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Analysis of innovation in the MIPYMES of León, Guanajuato, Mexico, during and post-covid-19

Análisis de la innovación en las MIPYMES de León, Guanajuato, México, durante y post-covid-19

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Abstract

The objective of this research is to analyze the main survival strategy during and after the pandemic of MIPYMES, which is undoubtedly innovation, it will analyze flugal innovation, open innovation and innovation in general of micro, small and medium-sized companies, Without a doubt, these types of companies represent the backbone of the economy in the world and in Mexico, especially in León, Guanajuato, the term innovation was used during and after the covid-19 pandemic by companies as a strategy to survive and adapt in the production processes and in the commercialization of their products, the innovation of the companies will be analyzed through the application of 350 surveys to the MIPYMES the grounded methodology is used, the research is quantitative because it measures the level of innovation that the Directors and owners of this type of company perceive they have had in their company. In the international innovation indices, Mexico is at the 55th place in the annual ranking by 2021. The result is that MIPYMES used innovation as a survival tool, to stay alive and maintain their production and marketing of their products.

Open innovation, Frugal innovation and innovation

Resumen

La presente investigación tiene por objetivo analizar la principal estrategia de supervivencia durante y post pandemia de las MIPYMES, que sin duda es la innovación, se análizara la innovación flugal, la innovación abierta y la innovación en general de las micro, pequeñas y medianas empresas, sin lugar a duda este tipo de empresas representan la columna vertebral de la economía en el mundo y en México, en especial en León, Guanajuato, el termino innovación fue empleado durante y post la pandemia covid-19 por las empresas como una estrategia para sobrevivir y adaptarse en los procesos productivos y en la comercialización de sus productos, se analizará la innovación de las empresas mediante la aplicación de 350 encuestas a las MIPYMES, se utiliza la metodología fundamentada, la investigación es cuantitativa por que mide el nivel de innovación que los directores y dueños de este tipo de empresa perciben haber tenido en su empresa. En los índices internacionales de innovación México se encuentra al año 2021 en el sitio 55 en el ranking anual, Se obtiene como resultado que las MIPYMES utilizaron como herramienta de supervivencia la innovación, para seguir vivas y mantener su producción y comercialización de sus productos.

Innovación abierta, Innovación frugal e innovación

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1. Introduction

It is very important to mention that the pandemic covid-19 is still present, that it is a phenomenon with which we are going to live at least until the whole world is vaccinated, economically we are living the consequences generated by this pandemic. Therefore, our objective of study is innovation, it is a very important subject of study, because it represents one of the necessary options of survival for many companies and its use was and is indispensable during and post pandemic covid-19, in order to survive the managers and owners of such companies, had to adopt the different terms of innovation among them is open innovation, frugal innovation and innovation in general terms.

The pandemic has not passed, neither economically nor in a sanitary way, in spite of the fact that vaccines for this disease have been applied and continue to be applied all over the world. MSMEs around the world received support and financing during the most difficult months of confinement and partial closures due to the confinement. Mexico was no exception. MSMEs were supported with economic aid, with projects to generate income for families through loans and donations.

The Ministry of Economy published calls for proposals where simple self-employment and business projects could be developed, for example, to set up taco, tamale and similar stalls, and interest-free loans were offered to be returned in an accessible manner. Now, despite the support and economic and health struggle, COVID-19 is present and the economic crisis will gradually withdraw step by step, and it will be an integral task of government, educational institutions, other organizations to support businesses and owners and managers, to eradicate as quickly as possible the economic aftermath that has left us the pandemic covid-19.

For the month of March of the year 2020 in the world the biggest isolation in history took place, and was characterized by the dismissal of many employees, temporary closure of most companies, only remained open the essential companies such as supermarkets and health, now it was in this isolation when companies around the world had to innovate their way of working from home, their way of producing, marketing their products and services.

It is worth mentioning that a large percentage of the companies in the study could not bear the burden of paying fixed costs and expenses such as payroll, rents and other expenses even when the company was not working and closed its doors forever.

Well, hence the importance of analyzing how the managers and owners of MSMEs in Leon, Guanajuato, Mexico, handled innovation during and after COVID-19. During the first red traffic light. And the gradual change of traffic lights from yellow to orange and finally in December some states are again in red traffic light, for the beginning of the year 2021 it starts again with orange and yellow traffic light and for the last months of the year most of the states are already in green traffic light, but with a new knowledge for the month of December this virus is already found in 51 countries and in Mexico for December 3 the first confirmed case of Omicron is found. According to the newspaper el (país, 2021). Undoubtedly, another new sanitary and economic challenge for Mexican companies.

The central question of this research is: Did MSMEs change and innovate their way of producing and marketing their products and use sustainability during and after the covid-19 pandemic?

The data collection was carried out in October 2021 in the city of Leon, Guanajuato, Mexico to know the management of open innovation, frugal innovation and innovation in general of MSMEs during and post covid-19.

1.1 Justification

The present research aims to analyze the innovation of MSMEs during and post covid-19 in Leon, Guanajuato, Mexico. The management given by the directors and owners of this type of companies to the aspects of open innovation, frugal innovation and innovation in general terms, in order to take care of the financial, cost and sustainable development aspects.

Their high business representation in Mexico, with 99.8% of the total number of companies, represents the backbone of the country's economy. However, these companies have gone through economic crises such as the covid-19 and now with the new omicron strain and continue to operate, this is due to the family roots that most MSMEs have.

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1.2 Problem

Since March 2020 and to date, covid-19 has caused a worldwide economic and health crisis and for the companies in Leon, Guanajuato, Mexico is no exception, so the MSMEs were forced to use and implement innovation, many of them closed their doors for good and those that are still alive had to adapt their production and financial processes to live with this phenomenon that affects all companies. And now with the new omicron virus.

1.3 Research questions

a. Has the company become more innovative in recent months compared to its competitors?

b. External sources of knowledge and technology were sought to develop new products?

c. Does my company use alliances with local companies in its operational process?

1.4 Hypothesis

Micro, small and medium enterprises in Leon, Guanajuato, do not have the levels of open and frugal innovation, during and after the covid-19 pandemic.

1.5 General Objective

To analyze the innovation acceptance of micro, small and medium-sized enterprises during and post covid-19 pandemic.

2. Theoretical framework.

2.1. Current situation of innovation at the international level

The following table number one shows the most innovative countries worldwide, as of September 2021. In the first 10 places we find: Switzerland, Sweden, United States, United Kingdom, Republic of Korea, Netherlands, Finland, Singapore, Denmark and Germany. (WIPO, 2021).

Analysis of Mexico's innovation with the other 132 countries. We occupy the 55th place of the countries analyzed in the International Innovation Index (WIPO 2021). It is worth mentioning that Mexico moved up one place to 56th place, which shows that this pandemic made us change rapidly in the way we produce and market our products. In 54th place we have Serbia and in 56th place Costa Rica, our closest competitors in innovation.

Index	Country
1	Switzerland
2	Sweden
3	United States of America
4	United Kingdom
5	Republic of Korea
6	Netherlands
7	Finlandia
8	Singapur
9	Dinamarca
10	Alemania
11	Francia
12	China
13	Japón
14	Hong Kong, China
15	Israel
16	Canadá
17	Islandia
18	Austria
19	Irlanda
20	Noruega
21	Estonia
22	Bélgica
23	Luxemburgo
24	Republica checa
25	Australia
26	Nueva Zelanda
27	Malta
28	Chipre
29	Italia
30	España
31	Portugal
32	Eslovenia
33	Emiratos Árabes Unidos
34	Hungría
35	Bulgaria
36	Malasia
37	Eslovaquia
38	Letonia
39	Lituania
40	Polonia
41	Pavo
42	Croacia
43	Tailandia
44	Vietnam
45	Federación Rusa
46	India
47	Grecia
48	Rumania
49	Ucrania
50	Montenegro
51	Filipinas

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52	Mauricio
53	Chile
54	Serbia
55	**Mexico**
56	Costa Rica
57	Brasil
58	Mongolia
59	Macedonia del Norte
60	Irán (República Islámica de)
61	Sudáfrica
62	Bielorrusia
63	Georgia
64	República de Moldova
65	Uruguay
66	Arabia Saudita
67	Colombia
68	Katar
69	Armenia
70	Perú
71	Túnez
72	Kuwait
73	Argentina
74	Jamaica
75	Bosnia y Herzegovina
76	Omán
77	Marruecos
78	Bahréin
79	Kazajstán
80	Azerbaiyán
81	Jordán
82	Brunei Darussalam
83	Panamá
84	Albania
85	Kenia
86	Uzbekistan
87	Indonesia
88	Paraguay
89	Cabo Verde
90	República Unida de Tanzania
91	Ecuador
92	Líbano
93	República Dominicana
94	Egipto
95	Sri Lanka
96	El Salvador
97	Trinidad y Tobago
98	Kirguistán
99	Pakistán
100	Namibia
101	Guatemala
102	Ruanda
103	Tayikistán
104	Bolivia (Estado Plurinacional de)
105	Senegal
106	Botswana
107	Malawi
108	Honduras
109	Camboya
110	Madagascar
111	Nepal
112	Ghana
113	Zimbabue
114	Costa de Marfil
115	Burkina Faso
116	Bangladesh
117	República Democrática Popular Lao
118	Nigeria
119	Uganda
120	Argelia
121	Zambia
122	Mozambique
123	Camerún
124	Mali
125	Togo
126	Etiopía
127	Myanmar
128	Benin
129	Níger
130	Guinea
131	Yemen
132	Angola

Table 1 International innovation index
Source: Own Elaboration with WIPO 2021 data

The cities in Mexico considered to have the most innovation and technology for (NEUBOX, 2021), in first place is Guadalajara considered the Solicon Valley of MexicoIBM, HP and Intel, collaborating in the development of the country's technology sector, in second place is the city of Mexico considered the most industrialized of the country, which aims to be the seventh global economic hub, in third place Monterrey with more than 100 industrial parks Neoris opened its innovation laboratory to boost the digital transformation of the city, In fourth place is the city of Tijuana, which is a 20 minute drive from the United States and its gross domestic product is comparable to Ireland's. In fifth place is Queretaro, located in the center of the country with the MAFTA highway development, through which many of the economic activities at national level pass, this brought with it the aerospace development, turning Queretaro into a new center for the aerospace industry.

2.2. Open innovation

First of all, let's talk about closed innovation, which represents the internal way of innovating within the company, with the ideas and materials of the entity, the core of developing products and services, with the human, technological and material resources the company has. Well, open innovation opens the doors to educational institutions to external advisors from Mexico and the world, working together closed innovation with open innovation without leaving frugal innovation, we can make the most of the opportunity to develop innovation in our companies, localities, states, countries and the whole world.

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Now, for Proum (2020), Mexican SMEs are in great economic affectation, this putting as background that the virus was born in the province of Wuhan, China and without losing sight of the bilateral relationship that exists between the two countries.

For (Calderon, 2010). Open innovation is the openness to cooperation is translated into contracts or agreements to carry out innovation in the administration or processes of the organization that requests the collaboration.

Now, another author who studies the relationship of innovation from the external aspect and the relationship of organizations with external actors is (Laursen, 2006). Analyzing the benefits of having a collaboration with external for the external innovation aspects of the company.

Well, internal and external innovation combined can produce better results than internally generated innovation. And even more so in this economic crisis caused by covid-19.

2.3 Frugal innovation

Undoubtedly, innovation is the most important tool that every company must develop to mitigate the economic impact brought about by the global pandemic, so we rely on flugal innovation that supports the questions raised by this research, and used by Japan to surpass the United States in the production of cars. Now, an author who supports this type of innovation is Basu, Banergee and Swenny (2013). Where he mentions the main characteristics that a frugal innovation must meet.

In his article, he states: "basic characteristics of a frugal innovation and how they relate to the classic innovation model".

Thus, the research instrument questions are shaped by open innovation, frugal innovation and innovation in general.

These characteristics are: being resilient, lightweight, mobile, human-focused, simplified, with new distribution models, use of local resources, green and affordable technologies.

Methodology to be developed

The present research is quantitative, 350 surveys were applied to the managers and owners of the MSMEs of Leon Guanajuato, the students of the economic-administrative area of the careers of administration and gastronomy mainly, were the ones who applied the surveys in person and captured it in the database of the network of technological universities, this same instrument was applied nationally by all the Technological Universities that participated in the network of research of crisis post covid-19. The instrument consisted of a total of 15 blocks, block four being the analysis of this research. It consisted of 19 items of general innovation, open innovation and frugal innovation.

Results

The following are the results of the application of 350 surveys to MSMEs in the city of Leon, Guanajuato, Mexico, applied to managers and owners, regarding block four corresponding to innovation with respect to internal and external sources of technologies, costs, finances and production during and post covid-19.

The following are the results of open innovation, which consists of 8 itms corresponding to this type of innovation of the MSMEs of Leon, Guanajuato, Mexico.

Table 2 below shows the response to the question "my company constantly scans the external environment for inputs such as technology, information, ideas and knowledge". As a result, only 18.3% of the directors and owners of the MSMEs agree in seeking external inputs.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	25	7.1	7.1
Agreed	39	11.1	18.3
Neither agree nor disagree	86	24.6	42.9
Disagree	102	29.1	72.0
Total disagreement	98	28.0	100.0
Total surveys applied	350	100.0	

Table 2 my company constantly scans the external environment for inputs such as technology, information, ideas, and knowledge.
Source: Own Elaboration

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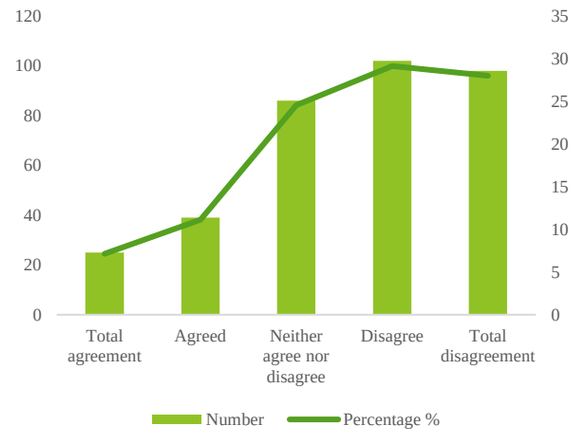
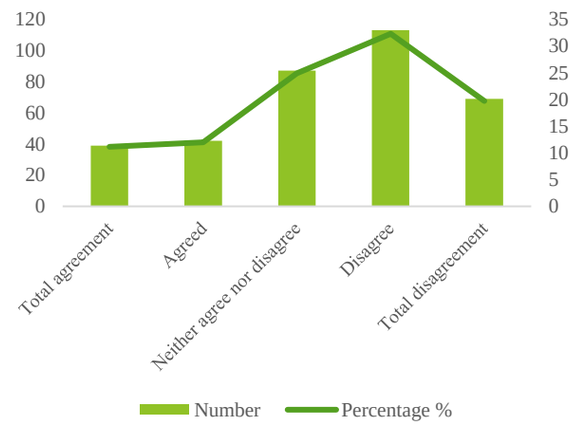


Graph 1 My company constantly scans the external environment for inputs such as technology, information, ideas, and knowledge.
Source: Own Elaboration

The following table number three shows how the managers of the MSMEs perceive the external search for technology and external knowledge for the generation of new products and only 23.1% agree that they have externally searched for knowledge and technology outside the company.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	39	11.1	11.1
Agreed	42	12.0	23.1
Neither agree nor disagree	87	24.9	48.0
Disagree	113	32.3	80.3
Total disagreement	69	19.7	100.0
Total surveys applied	350	100.0	

Table 3 My company effectively seeks external sources of knowledge and technology to develop new products.
Source: Own Elaboration

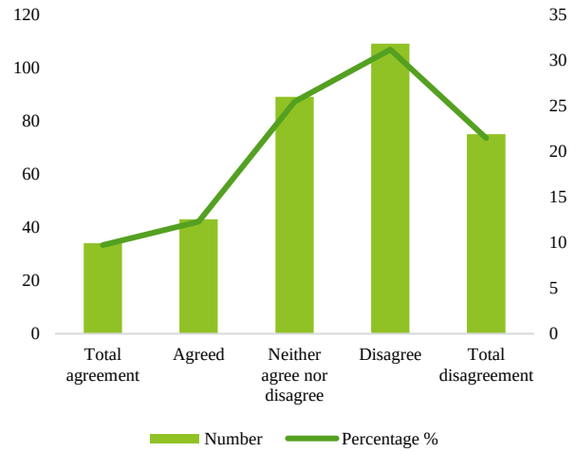


Graph 2 My company effectively seeks external sources of knowledge and technology to develop new products
Source: Own Elaboration

The following table number four shows how the managers of the companies under study perceive whether it is good to use external sources of knowledge, customers, suppliers and competitors. Only 22% believe that they agree with the use of external sources.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	34	9.7	9.7
Agreed	43	12.3	22.0
Neither agree nor disagree	89	25.4	47.4
Disagree	109	31.1	78.6
Total disagreement	75	21.4	100.0
Total surveys applied	350	100.0	

Table 4 My company believes it is good to use external sources of research, customers, suppliers and competitors
Source: Own Elaboration



Graph 3 My company believes it is good to use external research sources, customers, suppliers and competitors
Source: Own Elaboration

In this table number five, it is shown how the managers of the MSMEs perceive that they have received external advice and 27.1% agree that they have used external advice to combine it with internal technology.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	46	13.1	13.1
Agreed	49	14.0	27.1
Neither agree nor disagree	102	29.1	56.3
Disagree	97	27.7	84.0
Total disagreement	56	16.0	100.0
Total surveys applied	350	100.0	

Table 5 My company often brings in externally developed knowledge and technology for use in conjunction with our own research and development
Source: Own Elaboration

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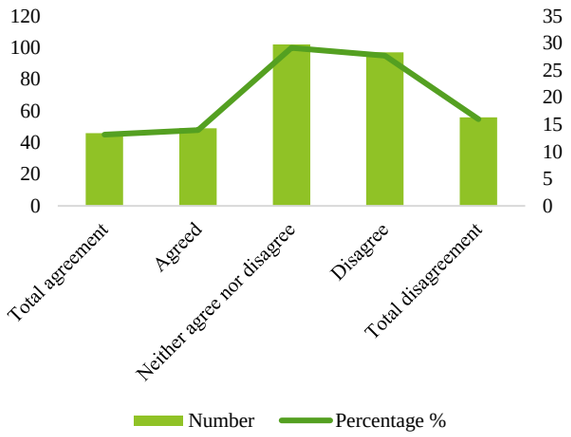
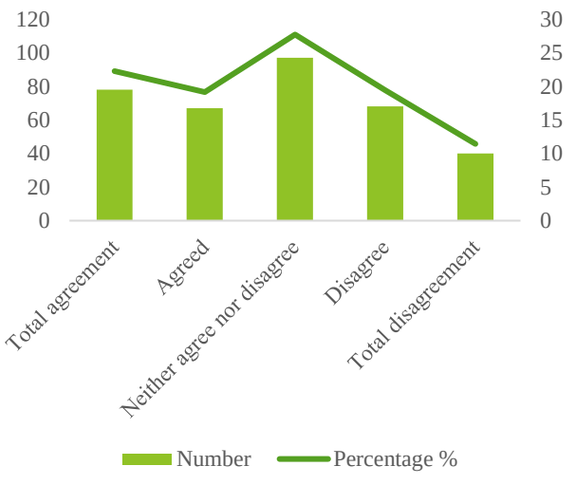


Graph 4 My company often brings in externally developed knowledge and technology to use in conjunction with our own research and development
Source: Own Elaboration

This table shows that entrepreneurs perceive that they have sought technology, research groups and patents from other companies, 41% agree that they have sought external support during and post-covid-19.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	78	22.3	22.3
Agreed	67	19.1	41.4
Neither agree nor disagree	97	27.7	69.1
Disagree	68	19.4	88.6
Total disagreement	40	11.4	100.0
Total surveys applied	350	100.0	

Table 6 My organization seeks technologies and patents from other organizations, research groups or universities
Source: Own Elaboration

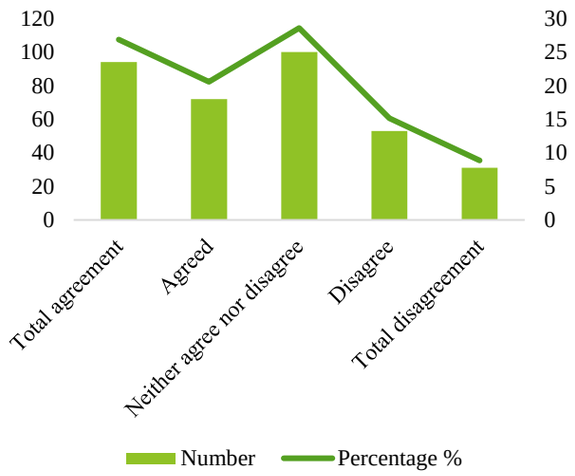


Graph 5 My organization seeks technologies and patents from other organizations, research groups or universities
Source: Own Elaboration

This table shows that 47.4% of the entrepreneurs perceive that they obtained external intellectual property to combine it with their own.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	94	26.9	26.9
Agreed	72	20.6	47.4
Neither agree nor disagree	100	28.6	76.0
Disagree	53	15.1	91.1
Total disagreement	31	8.9	100.0
Total surveys applied	350	100.0	

Table 7 My organization buys external intellectual property for use in its own organization
Source: Own Elaboration



Graph 6 My organization buys external intellectual property for use in its own organization
Source: Prepared by the organization

Now in the next block it is time to analyze competitiveness according to the costs of products, raw materials and services.

The following table shows that 48% of managers agree that technologies are marketed externally.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	104	29.7	29.7
Agreed	66	18.9	48.6
Neither agree nor disagree	67	19.1	67.7
Disagree	67	19.1	86.9
Total disagreement	46	13.1	100.0
Total surveys applied	350	100.0	

Table 8 Generally, in my company all technologies are marketed externally
Source: Own Elaboration

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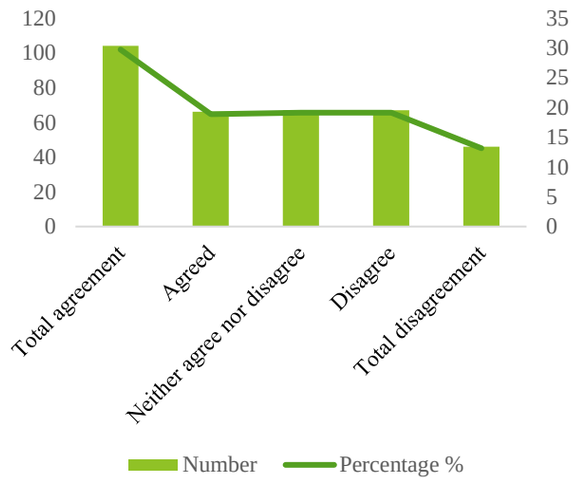
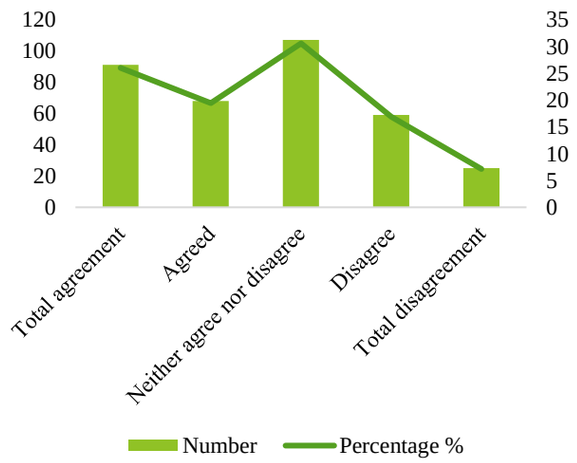


Graph 7 Generally in my company all technologies are marketed externally
Source: Prepared by the company

This table shows that managers and owners of MSMEs perceive that technology in their companies is restricted to external technologies that are not used internally. And 45.4% agree.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	91	26.0	26.0
Agreed	68	19.4	45.4
Neither agree nor disagree	107	30.6	76.0
Disagree	59	16.9	92.9
Total disagreement	25	7.1	100.0
Total surveys applied	350	100.0	

Table 9 In my company, the commercialization of external technology is restricted to technologies that are not used internally
Source: Own Elaboration

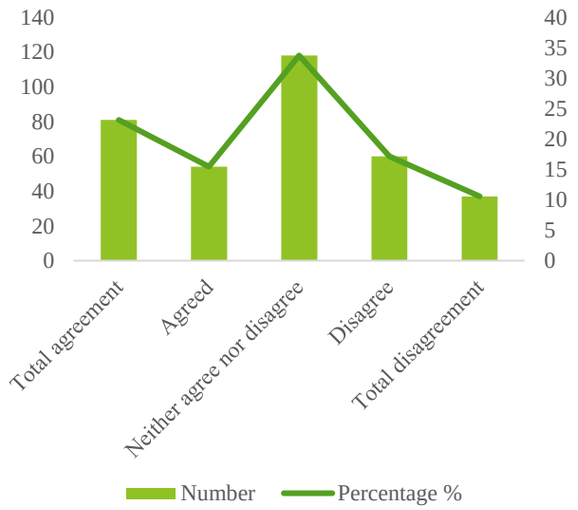


Graph 8 In my company, the commercialization of external technology is restricted to technologies that are not used internally
Source: Own Elaboration

The following table shows that 38% of the businessmen agree that external technologies in their company are restricted to those proven to be used in their institutions.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	81	23.1	23.1
Agreed	54	15.4	38.6
Neither agree nor disagree	118	33.7	72.3
Disagree	60	17.1	89.4
Total disagreement	37	10.6	100.0
Total surveys applied	350	100.0	

Table 10 In my organization, external technology is restricted to relatively mature and proven technologies
Source: Own Elaboration



Graph 9 In my organization, external technology is restricted to relatively mature and proven technologies
Source: Own Elaboration

This table shows that only 43.1% agree that their company acquires non-core technologies.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	88	25.1	25.1
Agreed	63	18.0	43.1
Neither agree nor disagree	123	35.1	78.3
Disagree	50	14.3	92.6
Total disagreement	26	7.4	100.0
Total surveys applied	350	100.0	

Table 11 In my company, the commercialization of external technology is restricted to non-special technologies
Source: Own Elaboration

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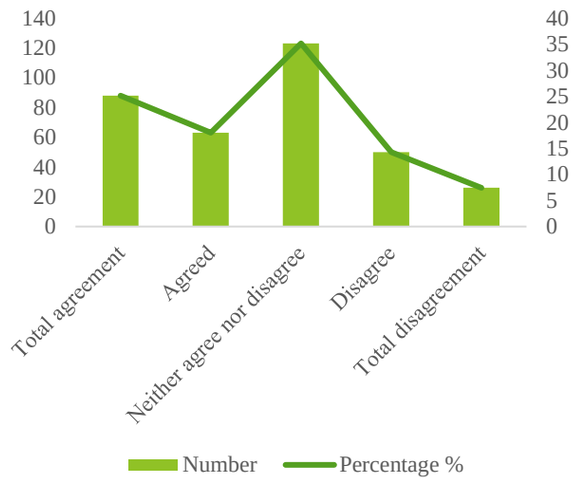
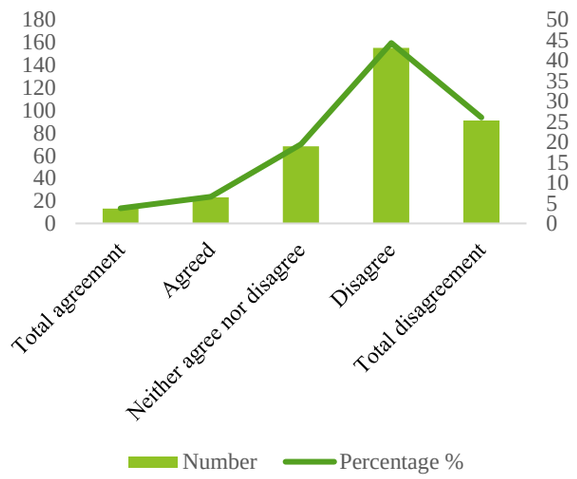


Graph 10 In my company, the commercialization of external technology is restricted to non-special technologies
Source: Own Elaboration

The following table shows that managers perceive that they have not given preference to good and cheap products. Only 10% agreed that they had acquired them.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	13	3.7	3.7
Agreed	23	6.6	10.3
Neither agree nor disagree	68	19.4	29.7
Disagree	155	44.3	74.0
Total disagreement	91	26.0	100.0
Total surveys applied	350	100.0	

Table 12 The company has given great importance to solutions that offer good and inexpensive services
Source: Own Elaboration

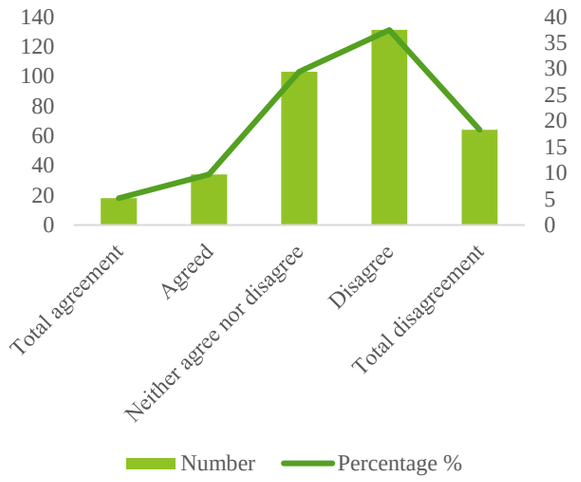


Graph 11 The company has given great importance to solutions that offer good and cheap services
Source: Own Elaboration

This table shows that the directors and managers perceive that they have lowered their costs in the operational process, 14.90% of the businessmen agree with this.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	18	5.1	5.1
Agreed	34	9.7	14.9
Neither agree nor disagree	103	29.4	44.3
Disagree	131	37.4	81.7
Total disagreement	64	18.3	100.0
Total surveys applied	350	100.0	

Table 13 In the last three years, in the development of its products and services, the company has given great importance to cost reduction in the operational process
Source: Prepared by the company itself



Graph 12 In the last three years in the development of its products and services, the company has given great importance to cost reduction in the operational process
Source: Prepared by the company

This table shows that 13% agree that they have reduced their final price, which shows that most of the entrepreneurs have not reduced their final price in the last three years.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	18	5.1	5.1
Agreed	28	8.0	13.1
Neither agree nor disagree	94	26.9	40.0
Disagree	140	40.0	80.0
Total disagreement	70	20.0	100.0
Total surveys applied	350	100.0	

Table 14 Significant reduction in the final price
Source: Own Elaboration

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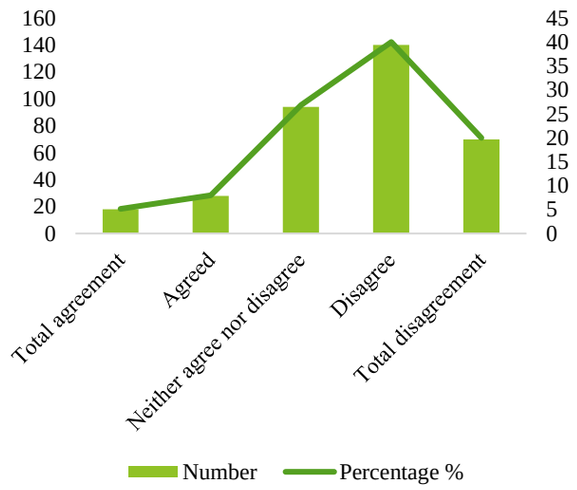
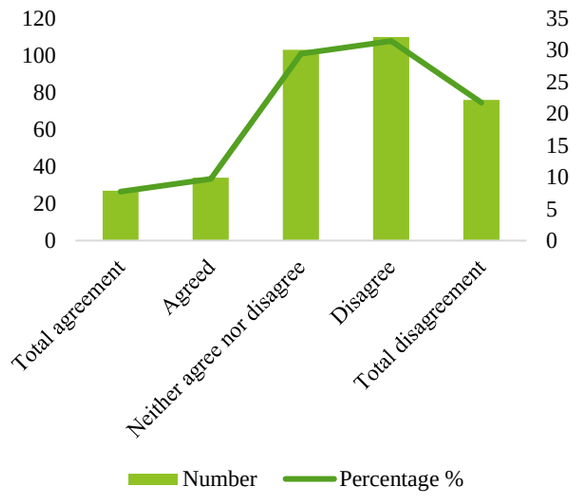


Graph 13 Significant reduction in final price
Source: Own Elaboration

This table shows that 17.4% agree that they have invested in sustainability in the production of their products or services.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	27	7.7	7.7
Agreed	34	9.7	17.4
Neither agree nor disagree	103	29.4	46.9
Disagree	110	31.4	78.3
Total disagreement	76	21.7	100.0
Total surveys applied	350	100.0	

Table 15 Have invested in environmental sustainability
Source: Own Elaboration

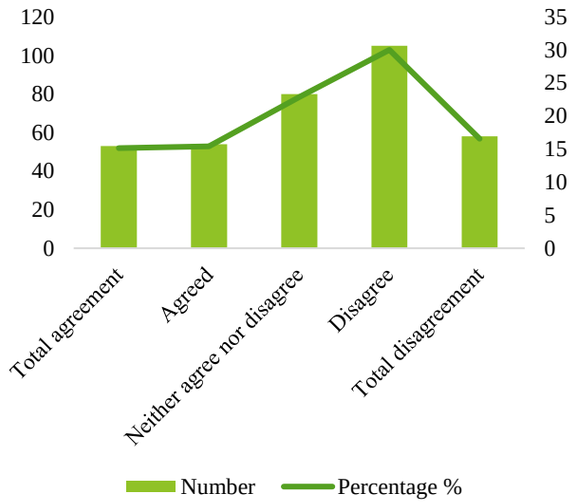


Graph 14 Have invested in environmental sustainability
Source: Own Elaboration

In this table, 30% of the entrepreneurs agree that they have used alliances with local companies for the production of their products and services.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	53	15.1	15.1
Agreed	54	15.4	30.6
Neither agree nor disagree	80	22.9	53.4
Disagree	105	30.0	83.4
Total disagreement	58	16.6	100.0
Total surveys applied	350	100.0	

Table 16 Have had alliances with local companies in the operational process
Source: Own Elaboration



Graph 15 Have had alliances with local companies in the operational process
Source: Own Elaboration

This table shows that the managers and duels of MSMEs perceive in 15.4% and agree that they gave social and environmental solutions to their clients.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	21	6.0	6.0
Agreed	33	9.4	15.4
Neither agree nor disagree	89	25.4	40.9
Disagree	145	41.4	82.3
Total disagreement	62	17.7	100.0
Total surveys applied	350	100.0	

Table 17 Efficient solutions have been provided to clients' social and environmental needs
Source: Prepared by the company

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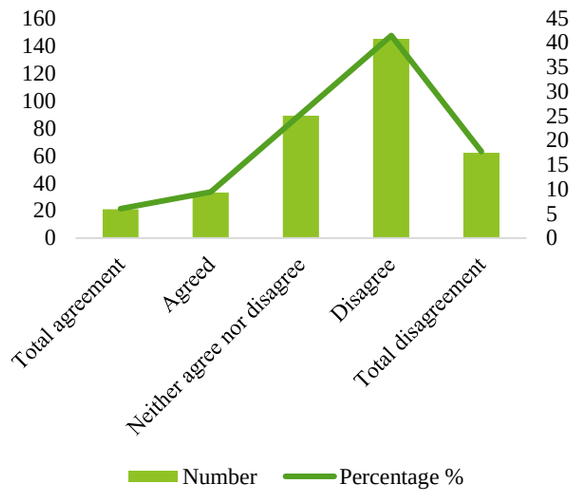
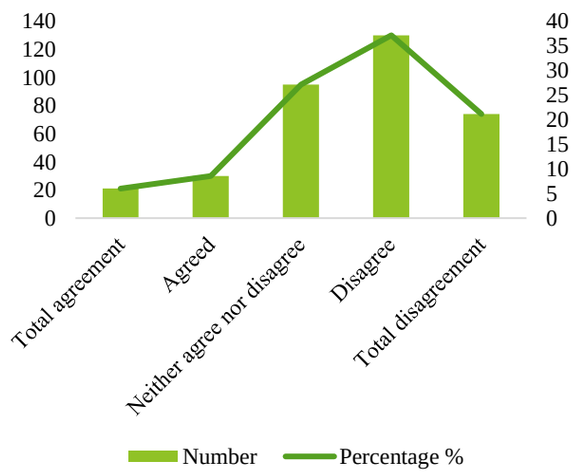


Graph 16 Efficient solutions have been provided to clients' social and environmental needs
Source: Prepared by the company

This table shows that only 14% of the entrepreneurs agree that priority was given to investing in the additional function of product or service. And all the rest were dedicated to investing in the normal functionality of the product or service.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	21	6.0	6.0
Agreed	30	8.6	14.6
Neither agree nor disagree	95	27.1	41.7
Disagree	130	37.1	78.9
Total disagreement	74	21.1	100.0
Total surveys applied	350	100.0	

Table 18 They have invested in the main functionality of the product rather than in additional functionality
Source: Own Elaboration

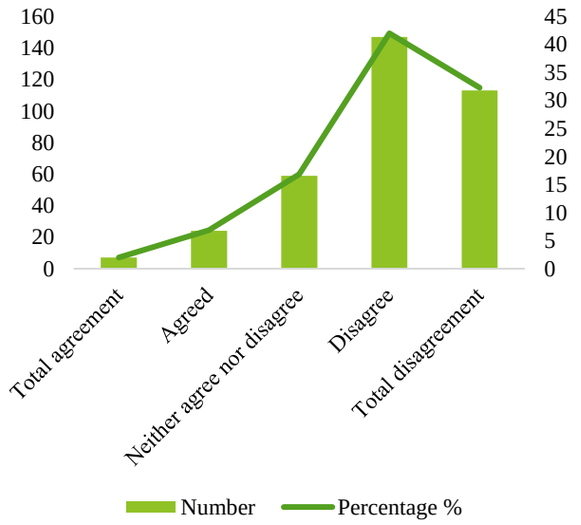


Graph 17 They have invested in the main functionality of the product instead of in the additional functional one
Source: Own Elaboration

This table shows that 8.9% of the entrepreneurs have the perception that they have invested in the ease of use of the product or service.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	7	2.0	2.0
Agreed	24	6.9	8.9
Neither agree nor disagree	59	16.9	25.7
Disagree	147	42.0	67.7
Total disagreement	113	32.3	100.0
Total surveys applied	350	100.0	

Table 19 They have invested in the ease of use of the product or service
Source: Own Elaboration



Graph 18 They have invested in the ease of use of the product or service
Source: Own Elaboration

This table shows that 12% of the entrepreneurs agree that they have invested in the durability of the product or service.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	16	4.6	4.6
Agreed	26	7.4	12.0
Neither agree nor disagree	63	18.0	30.0
Disagree	136	38.9	68.9
Total disagreement	109	31.1	100.0
Total surveys applied	350	100.0	

Table 20 They have invested in the durability of the product and service
Source: Own Elaboration

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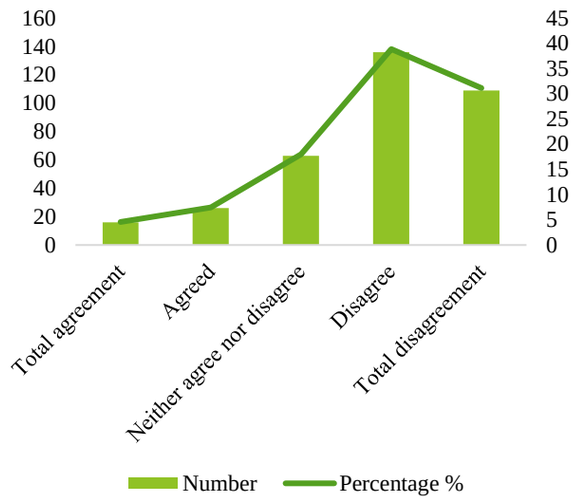
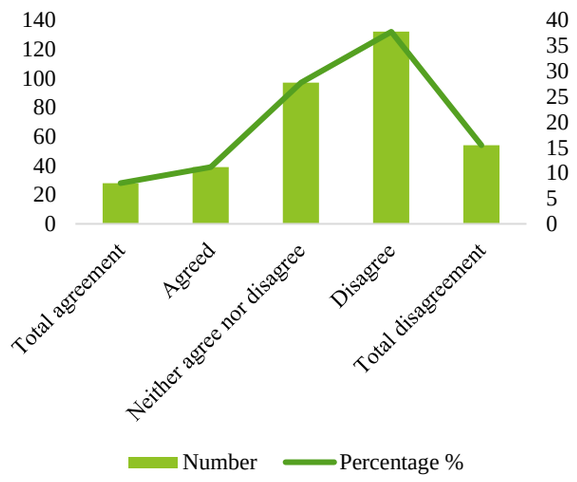


Graph 19 They have invested in the durability of the product and service
Source: Own Elaboration

The table above shows that 19.1% of the entrepreneurs agree that they have invested in the introduction of new products and services.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	28	8.0	8.0
Agreed	39	11.1	19.1
Neither agree nor disagree	97	27.7	46.9
Disagree	132	37.7	84.6
Total disagreement	54	15.4	100.0
Total surveys applied	350	100.0	

Table 21 Invested in the introduction of new products and services
Source: Own Elaboration

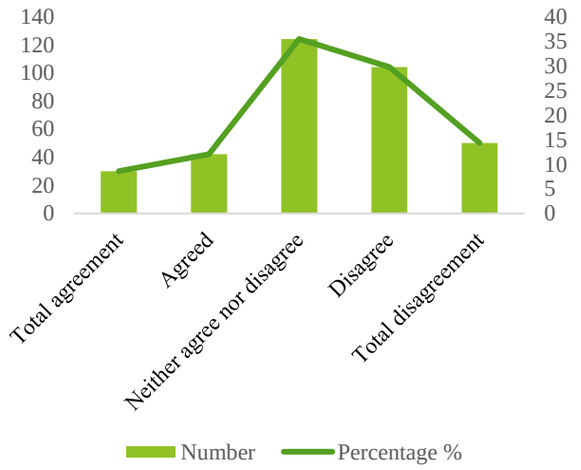


Graph 20 They invested in the introduction of new products and services
Source: Own Elaboration

This table shows that 20.6% of the entrepreneurs agree that they invested in the development of new production processes for their product or service.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	30	8.6	8.6
Agreed	42	12.0	20.6
Neither agree nor disagree	124	35.4	56.0
Disagree	104	29.7	85.7
Total disagreement	50	14.3	100.0
Total surveys applied	350	100.0	

Table 22 Invested in the introduction of new production methods
Source: Own Elaboration



Graph 21 Invested in the introduction of new production methods
Source: Own Elaboration

This table shows that only 11.10% of the entrepreneurs perceive that they are innovative in comparison to their main competitors, the other entrepreneurs do not perceive innovation better than their competitors.

Description	Number	Percentage %	Cumulative Percentage %
Total agreement	15	4.3	4.3
Agreed	24	6.9	11.1
Neither agree nor disagree	119	34.0	45.1
Disagree	120	34.3	79.4
Total disagreement	72	20.6	100.0
Total surveys applied	350	100.0	

Table 23 Compared to our competitors, our company has become more innovative
Source: Own Elaboration

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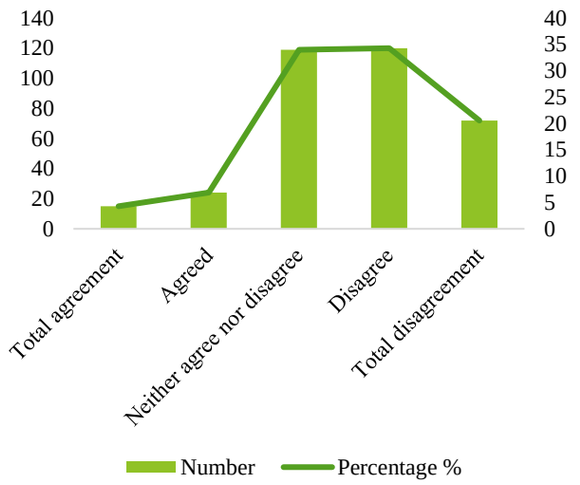

Graph 22 Compared to our competitors, our company has become more innovative
Source: Own Elaboration

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We would like to thank the Universidad Tecnologica de León and the Research Network of Technological Universities for the generation of this project and the application of the national surveys on productivity during and after covid-19.

Discussion and conclusions

Analyzing the annovae of this research we have the following;

Open innovation is 60.4% correlated with frugal innovation and is significant at 99% reliability.

Open innovation is 58% correlated with innovation outcome and is significant at 99% reliability.

Frugal innovation is 60.8% correlated with innovation performance and is significant at 99% reliability.

As an instrument of survival of the companies in this research, innovation is indispensable during and post covid-19.

There is a lack of investment by the entrepreneurs of MSMEs in open innovation, approaching research groups in each of their sectors and universities to receive technological and innovation support to develop their products and services as well as how to market and acquire their raw materials.

Frugal innovation requires the social commitment of entrepreneurs to offer products and services to their customers while caring for and protecting the environment.

Open and frugal innovation were significant in this research because it requires investment in innovation and urgent investment in technology to digitize and make production and marketing processes faster and more efficient, during and after the pandemic because the economic and health consequences will remain for several years around the world.

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