Determinants of innovation capacity in medium-sized firms

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Abstract. This paper aims to analyse the determinants of innovation capacity in medium-sized firms. It analyses the following factors: culture of participative leadership, work climate and well-being, ideation and organization structures, development of know-how, exploitation of external knowledge, regeneration and individual activity. The approach of this study is descriptive quantitative field and not experimental. The project used a data collection questionnaire with 21 items, to a sample of medium-sized companies in Valledupar, Colombia. The results indicate that the determinants of innovation capacity are present in the companies analysed in the study. Additionally, the ANOVA results show that there are significant differences between the culture factor and participative leadership, with the factor of regeneration. Likewise, there are differences between the exploitation of external knowledge and working climate and well-being, ideation and organizational structures, development of know-how, regeneration and individual activity.

1. Introduction
Based on the early theorizations of innovation, the emphasis was on the presence of contextual variables, because innovation does not occur in a vacuum. However, the innovation responds to an articulation of efforts between different actors that culminates with novelty in product, process, organizational technique or marketing [1]. The above arguments suggest that innovation capacity is a multi-faceted concept that usually adopts a certain type of innovation, or different intensities (radical and incremental) [2].

First, the determinant innovation capacity is the organizational culture, the leadership, the process of radical product innovation, the characteristics of the organization and the strategy of product launch [3]. Second, another line of research put emphasis on internal characteristics, those associated with the entrepreneur and the relationship with customers [4,5]. Third, a line of research signals as determinants of innovation capacity: cooperation, resources and territorial relationships, human and technological resources, as well as organizational culture [6]. Fourth, the literature presents the common elements as determinants of the capacity for innovation: the culture and climate of innovation, leadership, relational capacity, structures of organization and project management, management of ideas and the individual activity [7-10].

Other studies utter that determining factors in the capacity for innovation are the use of information and communication technologies by entrepreneurs, the organization and participation in cooperation networks and the realization of corporate social responsibility activities [4]. Some other studies argue that the convergence of literature about the main determinants of innovation capacity: transformational leadership, strategic intention to innovate, people management, customer and market knowledge,
strategic management of technology, organic structure and project management [8]. Recent works specify that there is a varied literature on innovation and its conditions in a number of specialized journals, but with almost exclusive emphasis in the developed countries [11]. To date, however, there is still no good understanding of innovation. How does it originate? And why it appears in some contexts and not in others? [11]. This paper aims to analyze the following determinants of innovation capacity [10,12,13]:

Participatory leadership culture: The culture of participative leadership is related to the general environment that supports and motivates innovation [12], as well as the advantages and actions of the leaders [2,13,14]. Other studies focus on the importance of the leader in the innovation process [3]. While other studies propose that the adhocracy culture is the best typology to improve innovation [3,15].

Work climate and wellbeing: The work climate and wellbeing refers to collaboration, values, welfare and the comfort that favors innovation [2,12,16]. In addition, this factor contains the motivation of employees [12,17]. Moreover, the climate of the employees favors the welfare of the workers [18].

Ideation and organizing structures: This factor is defined as the structure and systems required by effective innovation [2,12,13]. Therefore, the development of innovations requires a flexible structures and effective communication schemes [2,3,12,13,16].

Know-How development: This factor is explained as the development, implementation and exploitation of skills, knowledge and experiences of the coworkers to innovate [2,12,19,20]. The literatures give emphasis in the importance of generating capacity to absorb the developed know-how, which guarantees its implementation and competitiveness in the current context [21].

Exploitation of external knowledge: Recent findings argue about the importance of the exploitation of external networks and knowledge of the groups of interest to innovate [2,12,13,19,22]. Similarly, the process of this factor integrates the transfer of knowledge and technical learning, important for innovation [23].

Regeneration: The regeneration as the capacity of an organization to learn from previous experiences and apply that knowledge to innovation [2,12,13,19,]. Thus, the risk tolerance and systematization of lessons learned from errors are fundamental for the regeneration [16]. The above, knowledge occurs when individuals react to changes in the environment, detecting errors and taking corrective actions [24]. Hence, organizations must encourage learning that stimulates regeneration [20].

Individual activity: The literature review related to the individual activity demonstrate that the capacities and activities of each one of the workforces are fundamental to consolidate the innovation capacity inside the organization [2,12,13,1925]. So, it is essential to generate trust for the exchange of knowledge among employees [26] and the promotion of support and empowerment climates for personnel [27].

2. Methodology
The present research is based on the logical positivism [28]. Additionally, the approach of this study is descriptive quantitative field and not experimental [29-31] The population is 81 medium-sized companies of the municipality of Valledupar, Cesar, Colombia. The Valledupar Chamber of Commerce reported the data and information. This research uses a probabilistic, simple random sampling. The optimum size of the sample in finite populations [32], give a sample of 44 medium-sized companies.

This research employs the survey as a data collection technique [33], using a questionnaire of closed questions [31]. The questionnaire is made up of 21 items with a Likert scale with 5 response options: 5: Always, 4: Usually, 3: Sometimes, 2: Almost never, 1: Never. The expert judgment validates the instrument. In addition, the Cronbach's alpha coefficient confirms the reliability [31]. A scale of interpretation was established for the interpretation of the data, to carry out the process of
confronting the results. The Table 1 presents the scale used for the analysis of the means and the standard deviation.

**Table 1. Scale used for the analysis of the means and the standard deviation.**

| Intervals used for the analysis of the means | Categories/Convention  |
|--------------------------------------------|------------------------|
| 4.20–5.00                                   | Very present (VP)       |
| 3.40–4.19                                   | Present (P)             |
| 2.60–3.39                                   | Moderately present (MP) |
| 1.80–2.59                                   | Few present (FP)        |
| 1.00–1.79                                   | Absent (A)              |

| Intervals used for the analysis of the standard deviation |
|----------------------------------------------------------|
| 1.39–1.74                                                |
| 1.05–1.38                                                |
| 0.70–1.04                                                |
| 0.35–0.69                                                |
| 0.00–0.34                                                |

| Categories/Convention                              |
|---------------------------------------------------|
| Very high deviation (VHD)                         |
| High deviation (HD)                               |
| Intermediate deviation (ID)                       |
| Low deviation (LD)                                |
| Absent deviation (AD)                             |

3. **Results**

Table 2 shows the results obtained regarding the determinants of innovation capacity.

**Table 2. Results of determinants of innovation capacity.**

| Determinants                              | Mean (\(\bar{X}\)) | Standard Deviation (\(\sigma\)) |
|-------------------------------------------|---------------------|----------------------------------|
| Participatory leadership culture          | 3.26                | 1.50                             |
| Work climate and wellbeing                | 3.57                | 1.15                             |
| Ideation and organizing structures        | 3.61                | 1.43                             |
| Know–How development                      | 3.64                | 1.35                             |
| Exploitation of external knowledge        | 2.64                | 1.62                             |
| Regeneration                              | 4.04                | 0.94                             |
| Individual activity                       | 3.58                | 1.28                             |

Means (\(\bar{X}\)) determinants of innovation capacity 3.48
Categories determinants of innovation capacity (Means \(\bar{X}\)) Present (P)
Standard deviation (\(\sigma\)) determinants of innovation capacity 1.40
Categories determinants of innovation capacity (Standard deviation \(\sigma\)) Very high deviation (VHD)

First, the participatory leadership culture factor we get 30% responds always, 20% answer usually, 18% replies never and 16% of the answers are for the alternatives almost never and sometimes. Thus, the participatory leadership culture factor is moderately present in the companies according to the scale, with an average of 3.26 (Table 1). In addition, we obtain a standard deviation of 1.50, which signifies a very high dispersion in the responses (Table 1).

Comparing the results of this paper, the literature aims to the relationship between transformational leadership and innovative performance is driving by culture, external conditions and the structure of the organization [14]. In a similar vein, the culture is one of the most stimulating aspects for innovation [34]. Specifically, the culture that favors innovation the most is the adhocracy, defined by the model of Competing Values Framework [35], due to its flexibility and external orientation. Therefore, the characteristic of the organizational culture with the greatest influence on innovation are the values shared by the staff [15]. Also, innovation capacity requires collaboration, an open culture, and incentives for actions [2,12,13].

Second, the informants for the factor of work climate and wellbeing respond 32% usually, 25% always, 23% almost never, 18% sometimes and the remaining 2% corresponds to the option never. These results demonstrate that the factor of work climate and wellbeing is present according to the responses of the key informants (Table 1), with an average of 3.57. Furthermore, we find a standard deviation of 1.15, which draw attention to a high dispersion in the responses (Table 1). Recent studies of work climate and well-being factor accentuate the empowerment of leaders improves the well-being of employees, while the equal treatment of workers is a favorable condition for innovation [12]. Besides, welfare corresponds to a link in the team climate for innovation [18]. Therefore, the well-being of employees and the work climate are a determining factor for innovation capacity [2,12].
Third, the ideation factor and organization structures get the following answers 36% always, 25% usually, 18% sometimes, 16% usually and 5% never. These results highlight that the ideation factor and organization structures are present in accordance with the responses of the key informants, with an average of 3.61. Likewise, we attain a standard deviation of 1.43, which reveals a very high dispersion (Table 1). As expected and in accordance with previous research, the ideation and organizational structures are related to the systems required for the success of innovation, including the forms of work organization and the idea generation system [2,12,13]. The above discussion leads us to believe that is very important to promote a flexible structure, with good communication [3,16]. Therefore, the capacity for radical innovation requires that the organizational structure support the processes of discovery, incubation and acceleration [3]. They argue that collaborations with universities or suppliers have a greater impact on innovation, due to the ease of transferring knowledge in this type of collaboration [3].

Fourth, in the know-how development factor, the subject answer 34% always, 30% usually, 18% sometimes, 14% never, and 5% almost never. These results signify that the factor of development of know-how is present according to the responses of the key informants, with an average of 3.64(Table 1). As well, we get a standard deviation of 1.35, which demonstrates a high dispersion in the responses. The literature points out that the factor of development of know-how, is oriented to develop in the employees the skills required to consolidate the capacity for innovation [13]; with the use of knowledge and the improvement of the staffs abilities [2,12,19]. Hence, the organization must seek a complete understanding of its environment, while strengthening the individual development of the human resources [12]. For example, the subcontracting of orders, the temporary transfer of personnel and the common use of machinery and equipment are knowledge transfer mechanisms with customers and suppliers [21].

Fifth, in the external knowledge exploitation factor, the key informants answer 43% never, 20% always, 18% sometimes 14% usually and 5% almost never. These results spotlight that the external knowledge exploitation factor is moderately present, according to the responses of the key informants, with an average of 2.64 (Table 1) with a standard deviation of 1.62. These highlight a very high dispersion of the responses (Table 1). In contrast with this paper, the literature call attention to the strength of relations between companies influences the degree of knowledge transfer, favoring innovation capacity [12]. Moreover, the exchange of knowledge with external agents is a key element in the creation of new experience [22]. Thus, the competence to capture and transform tacit to explicit knowledge is necessary to influence innovative processes and develop dynamic capacities [23].

Sixth, in the regeneration factor, the key informants’ report 39% always, 32% usually, 23% sometimes, and the remaining 7% almost never. Our results demonstrate the regeneration factor is present according to the answers with an average of 4.04 (Table 1). Besides, we get a standard deviation of 0.94, which specifies an intermediate dispersion of the responses (Table 1). In accordance with previous research, the regeneration reflects the ability of the company to learn from previous experiences and use that experience to create innovations and develop their operations [2,12,13,19]. Regeneration requires being error tolerant, exchanging ideas in a framework of trust, and willingness to take risks [12]. Thus, innovative companies usually assume risks; mitigate the uncertainty through effective management of information and control of project milestones [16]. Therefore, companies should stimulate regeneration by encouraging continuous learning to improve their responses to the challenges they face [20].

Seventh, in the individual activity factor, we got 32% usually, 30% always, 18% sometimes 11% almost never and 9% never. These results lead that the individual activity factor is present according to the responses of the key informants, with an average of 3.58 according to the scale, (Table 1) with a standard deviation of 1.28, which aims a high dispersion in the responses (Table 1). As expected and in accordance with previous research, the literature highlights the individual innovation capacities and activities of the labor force are necessary to consolidate the capacity for innovation, because people are the source of creativity and innovation [2,12,13,19]. Therefore, the ability of employees to continuously innovate and improve products is increasingly vital for companies [25]. Thus, it is
important to promote organizational climates characterized by organizational support and empowerment [27], in order to stimulate the tendency of employees to generate new ideas, promote and implement them to achieve the objectives of the organization [36].

In sum, the general average of the determinants of innovation capacity is in the present category, with an average of 3.48 according to the scale (Table 1). Besides, the standard deviation of the dimension is 1.40, which indicates a very high dispersion in the general responses of the dimension. The factors: culture of participative leadership and exploitation of external knowledge are moderately present; the five remaining factors are present. In accordance with previous research [10,12,13], our study validates the existence of determinants of innovation capacity linked to participatory leadership culture; the work and well-being climate; the ideation and organizational structures; the development of Know-How; the exploitation of external knowledge; and regeneration and individual activity.

Table 3 shows result of ANOVA analysis. This analysis aims to determine the significant differences between the determinants of the innovation capacity analyzed.

**Table 3. ANOVA to determinants of the innovation capacity.**

|                     | Sum of squares | Degrees of freedom | Half quadratic | F   | Significance (Sig.) |
|---------------------|----------------|--------------------|----------------|-----|---------------------|
| Between groups      | 49.965         | 6                  | 8.327          | 6.256 | 0.000               |
| Within groups       | 400.654        | 301                | 1.331          |      |                     |
| Total               | 450.619        | 307                |                |      |                     |

The level of significance is less than 0.05, it exposes the significant differences between the groups analyzed, in our study, among the determinants of innovation capacity analyzed in medium-sized companies. To establish the factors that present this difference, a post hoc test is performed, in this case the Tukey HSD. From the multiple comparisons resulted, significant differences (Sig. <0.05) are present among the following factors (we omitted levels of significance higher than 0.05 from the table) (Table 4): Finally, between the participatory culture and leadership factor with the regeneration factor. Additionally, there are significant differences between the factor of exploitation of external knowledge and working climate and well-being, ideation and organizational structures, development of know-how, regeneration and individual activity.

**Table 4. Multiple comparisons (Post hoc HSD Tukey Test).**

| (I) Factor                          | (J) Factor                          | Difference of means (I-J) | Standard error | Significance (Sig.) | Confidence interval at 95% | Lower limit | Upper limit |
|-------------------------------------|-------------------------------------|---------------------------|----------------|---------------------|----------------------------|-------------|-------------|
| Participatory leadership culture    | Regeneration                        | -0.78030*                 | 0.24597        | 0.028               | -1.5105                    | -0.0502     |
|                                     | Work climate and wellbeing          | -0.93182*                 | 0.24597        | 0.003               | -1.6620                    | -0.2017     |
| Exploitation of external knowledge  | Ideation and organizing structures  | -0.97727*                 | 0.24597        | 0.002               | -1.7074                    | -0.2471     |
|                                     | Know-How development                | -1.00758*                 | 0.24597        | 0.001               | -1.7377                    | -0.2774     |
|                                     | Regeneration                        | -1.40152*                 | 0.24597        | 0.000               | -2.1317                    | -0.6714     |
|                                     | Individual activity                 | -0.94697*                 | 0.24597        | 0.003               | -1.6771                    | -0.2168     |

* The difference in means is significant at the 0.05 level.

In contrast, the literature analyzes as determinant factors of innovation: skills, measurement, management processes and research technology in the context of small and medical companies in the textile industry of Mexico [37]. This study concludes that, in the medium-sized company, the measurement factors and management processes are significant, generating a higher level of innovation [37]. Contrariwise, in the textile companies of the textile trade sector in Colombia, innovation activities in services are associated with the acquisition of machinery and equipment, tools
and information systems [38]. Therefore, in the context of Malaysian public sector companies, they are unleashed as determinants factors for innovation management: the leader's commitment to innovative culture, communication at all levels of the organization and the rewards to employees [39]. On the other hand, cooperation in innovation is an alternative to increase the capacity for innovation in small and medium-sized companies [40].

Hence, the literature investigates the determinants of innovation capacity from different approaches: first, from the capacities for internal innovation and the capacities for the adoption of technology [41]. Second, inputs of innovation (collaboration, human capital, IT expenditures, funding) and institutional factors (firm size, ownership, competition, environment, industry) [42]. Third, the literature explored the factors that drive the capacity for innovation in 11 countries of Mediterranean Europe, finding that economic growth, foreign investment (FDI) and employment in I+D are positive factors that promote innovation [43].

4. Conclusions
In this paper, the presence of the determinants of innovation capacity in medium-sized companies is validated, corresponding to: work climate and well-being, ideation and organizational structures, development of know-how, regeneration and individual activity. Conversely, the factors of exploitation of external knowledge and culture of participative leadership report a medium presence in the companies analyzed.

In particular, there is a medium presence of participatory leadership culture in companies, given the deficiencies associated with the promotion of leadership to develop innovations in the company's products. As well as, medium presence of incentive systems to reward participation of the collaborators in the processes of innovation. Moreover, deficient participation of the managers the creative development of the medium-sized companies. In the analyzed companies, a work climate and well-being in companies is present as a determining factor of innovation capacity, because they favor a work climate with values to innovate, favoring the development of creativity and with personnel motivated to work in these companies.

Additionally, the ideation and organization structures are present in the analyzed companies, because they organize the work of the members to favor innovation, supported by a flexible organizational structure. However, there are deficiencies in the structuring of an established process to support innovative ideas in these companies. Besides, the presence of know-how development is concluded, through the promotion of experiences and the constant search to understand the environment. Nevertheless, it is important to strengthen the use of the experiences of the employees for the development of products. Still, there is a medium presence of the exploitation factor of external knowledge, associated with deficiencies in collaboration and the development of products with external networks. Finally, regeneration is present given that knowledge of previous experiences used to change processes, as well as a presence of individual activity as a determining factor of innovation capacity, since employees are willing to develop activities individually.

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