked with a sample of 88 answers for the execution of the research.

## Data Analysis

Since the emphasis is on explaining the variance and in developing casual relationships, the field study methodology is used and a subsequent statistical analysis is performed. After a preliminary analysis of the results, we determined that item responses were not normally distributed. Because the behavioural and organizational variables do not necessarily follow a normal distribution, non-parametric statistical methods are considered more robust and appropriate (Thamhain, 2004). Following these results, and working with qualitative variables measured using the Likert scale, we performed the statistical analysis using the Kendall's tau-b non-parametric correlation coefficient in order to show the relation between the independent and dependent variables. Correlation testing is performed using Kendall's tau-b in order to identify the independent variables which are correlated with the IT innovation process. In other words, this multiple linear regression analysis is performed to identify factors which predict the IT dependent variable.

## RESULTS

The total sample of the research is composed by 88 cases. Using Kendall's tau-b correlation coefficient, commonly referred to as Kendall's tau ( $\tau$ ) coefficient, Table 2 and Table 3 report the association among the internal, organizational and motivational factors and the attitude towards innovation. Tau-b statistic, unlike tau-a, makes adjustments for ties and is suitable for square tables. The coefficient values of tau-b range from  $-1$  (100% negative association) to  $+1$  (100% positive association). A coefficient value of zero indicates the absence of relationship.

<b>FACTOR</b>	<b>Correlation Coefficient</b>	<b>Significance</b>
<b>Creativity</b>	0.305	0
<b>Technology Self-Efficacy</b>	0.095	0.260
<b>Learning Goal Orientation</b>	0.166	0.051
<b>Execution Goal Orientation</b>	-0.033	0.697
<b>Management Practices</b>	0.298	0
<b>Work-Environment</b>	0.032	0.712
<b>Innovation Culture</b>	0.252	0.003
<b>Technological Culture</b>	0.198	0.019
<b>Utility/Valence</b>	0.186	0.038
<b>Instrumentality</b>	0.102	0.257
<b>Expectations</b>	0.245	0.006

**Significance acceptance value: 0.05**

*Table 2. Kendall's tau-b correlations.*

FACTOR	TOTAL
Creativity	**
Technology Self-Efficacy	-
Learning Goal Orientation	-
Execution Goal Orientation	-
Management Practices	**
Work-Environment	-
Innovation Culture	**
Technological Culture	*
Utility/Valence	*
Instrumentality	-
Expectations	**

\*= Very Low Correlation, \*\*=Low Correlation

Table 3. Interpretation of Kendall correlation results.

For the total sample, the following factors show a significant correlation coefficient value of at least .200 (low correlation): creativity (.305), management practices (.298), innovation culture (.252) and expectations (.245). On the other hand, technological culture and utility/valence show a very low correlation coefficient value (0.199 or less). Bearing in mind the complexity of the model and the number of possible influencers, we consider very low correlation values to be relevant enough for the incorporation of both factors in the IT innovation model. However, according to our results, there is not an associated impact for the following factors: technological culture, learning goal orientation, execution goal orientation, work environment and instrumentality. These results suggest that additional research should be carried out in this field. As a result, we can represent graphically the factors affecting the innovation process using new technologies as follows:

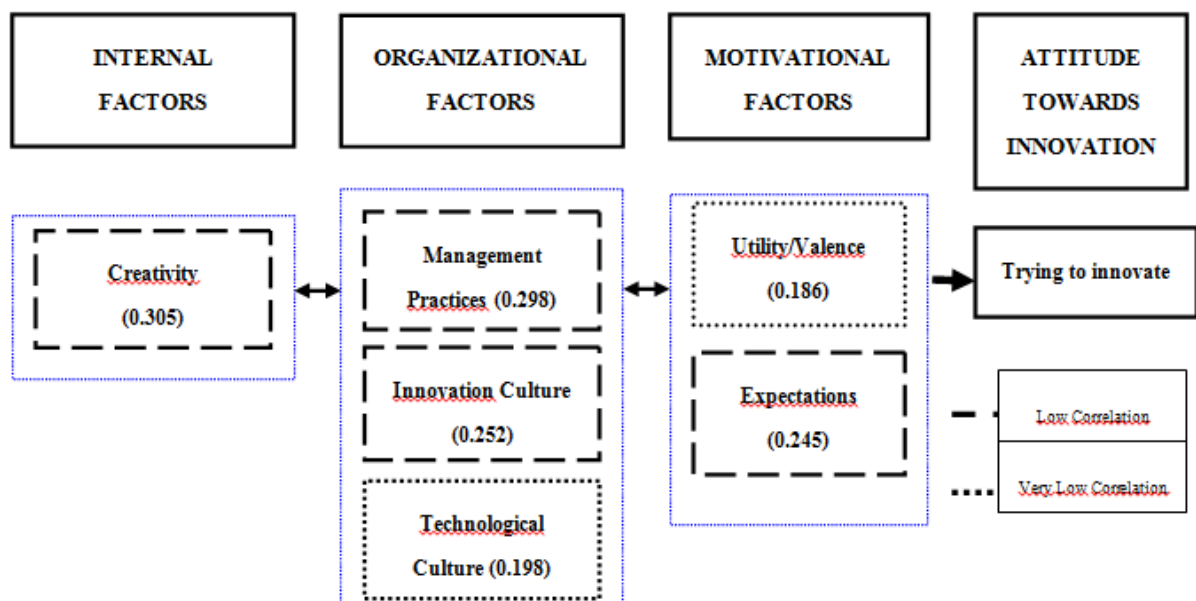


Figure 2. Factors influencing the IT innovation process.



## **DISCUSSION AND IMPLICATIONS**

There are significant findings from this study. First, with respect to individual factors, our findings are consistent with, and support, Woodman's theory (1993), which argues that an individual's innovation potential is highly influenced by his or her own creativity. Similar suggestions have been made by authors like Amabile (1988) or Romer (1993). Equally, with respect to organizational factors, regarding management practices and innovation culture, our findings are also consistent with, and support, Woodman's theory (1993), as well as contributions of authors such as Amabile (1988), Ilgen and Hollenbeck (2005) or Ahuja and Thatcher (2005). Regarding technological culture, our research supports contributions of authors like Bijker (2006) who considers this element a critical factor in the innovation process. On the other hand, with respect to motivational factors, regarding utility/valence our study confirms recent research that has argued that the subjective value attributed to the result of an action clearly influences the attitude and performance of employees at work, where the innovation process should be included (Vroom, 1964; Lewin, 1935). Additionally, according to our research, expectations show a clear correlation that supports Vroom's theory (1964) about the impact of motivation on the performance and the attitude of employees at work, as well as additional existing literature around this field (Tolman, 1932; Atkinson 1964).

However, according to our research, the following factors: technology self-efficacy, learning goal orientation, execution goal orientation, work-environment and instrumentality do not have any correlation with the attitude towards the IT innovation process.

First, regarding individual factors, our results are not consistent with Bandura's theory (1977 and 1997) about the influence of technology self-efficacy. In this sense, our research does not support contributions of additional authors such as Friend (1982). In our opinion, the reason might be that our study has been executed using students highly IT qualified. That is why our results suggest that additional research should be carried out in this field.

Equally, our results are not consistent with Dweck y Reppucci's research (1973), about the influence of learning and execution goal orientation on the individual's behaviour at the workplace. The role and impact of goal orientation is a contemporary line of research, with relevant contributions in the field of behaviour at the workplace. However this theory might have no impact on the IT innovation process. These results suggest the possibility of additional research about these elements and their impact on the innovation process.

Additionally, our research does not confirm the latest contributions about the impact of work-environment on the employees' performance and their creative process (Gundry et al., 1994). However, work environment is regarded by many people as one of the factors that most influences the development of the creativity of each individual, and subsequently of the organization as a whole. The reason might its nature's complexity, given that, among many others, very different components such as personal implication, freedom, emotional security, support received and physical environment, should be taken into account. In this sense, additional research should be carried out in this field to confirm the existence of this relationship in the IT innovation process.

Finally, according to our research, instrumentality does not show a clear correlation with the IT innovation process. This result suggests the possibility of including additional motivation theories to validate and complete the model. In other words, our results suggest the requirement of additional research about this element.

### **Theoretical Implications**

This research offers several implications and contributions to theory. A primary contribution is combining five important and recognized theories to examine factors that move individuals to innovate using new technologies: Woodman's model, Bandura's theory, Vroom's expectancy theory, the theory of trying and the goal orientation theory. By making use of the extensive literature in this

field, and integrating the relevant concepts provided by these theories, this study has offered a model reflecting the factors influencing the process for the total population. Second, this research has analysed the influence of technology self-efficacy, and the results do not support contributions of authors such as Friend (1982). This result suggests that additional research should be carried out in this field.

Third, this study has analysed the impact of goal orientation theory on the IT innovation process. However, no relationship has been found between the learning and execution goal orientations and the IT innovation process. This result suggests the possibility of additional research about those elements and their impact on the IT innovation process. Fourth, there is quite extensive literature and research about the impact of work environment on the innovation process. However, according to our research, this element has a non-existent relationship with this process. Additional research should be carried out in this field to confirm the existence of this relationship.

Finally, with respect to instrumentality, our results suggest the possibility of including additional motivation theories to validate and complete the model. Those additional theories might include new factors that could have a relevant influence on the process.

### **Limitations and Future Research Lines**

The results of this study should be interpreted in the context of its limitations. First, we have worked with what are in our opinion the main existing theories found in the respective available literature about internal and organizational factors influencing the innovation process. However there are other existing theories that have not been included given the need to limit the model and the research framework. Those theories might include factors that could have a relevant impact on the process, which would make it necessary to consider them in further research to complete the model. Second, we have included one of the most important and influential theories of motivation, currently being used in business and innovation research. However, we consider that additional motivation theories could be included.

Third, the research was executed using a survey given to students from a business school, which according to different researchers is a valid tool in the investigation of phenomena not crystallized in time, for instance events in sociology or politics. However this sample has a particular standard of living and/or level of studies that might not represent the behaviour of every employee. Future research could include more people with a lower academic level or standard of living. Additionally, being the objective of the paper to examine the influence of those internal, organizational and motivational elements that, according to prior research in this area, impact this process, we suggest additional research to develop a global model to explain all the existing relationships, and the global impact on the dependent variable.

Finally, we have to take into account that innovation is a complex and dynamic process, especially the technological innovation process, so we have to take the timeframe into account, because the model might change as a result of the development of the information society.

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