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The Impact of COVID-19 in the Innovation of PPE Companies

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Master in International Management

Supervisor:

Doctor Renato Telo de Freitas Barbosa Pereira, Professor of General Management

ISCTE-IUL

November, 2021

BUSINESS SCHOOL

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“Innovation is the central issue in economic prosperity.”

- Michael Porter

Acknowledgements

The delivery of this dissertation means a lot to me and represents a big achievement in my student and professional life. Since I finished graduation in 2012, I intended to conclude a master's degree, and this dissertation represents the ending of two years of hard work and one of my biggest efforts: studying and working at the same time during a worldwide pandemic.

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Abstract

Since the onset of the COVID-19 pandemic in March 2020, the awareness surrounding Personal Protective Equipment (PPE) has increased considerably. The term PPE has become more commonplace, as well as general knowledge about what it is and why it is used.

The sector of safety was highly influenced with shortage of supplies. Companies had to adjust their internal processes and methods to respond to the new market necessities. At the same time, PPE is being affected by innovative products and processes. Companies became more competitive with research and product development, and this brings value to the final product.

The objective of this research is to demonstrate how the employees of PPE companies got affected by the pandemic, while thinking of innovation. Also, it is aimed to analyze and confirm if COVID-19 affected the innovation processes in the companies.

After analyzing the data collected through a questionnaire in two multinational PPE companies, the results reveal the workers of PPE companies are worried about COVID-19, and this fact influenced their initiatives regarding innovation at work during last year.

Companies changed their innovation approach, and allowed the workers to get involved in more processes. The uncertainty created by COVID-19 affected the innovation departments of the companies, but in a positive way, by allowing the employees to participate and give their contribution.

Innovation must be a continuous process, especially in PPE companies, which are commercializing products that provide health and safety for workers in many different areas.

Key words: Innovation, Personal Protective Equipment, Safety, COVID-19, Pandemic, Company.

JEL Classification System Code: O3 – Innovation, Research and Development, Technological Change, Intellectual Property Rights; O20 – General.

Resumo

Desde o início da pandemia pela COVID-19 em Março de 2020, a consciencialização relativa a Equipamentos de Protecção Individual (EPIs) aumentou consideravelmente. O termo EPI tornou-se mais comum, assim como o conhecimento geral sobre o que é e por que é usado.

O sector de segurança foi altamente influenciado pela escassez de produtos. As empresas tiveram que ajustar processos e métodos internos para atender às novas necessidades do mercado. Ao mesmo tempo, o mercado dos EPIs é continuamente afectado por produtos e processos cada vez mais inovadores. As empresas tornam-se mais competitivas com pesquisa e desenvolvimento de produtos, e isso adiciona valor ao produto final.

O objectivo desta pesquisa é demonstrar como os colaboradores de empresas de EPIs foram afectados pela pandemia, relativamente à inovação. Além disso, objectiva-se analisar e confirmar se a COVID-19 afectou os processos de inovação nas empresas.

Após a análise dos dados colectados através de um questionário a duas empresas multinacionais de EPIs, os resultados revelam que os trabalhadores estão preocupados com a COVID-19, fato que influenciou as iniciativas de inovação no trabalho durante o ano passado.

As empresas mudaram a abordagem de inovação e permitiram que os trabalhadores se envolvessem mais nos processos. A incerteza gerada pela COVID-19 afectou os departamentos de inovação das empresas, mas de forma positiva, ao permitir que os colaboradores participassem e dessem o seu contributo.

A inovação deve ser um processo contínuo, principalmente nas empresas de EPIs, que comercializam produtos que proporcionam saúde e segurança aos trabalhadores.

Palavras-chave: Inovação, Equipamentos de Proteção Individual, Segurança, COVID-19, Pandemia, Empresa.

Classificação JEL: O3 - Inovação, Pesquisa e Desenvolvimento, Mudança Tecnológica, Direitos de Propriedade Intelectual; O30 – Geral.

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Glossary

PPE - Personal Protective Equipment

RQ - Research Question

WHO - World Health Organization

OSHA - Occupational Safety and Health Administration

HSE - Health, Safety & Environment

WHS - Workers' health surveillance

ISO - International Organization for Standardization

OECD - Organization for Economic Co-operation and Development

OPSI - Observatory of Public Sector of Innovation

SARS-CoV-2 - Severe Acute Respiratory Syndrome Coronavirus 2

R&D - Research and Development

Chapter 1: Introduction

1.1 Contextualization

The pandemic of COVID-19 affected people all over the world with Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and had a huge impact on society and on the supply of PPE for every country (Rendeki et al., 2020).

COVID-19 was declared as a Public Health Emergency of International Concern on the 30th of January 2020, by the World Health Organization (WHO). It was also declared a global pandemic by the 11th of March 2020. Every country was and still is being affected by the new virus and every country had to take measures in order to decrease the number of active cases and protect the population against the viral transmission (Hiscott et al., 2020). Between March 2020 and today´s date, many social distancing and quarantine measures were adopted, so that citizens could be protected.

COVID-19 affected globalization and companies were forced to readjust, in every type of business. The word "deglobalization" started to be mentioned in some discussions (McCausland, 2020), specially around PPE industry. Most of the PPE come from China, India or other Asian countries, which makes globalization one of the most important factors for the industry to be as it is today. Without globalization, probably the safety industry would be still very slow in terms of development.

After the virus started to be spread, companies were forced to innovate because of the shortage of PPE supply that affected most of the PPE companies. There was an opportunity to innovate coming from the crisis itself and some companies started to reconsider their strategy and innovative structure (McCausland, 2020).

1.2 Research Objectives:

The main objective of this dissertation is to understand the possible influence of the COVID-19 pandemic in the innovation practices of PPE companies. We aim to assess if changes occurred, and how the pandemic specifically contributed to these changes.

The research will focus on four main Research Questions:

1. Are the employees of the analyzed PPE companies negatively influenced by

COVID-19?

2. Do the companies allow the employees to get involved in innovation during the pandemic (March 2020 to January 2021)?
3. Have the employees made the effort to do what is best for the company during the pandemic (March 2020 to January 2021)?
4. The uncertainty created by COVID-19 affected the innovation departments of both companies?

These questions were formulated to analyze this problem, created and explained in the contextualization, because they answer and clarify important points of both perspectives: the company itself (management/group), and the employees that participated in the research.

First, it is important to discover if in the overall situation, the employees were or felt at some point affected by the pandemic, and if they still have their minds around this world health problem.

Secondly, the objective is to analyze and receive some feedback about the company behavior, based on the answers of these employees.

The third question analyses the perspective of the employees about their own behavior towards the company.

Finally, the last question aims to relate the three topics. It also purposes to contribute to reach the final conclusions about COVID-19 affecting the innovation and the behavior of the companies.

1.3 Dissertation Structure

This dissertation begins with the literature review, which explains the three topics chosen and also includes the world scenario during this last year. It puts together many articles written about the three topics in order to look at the overall situation they describe and go from there to the findings.

After this, the research includes the methodology, where it is explained the method used, and after that there will be the data analysis, which includes the conceptual model and the sample characterization.

To finish the dissertation, the findings are presented and discussed. Here, the Research Questions (RQ) will be answered one by one in order to reach the final conclusions. Two limitations found were also explained after the conclusions.

Chapter 2: Literature Review

2.1. Personal Protective Equipment (PPE)

Most of the workplaces nowadays have hazards that can put the workers at risk, and this can create legal problems for the companies and health problems for the workers. There are physical, chemical, and biological hazards. PPE is considered one of the alternatives to be used in order to avoid harmful situations to the workers, and to protect their health (Sawada et al., 2017).

According to the EU Directive 89/656/EEC, article 2, Personal Protective Equipment (PPE) means "all equipment designed to be worn or held by the worker to protect him against one or more hazards likely to endanger his safety and health at work, and any addition or accessory designed to meet this objective". This definition excludes ordinary working clothes that do not protect the health of the worker; equipment used by emergency; military, police and public garments and accessories; sports equipment, self-defense equipment and products used for road transport.

PPE started to be used specially by the military army, firefighters, constructions, and manufacturing workers, with the objective of avoiding accidents at the workplace. Before the Occupational Safety and Health Administration (OSHA) created the regulation, it was optional to use the PPE since there were no mandatory regulations. The first regulation was imposed in 1970. The act was implemented, at first, to protect the workers (Alaloul et al., 2020).

PPE, although they have been developing fast in the last years, are still the least effective way of protecting against hazards in the workplace. More effective ways could be to remove or replace the hazard, isolate people from the hazard and change the way people work, as we can see in Figure 1. But many times, this is not possible or an easy task (Reddy et al., 2019).

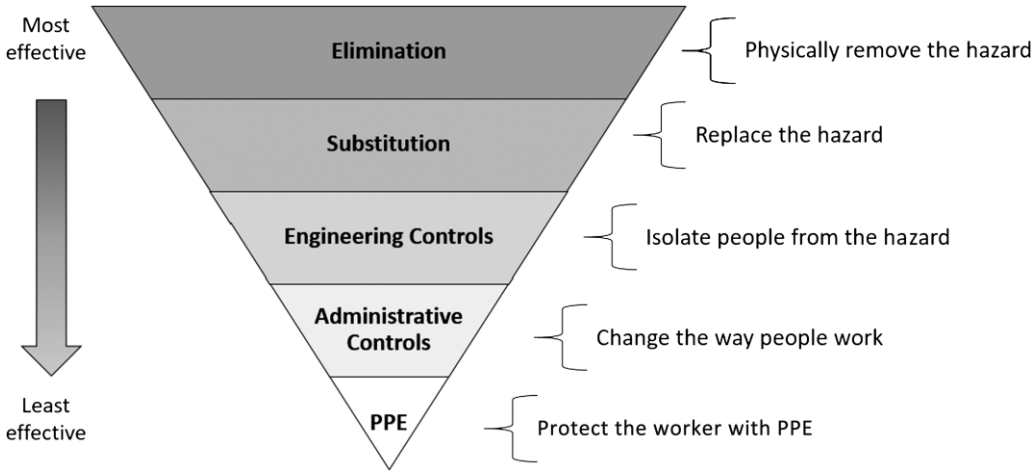


Figure 1: Hierarchy of controls for occupational hazards. (Reddy et al., 2019).

Eliminate the hazard is the most potentially effective control. While with PPE, the effectiveness depends on the correct use, which is responsibility of the workers (Reddy et al., 2019).

PPE in Europe is regulated by the European Norms. The Directive 89/656/EEC of 30 November 1989 lays down the minimum requirements for PPE used by workers and sets the obligations for employers. Regulation 2016/425/EU of 9 March 2016 contains the provisions on the design, manufacture, and marketing of PPE in Europe.

According to OSHA´s website, it is the employer's responsibility to ensure the safety and adequate health conditions for workers. PPE is never used or design to eliminate completely the hazard, but to reduce the possibility of exposure to the hazard while doing the work. PPE must be implemented if it is not possible to eliminate, substitute or control the hazard at the workplace (Occupational Safety and Health Administration, 2021). The PPE selected to use in the workplace should bear the CE marking in order to be compliant with the European Regulation and the basic health and safety requirements, according to OSHA (2021).

The regulation 2016/425/EU divides PPE into three categories according to the level of risk against which PPE is intended to protect users. Category I includes PPE that protects against minimal risks such as superficial mechanical injury or contact with hot surfaces not exceeding 50 °C. Category III includes PPE that protects against risks that may cause very serious consequences such as death or irreversible damage to health. Category II includes PPE that protects against risks other than those listed in Categories I and III.

There are industries that still need a lot of PPE solutions in order to protect the workers against the traditional methods; while others have improved so much technologically, the hazards were reduced (Sawada et al., 2017). Although, in the places where there are still risks, it is very important to develop safety awareness in order to avoid accidents or injuries to the workers. The workers should have the complete information about the possible hazards they can face in the workplace, and must be educated about the possibility of injuries, illnesses, or fatalities (Alaloul et al., 2020).

According to Dias et al., for each injury that may happen in a workplace, it is necessary to analyze the environment in which the worker was, and not only the lack of knowledge about the function performed. Most of the workplaces have mechanical and biological risks, and the worker must receive training in order to develop the tasks safely.

Each manufacturer or construction company has a system where a product is made, and not all the workers are in all the phases of production. The complexity of the process originated the use of workers in different stages. The human factor is still the most import one, and it must be protected. Over the years, the workers have realized the importance of protection of their physical and mental integrity (Dias et al., 2019).

According to the study realized by Alaloul et al., workers claimed the importance of PPE was essential to maintain health and safety. The PPE should be implemented by the management and it must be easy to use during work hours. PPE must be assigned according to the work tasks, and it must be comfortable, so it won't reduce the productivity. Additionally, the safety-offense points need to be recorded by the HSE (Health, Safety & Environment) supervisor if the workers were not using the PPE during working hours.

The European directive 89/391 was launched on 12 June 1989 to increase prevention in the workplace, by detecting and reporting the risks and possible diseases. It was implemented to encourage the European Union to increase the health surveillance for the workers (Colosio et al., 2017). Workers' health surveillance (WHS) was addressed in Article 14 of the Directive, stating "to ensure that workers receive health surveillance appropriate to the health and safety risks they incur at work, measures shall be introduced in accordance with national law and/or practices".

The measure was implemented in all 28 EU countries, which adopted it between 1994 and 2014. According to Colosio et al., 2017, all workers have access to WHS in at least 15

countries. The access is defined differently among European countries: on "exposure to specific risk factors in eight countries, enterprise size (Malta and Greece), industrial sector (Cyprus and Portugal) or vulnerability such as pregnancy or young age (Belgium and Cyprus)."

The WHS became obligation of the employer, and in most countries (21) the worker must participate, creating conditions to be safe. Anyhow, the concept in not defined equally in all European countries and it could be necessary to harmonize it in the next years (Colosio et al., 2017). The goal of the directive on implementing the WHS is to reduce the occupational diseases and work accidents and combining it with the other regulations already ongoing.

The work accidents can be responsibility of the workers when they do not use the equipment provided, or when they take risks to produce faster, against the employer's indications. Creating the right conditions and avoiding accidents is no longer seen only as the absence of legal problems, but as a promotion of a well-being environment generating factors that motivate employees. Nowadays, the workers became involved in the protection process (Dias et al., 2019). Following this idea, all employees should be aware of the importance of PPE, regardless of the hierarchy established at the work site, as good work in this direction will result in the reduction of work accidents.

According to Goal et al., 2021, in order to provide the specifically needed PPE to avoid accidents, countries need a reliable supply chain. Specially in times of crisis, like the COVID-19 pandemic, a trustworthy supply is crucial to face the challenges, specifically considering the globalization times we are living in. The dependence we have on supply increased after globalization, since countries started to outsource most of products from other countries (Goal et al., 2021).

PPE improves the workers' health and safety in many ways, but it must comply with regulations, in order to avoid the risk of work accidents. The responsibility to request PPE to the productors that can protect and can be useful to the end users belongs to the PPE companies and distributors (Akavia, 2017).

The companies distributing PPE should be aware of the product quality and evaluate not only the products, but the manufacturers as well. The quality of the product and the quality of the production process should match with the ISO (International Organization for Standardization) standards which became stricter with the evolution of this sector. Suppliers should be reliable and regulated (Smith, 2020).

The PPE market is also growing, speeded up with the COVID-19 pandemic. According to a new research report by Global Market Insights, Inc., the PPE market size is set to surpass USD 120 billion by 2027 (Ahuja, 2021).

PPE is becoming more related with technology, and it started to be Smart PPE. Like Akavia, co-founder and CEO of Seebo, mentioned, "Smart PPE saves time and improves productivity through connectivity, live updates and remote communication."

Some of the most common applications that improve safety at work are the location systems (for example in mines), smart communication systems (for example smart helmets, earmuffs with micro and radio), safer equipment (smart lockout and tagout of industrial machines, cameras, warning devices), environmental protection from invisible risks (smart protective clothing with gas, chemical, heat, UV), among others (Akavia, 2017).

Apart from technology, which became impossible to avoid, the future of PPE must include sustainability, reusability and safety. With COVID-19, the term PPE stopped being important only for the industry environment and started to matter for everyone, at a personal level. In Popescu's (2020) opinion, we should start innovating in all kinds of PPE and protection; and we shouldn't focus only on breathing protection. So far, the innovations registered during COVID-19 were mostly in masks and face shields.

Two important things that Popescu mentioned (2020) are the medical waste and the pollution, which are increasing with the use of disposable masks and materials. It is urgent to start finding solutions and more sustainable options for PPE supplies.

Society and companies should start creating a new approach to PPE use, specifically in healthcare. The approach should be based on reprocessing, collecting and redistributing the products (Popescu, 2020).

2.2. Innovation

Innovation is an essential concept for any company to create value, but many companies are still struggling with reaching their targets in this department (Lang, 2020). Innovation, according to Lang, is characterized as the aptitude of the company to change their habits, in order to create new and better ones. The change of these habits will create value for the company.

Innovation has an important role in each organization, but it should be structured in order to create benefits for the company. It can be implemented with many different tools, that can be used in creating a structured innovation department in the first place. In order to be successful, there must be a strategy about the direction the company wants to follow (Minatogawa et al., 2018).

As Barbosa & Romero (2016) said, innovation and strategy are complementary, and one helps to develop the other. In order to achieve a better performance, the ideal is to combine the two terms, with innovation being the source of value creation and the source of knowledge. Innovation is essentially based on analysis and creation as the two most important concepts around a new idea. So, to create value in a business, an innovation process is needed (Lang, 2020).

Globalization and the technology industry have challenged companies to be at their best, and to never stop following the ideal innovative idea. There is a huge competition in the market, in which it is very difficult to survive if innovation is left behind (Barbosa & Romero, 2016).

The COVID-19 pandemic created huge challenges for society, and changed the future of humanity, according to the book *Gestão no Pós-Covid-19 - Exemplos e Tendências Inspiradoras*, by Moutinho (2021), humankind will benefit from more innovative companies, since businesses have faced challenges that made them innovate and go beyond their capacities. In this new phase, digitalization, social networks, and sustainable innovation became very important tools.

Many companies had to start adjusting themselves and create new initiatives. Companies which practice innovation and sustainability nowadays, are the ones that will be ready to face the challenges and crisis like a world pandemic, as Luis d'Eça Pinto, managing director of *Via Verde*, stated.

Another interesting idea came from Verbeke & Yuan (2020), as they wrote that companies that are dispersed geographically intend to be more exposed to new opportunities and product innovations. COVID-19 had a huge impact on international business strategies and by innovating, the pandemic could be seen as an opportunity to design a smarter strategy.

According to Moutinho (2021), innovation nowadays must come together not only with strategy, but with sustainability as well. The world cannot risk starting innovating, and suddenly lose all the progress made in the last years in order to reduce the climate change. We cannot go carelessly into innovation, without thinking about every other aspect. This could cause more damage than COVID-19, in the next years. The ideal scenario is to create a more innovative society that is also more sustainable (Moutinho, 2021).

Following Moutinho´s theory (2021), innovation must be based on sustainable principles, consisting in social, environmental, and cultural motivations, apart from the economical ones. It is important to save the business, but in a way that doesn't compromise future generations. Giving priority to sustainable ideas is seen as a value creator for companies. Although, the benefits are not tangible or seen as economic growth and most of the times, they only influence the reputation or brand image.

Innovation should be based on sustainable methods, due to the finite resources available. With the pandemic, the use of plastics in respirator masks, PPE and medical devices became higher and we cannot bear to increase unsustainable behavior (Din et al., 2021). According to Din et al. (2021), 85% of the medical waste is not recycled. The solution is to use reusable PPE.

The most impacted areas by this innovation improvement are the production and manufacturing of new products, the packaging industry, the factory processes, and the distribution (Moutinho, 2021). PPE business can be included in all these stages of the supply chain.

As Sawada et al (2017) said, many types of PPE have been created and developed by manufacturers and PPE is a business which needs to be constantly evolving and innovating, in order to respond to the new threats that appear every day. It is necessary to create a breakthrough that could derive from the innovation of the companies which are the manufacturers, the distributors, and the final users.

With the progress in developing many fabrics and technical materials, innovation has been essential in creating the best PPEs to be used in different situations demanded by the market.

The market of PPE is very promising, but companies need to stay focused on the innovation processes (Sawada et al., 2017).

The use of PPE should be improved, protocols must be reviewed and created, and practices must be implemented. Also, workers can benefit from improvements in PPE design. PPE plays an important role in preventing work accidents, future diseases and transmissions; and the companies should explore and implement improvements in the design of PPE, through innovation and research (Reddy et al., 2019).

Following up on this idea of Reddy et al. (2019), by improving stablished protocols, companies are contributing for the education and training of workers and are creating the ideal environment to use the PPE correctly. On the other side, by improving PPE design, it is expected that the products will be more effective and will provide a better protection for workers at risk. This will also contribute for an improvement of performance. It is also needed to improve research about the risks a worker can have, so the innovation and R&D departments can focus on the missing protection points (Reddy et al., 2019).

According to Reddy et al. (2019), when Ebola crisis happened, there was significantly improving in the PPE area for health care workers. PPE companies were forced to innovate and create better PPE, in order to face the disease. The same thing is happening during COVID-19 pandemic.

According to the new research of Zimmerling & Chen (2021), most of the innovations created by the pandemic will have a long-term impact on society. With more technology, companies created a more flexible and advanced manufacturing process, which originated more adaptable and resistant products. COVID-19 pandemic is being responsible to pressure society towards innovation. COVID-19 was a “driving force of innovation throughout society”, as Zimmerling & Chen said (2021).

PPE was one of the areas that reacted more to the pandemic pressure and some organizations had to innovate their producing methods for PPE, creating new ones. Other companies focused on improving the existing methods, in order to respond to market demands (Zimmerling & Chen, 2021).

During COVID-19, the development of PPE that was used to face the pandemic and transmission suffered a rapid development. New solutions came to the market (Din et al.,

2021), as for example the NK95 masks, 3D printing PPE, shoe covers, gowns, skull caps, disposable gloves, CleanSpace Respirators (which makes the air breathable), transparent masks to allow to see the face, among many others.

After creating the innovations, companies must invest in communication and dissemination. Both are very important and contribute to develop the innovation. Nowadays, with social network, it is essential to spread the communication in the social platform to gather people and rise interest about the product (Din et al., 2021).

Zimmerling and Chen (2021) concluded that by changing the innovation and research methods, it is possible to overcome the limitations on the supply chain and those caused by scarce resources. COVID-19 pandemic brought many innovation initiatives and companies had to adapt to new realities. There was an increase in research, innovation and implementation of new techniques and strategies.

To gain competitive advantage and be more productive, companies create innovation strategies. To make the most of these strategies, innovation management became a needed process. Innovation is the promoter of the economic growth and competitiveness of each company. Managing the innovation helps in its formalization and helps the workers to create new ideas easily and in a more systematic way. It creates an effective implementation of innovation department and processes (Melendez, Dávila & Melgar, 2019).

According to Ramalingam & Prabhu (2020), innovation became essential to start overcoming the COVID-19 pandemic. Innovation, since COVID-19 started, had mobilized more resources and moved more money than any other pandemic. The urgency caused by the pandemic had accelerated the innovation approaches and decisions were made faster than normal.

OECD (Organization for Economic Co-operation and Development) identified innovation types can be related with COVID-19 to see what the biggest innovations during the pandemic were. According to OPSI (OECD Observatory of Public Sector of Innovation), there are 4 types of possible innovations: Mission-driven innovation, Enhancement-oriented improvements, Adaptive innovations and Anticipatory efforts.

Relating these with COVID-19, the mission-driven innovation can be the development of the COVID-19 vaccine, and related arrangements. The enhancement-oriented improvements are the efforts taken to quarantine and stop contamination through the spread of the virus. The

adaptive innovations originated in places where there were scarce products, so people had to adapt and generate new ideas. Finally, the anticipatory efforts are the decisions made (for example by governments) to organize the post-pandemic world, and to try to minimize as much as possible the consequences of the pandemic (Ramalingam & Prabhu, 2020).

Concluding this topic with an idea of Ebersberger & Kuckertz, (2021), innovation is considered an answer to a major crisis. If we can innovate in testing procedures, equipment and vaccines, we can overcome the crisis and improve the financial market as well. Innovation helps a company to survive and recover from a crisis but most of the times there is a fear of it and companies tend to cut down on innovation. COVID-19 may have introduced an innovation landscape in society and proof that a crisis can give opportunity to create new approaches in the markets (Ebersberger & Kuckertz, 2021).

2.3. COVID-19

According to the WHO, as of 20th November 2021, there have been 255.324.963 confirmed cases of COVID-19, including 5.127.696 deaths, all over the world. America, Europe, and Asia are the most affected continents (WHO, Coronavirus Dashboard, 2021). Some countries are already entering in the fifth stage of this worldwide health crisis.

COVID-19 affected the world and changed it in many ways, even in our smaller and less important activities. We had to adapt and so did the companies. Businesses reshaped in order to avoid the risk associated with the pandemic (McCausland, 2020).

With the beginning of COVID-19, some events started to be recommended, like safety meetings and training, in order to create awareness in the workplaces. The new measures, for example limiting the attendance, and always implementing the 2 meters social distance, made work more complicated in factories and production sites. Most of the places where PPE is needed, require work and involvement on-site to perform the work activities (Alaloul et al., 2020).

According to Reddy et al., (2019), with the reality of COVID-19, the healthcare workers became one of the most important users of PPE, and it is very important that the PPE is prepared for the risk's healthcare workers take. Protecting them, is also protecting the healthcare patients.

As Rendeki et al. (2020) stated, before the vaccine, there was no treatment available for COVID-19, so the prevention of the transmission became extremely important. Two of the most important measure to assure are the social distance and the proper use of PPE. This had a huge impact in the PPE industry.

COVID-19 affected the supply of PPE, and some changes are short-term, others are transformative to the future, according to Bhaskar (2021). Short-term changes are the ones that try to answer the current pandemic crisis in an immediate way and give answers: shift production spots to answer the PPE demands or easing the controls on PPE while importing. The long-term and transformative changes were sped up by COVID-19 as well: stocks of critical PPE will increase in case another pandemic starts, change in the distribution strategy, growth of PPE companies, growth of manufacturing companies not only in Asia, but all over the world (Bhaskar, 2021).

2.4. World Scenario 2020 - 2021

With the COVID-19, most of the countries have experienced difficulties in preparing for the emergency and for facing the needs, especially in health care environment. After January 2020, the global shortage of personal protective equipment started to affect most countries and contributed to the rise in cases of people infected with the virus (Sterman et al., 2021). In some cases, such as in Peru, improvised PPE was used, which originated more cases, more infections and more deaths.

According to Sterman et al. (2021), during the pandemic, most of the PPE available were not the ideal for prolonged use which caused problems such as headaches and vision issues. Apart from this, PPE were causing skin irritation as well as hair pulling and increased temperature sensation, which reduced the effectiveness of the PPE.

As the crisis of shortage of material supply started, many industries were forced to stop. Nicola et al. (2021) stated the restrictions implied the reduction of the mobility, causing many industries to shut down and a huge jobs loss. In addition, Harari (2020) also expressed that COVID-19 pandemic is the biggest crisis of the generation and it may take years to recover.

But it´s necessary to explain a little before COVID-19, to understand what happened during last year. In the PPE area, the production has always been cheaper in China and eastern countries. According to Jane Feinmann (2020), in 1990 the world registered a huge growth of container shipping, which reduced the costs dramatically specially in some routes, like from Asia to Europe. Taking advantage of this, China also created a huge trade infrastructure to be able to respond to the European needs. The richest countries could get their income to increase by purchasing at lower cost from countries like China, and with this, achieve greater efficiency in the PPE companies. With outsourcing, countries like China increased their exports, and European and American countries could increase profits by purchasing at lower value. As Fainmann refers in the article (2020), PPE world stock was made in China, at a lower cost.

With COVID-19 appearing in China, right in the middle of the manufacturing of most of the PPE products of the world, we went through a supply crisis that affected most of the countries. PPE started to be needed and purchased in huge quantities, especially to protect the healthcare professionals (Feinmann, 2020). According to the New York Times, on the last day of January, China imported 20 million masks in just 24 hours.

In the beginning of the COVID-19 pandemic, China companies started to contact PPE distributors outside China, which was an indicator that something was wrong, being China the biggest distributor in the world. Many companies outside of this industry shifted resources and started making disposable PPE products like masks (Smith, 2020).

China was the first country to be affected and has seen its supply chain system totally disrupted (Goal et al., 2021).

According to Wilson (2020), supply chain disruptions are most of the times noted geographically. For example, when Australia suffered with the fires and the United States with the hurricanes, the disruptions happened only in these countries and neighbor ones.

With COVID-19, the disruption had a bigger impact and affected the entire world. COVID-19 ended up by proving that the world is totally connected and what happened in one country can affect people who live miles away. China affected other countries when the production and supply of PPE stopped. Countries had to wait for the products or had to start their own production internally (Wilson, 2020).

When COVID-19 was officially declared in Europe, the World Health Organization advised (2020) that "9 million medical masks, 76 million examination gloves, and 1.6 million pairs of goggles would be required worldwide for the COVID-19 response each month, with a dire shortage putting healthcare workers at risk."

Most of the products that became scarce are the disposable ones and companies like 3M, Ansell, DuPont, Honeywell Safety Products, Kimberly-Clarke Corporation, Lakeland, Moldex, among others, had to try with all their suppliers to be able to continue the distribution (Bhaskar, 2021).

Most of the governments had to get involved and distribute the PPE by itself, creating new rules and legislations to be applied in the private sector (Goal et al., 2021).

Some countries rushed to buy millions of PPE and some stopped the exports to other countries. Most of the country's stocks were not prepared for this usage created by the pandemic, according to Feinmann (2020)

Countries had to evolve governments and take measure never seen before. For example, in March 2020, Salvador Illa, Spanish Health Minister, announced that Spain "signed a contract

with China worth 432 million euros to purchase 550 million masks, 5.5 million rapid test kits, 950 respirators and 11 million pairs of gloves".

The World Health Organization shipped almost 2 million protective gear items to 74 countries by 27th March 2020, as announced Tedros Adhanom Ghebreyesusthe (WHO´s General Director).

After 20 years of importing from China, taking advantage of the globalization, the high-income countries lost the experience and the infrastructures to produce and export PPE by themselves (Feinmann, 2020).

The virus had, thus far, many negative consequences for individuals and corporations. Every type of business got affected, and it is still difficult to estimate the long-term economic outcomes. The historical data suggests that every business will be less interested in investing and more interested in saving the capital and value created previously. The consequence of this is the reduction of the economic growth (Donthu & Gustafsson, 2020).

COVID-19 has made companies shut down and has made many people stay home and work from there, for months at a time. Thousands of people have lost their jobs. This pandemic has disrupted international networks essential to the innovation processes of many businesses (Zahra, 2021).

According to Donthu and Gustafsson (2020), the businesses that could stay opened are facing many challenges related with health and safety, supply chain, workforce, cash flow, sales, consumer demand and marketing. Caused by this, businesses tend to become more conservative and protective, and companies tend to save their resources; in case it happens again. Managers started giving priority to local production and want to avoid a big scale supply chain. Companies want to become less globalized, in order to avoid the risks taken in the past.

For an international business which is outsourcing, it could be good or bad to reallocate business "at home" during the crises. The international supply chain was affected and the companies that moved their manufacturing outside to take benefits from the competitive prices had problems with scarce products and limited resources (McCausland, 2020).

Although, there are also considerable costs associated with leaving countries like China and relocating in the home country. For example, companies had to search for infrastructure and

purchase places, machines and hire more people. Considering that companies could have decided to move completely, the supply chain even "has held up well" (McCausland, 2020).

As McCausland (2020) said in his article, to find the "most cost-effective suppliers", some PPE companies went through the pandemic's first months without a defined plan regarding where to purchase their products. Some companies had to find solutions and reshape the business model.

However, companies did not stop innovating, and the pandemic forced businesses to increase their innovation processes, in order to maintain their relationship with their customers, stated Zahra (2021). Some businesses have reevaluated their supply chain, operations, products, but in general, most businesses relied on innovation during these difficult times, in order to stay in the market with a competitive advantage (Zahra, 2021).

There were companies that completely shifted their production focus and took advantage of the factories and infrastructures to produce what the market was requesting. COVID-19 will probably change the innovation concept worldwide, as a way of creating new solutions to the existing problems (Zahra, 2021).

According to Smith (2020), before this pandemic, there was no need for a high-level product evaluation. Although, with the need to use PPE to protect at a personal level, it became important to create effective products and to work with evaluated suppliers, who follow the rules when manufacturing.

Supply chain disruption can affect and impact most of the industries, since production depends on that (Wilson, 2020).

With all the effects COVID-19 had in only a few months and considering we are living in a world which has 7.8 billion people, individuals and corporations need to be prepared to deal with infectious diseases. The focus must be coordinated between all departments of the governments, so that people's health and the economic growth won't be affected significantly (Tabish, 2020).

After COVID-19, once the pandemic is controlled, the structure of the economy and the society changes, new concepts will emerge, and the lives of companies will also change, by creating new habits (Tabish, 2020).

Chapter 3: Methodology

The research method used was hypothetical deductive. The intention was to analyze three topics which are: innovation, the pandemic of COVID-19, and, more specifically, the work environment in two PPE companies regarding innovation.

There was a formulation of four research questions (RQ) in a way that all can be falsifiable, using the observable data collected during the research. The research will use non-numerical data. It will be predictive research, where the speculation will be on how COVID-19 affected the two PPE companies analyzed and how it affected the workers activities and behaviors.

The companies are from Portugal and Spain; and are in the PPE business, both as part of a multinational group.

The sample tested will be non-random sampling with a convenience and intentional purpose, designed to offer information on the insight's behaviors of each company, and to show possible conclusions taken from those behaviors.

The aim of using the questionnaire was to explore the relation between both situations, assessing if and how COVID-19 has affected workers, which could impact or not the innovation processes and procedures.

The questionnaire was answered anonymously, and it was administered in the two countries. By using this questionnaire, the aim is to have representative data about each company, and not to identify the individual data of the participants.

The questionnaire was sent by email to the Human Resources department of each company, which shared it among the workers.

The Portuguese company (Company A) is Sintimex, a distribution company in the area of PPE. Sintimex has around 70 workers in Portugal, and it is located in Lisbon. It started its business in 1960 as the first PPE distributor in the country. It is specialized in the distribution of PPE. Its mission was to change the employer mentality in Portugal and provide the means to protect the lives of Portuguese workers. Today it is market leader in Portugal (*Sintimex - A sua loja online de proteção*, 2021).

The questionnaire was sent to Sintimex on the 3rd of December 2020, and it was active until

the 3rd of January. In total, 61 responses were submitted which will be part of this analysis.

Bunzl Safety is the Company B, which is an English group specialized in the management and distribution of non-food products. Bunzl has three companies in the PPE business in Spain: Juba, Marca Protección Laboral and Faru. These three companies have around 300 employees shared between them and were the companies to whom the questionnaire was sent. Bunzl has, in total, eight companies in Spain, but only these three are in the PPE business so these were the ones chosen to participate in the research and data collection. The other companies of the group are related with products such as chemicals, cellulose, disposable kitchenware, welcome products, bags, utensils and cleaning machinery.

Juba was originally founded as a manufacturing company of leather seat covers. It began making industrial gloves in 1950. Its location is in La Rioja, and it is market leader in Spain (*JUBA PPE - Luvas e roupas de trabalho para sua proteção*, 2021).

Marca Protección Laboral started its business in Cartagena, in 1966, as a manufacturer of work clothing to supply the industry on the South of Spain. It increased its catalogue by adding different type of PPE, providing nowadays a completed protection for the workers. (*Marca Protección Laboral*, 2021).

Faru is located in Zaragoza, and it has also more than 50 years of experience in this sector. It has the biggest PPE catalogue in the area since 2017 (*Faru - Seguridad, protección e hygiene,* 2021).

The questionnaire was sent to Bunzl on the 21st of December 2020, and it was active until the 22nd of January. In total, 109 responses were submitted, and it will be part of this analysis.

A qualitative questionnaire was used as the form of data collection. With the questionnaire sent to the companies, the objective was to take conclusions about the behaviors of the workers, and to know if that behavior was affected by COVID-19. On the other hand, it was interesting to learn more about the approach of the companies regarding innovation.

Chapter 4: Data Analysis

This chapter of data analysis has the objective to structure the data collected on this topic and to characterize the sample. The analysis was done with the support of Excel after carrying out the questionnaires in both companies.

4.1. Conceptual Model and Research Hypotheses

After analyzing the literature review and the articles that were linked to the three topics considered, this dissertation aims to relate the conceptual framework with a few questions, explored and analyzed on the findings.

The questions addressed in this research intent to relate how the pandemic of COVID-19 affected the workers of two PPE companies. Apart from this, the population was observed in order to understand if the pandemic influenced the innovation departments and approaches of the companies, during the time of the questionnaire.

The objective is to use the data from two companies to reach general conclusions under this professional area of the PPE companies.

Based on the above, the testable hypotheses are the following:

Research Hypotheses:

1. Are the employees of the analyzed PPE companies negatively influenced by COVID-19?
2. Do the companies allow the employees to get involved in innovation during the pandemic (March 2020 to January 2021)?
3. Have the employees made the effort to do what is best for the company during the pandemic (March 2020 to January 2021)?
4. The uncertainty created by COVID-19 affected the innovation departments of both companies?

With the four research questions, the purpose is to relate the data collected with a few conclusions, answering the questions created during the research work. The findings will be informative, and the objective is to use two examples in the area of PPE, to create more

generalized conclusions about the overall situation created by COVID-19. The structure of the rest of the paper includes the data analysis, the results, the conclusions and the limitations.

A method of descriptive statistics was used to analyze and summarize the data collected because it provides simple summaries about the sample and the observations that were made.

In the data analysis, there are a few statistic techniques such as descriptive graphs (various types of graphs are used to summarize the data); and parametric description, in which the values of certain parameters that are estimated are assumed as complementary in the description of the data set (for example: the average and the percentage according to the total of answers submitted).

4.2.Sample Characterization

The sample characterization is very important and it should be analyzed before getting to the conclusions regarding the responses obtained. The sample can influence the conclusions taken from the questionnaires. The focus of this research was on two multinational companies, one based in Portugal and other in Spain.

Both companies are market leaders in the PPE sector. Sintimex is a distributor and Bunzl is a manufacturer. In total, 170 responses were collected among the two companies and are going to be analyzed to take a few conclusions, and to answer the research questions.

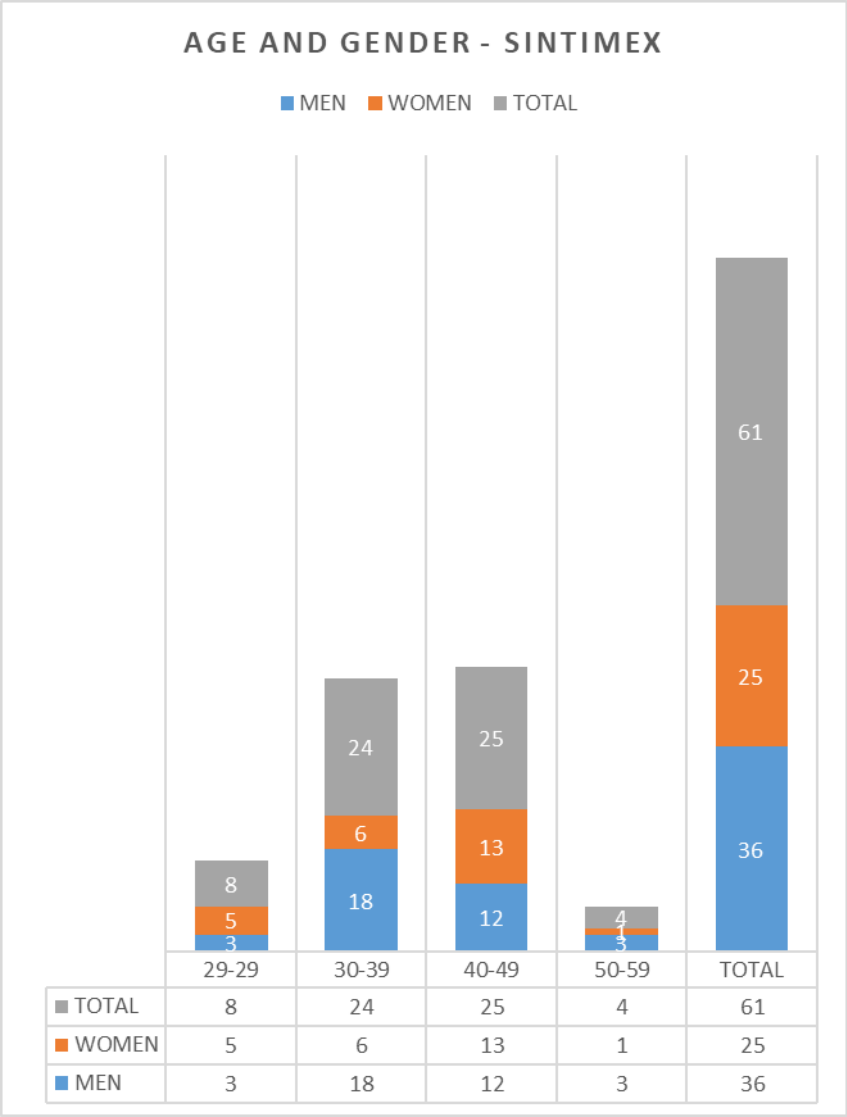
The sample for this research is structured under five aspects: age and gender, academic qualification, role in the company (by departments) and time in the company and in the present position. Also, a last aspect was added which discriminates and analyses the three companies in Bunzl Group individually.

a) Age and Gender

The age aspect was included in the questionnaire with four options: between 20 and 29 years old, between 30 and 39 years old, between 40 and 49 years old, and between 50 and 59 years old. The gender had two options: female or male.

In Sintimex, 61 responses were submitted. The replies included 25 women and 36 men. From these 61, 8 people have between 20 and 29 years. Between 30 and 39, 24 people submitted their replies. The biggest group is between 40 and 49 years old, which registered 25 replies.

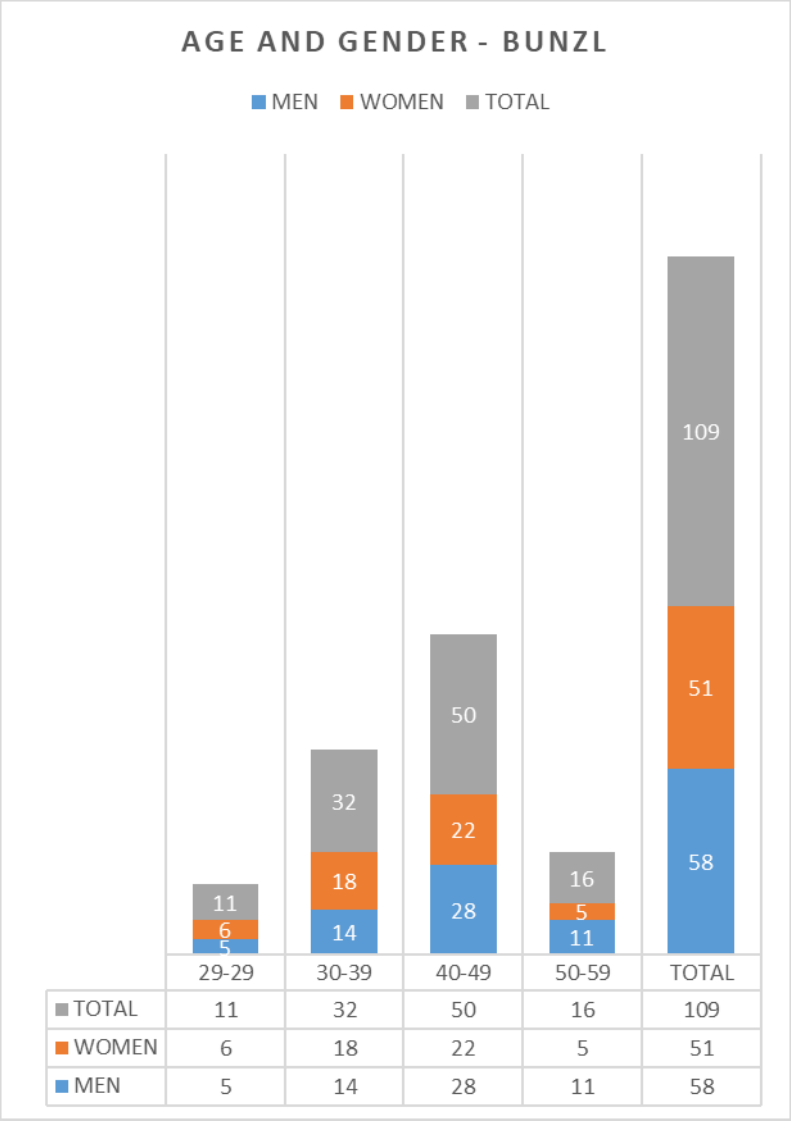
Only four people are between the age of 50 to 59 years old. There are five women with 20-29 years old, and 3 men. Between 30-39, there are 6 women and 18 men. Within the range of 40-49, there are 13 women and 12 men. With the age of 50-59 there are 3 man and 1 woman. The summary of these results can be observed in Graph 1.



	29-29	30-39	40-49	50-59	TOTAL
TOTAL	8	24	25	4	61
WOMEN	5	6	13	1	25
MEN	3	18	12	3	36

Graph 1: Age and Gender - Sintimex

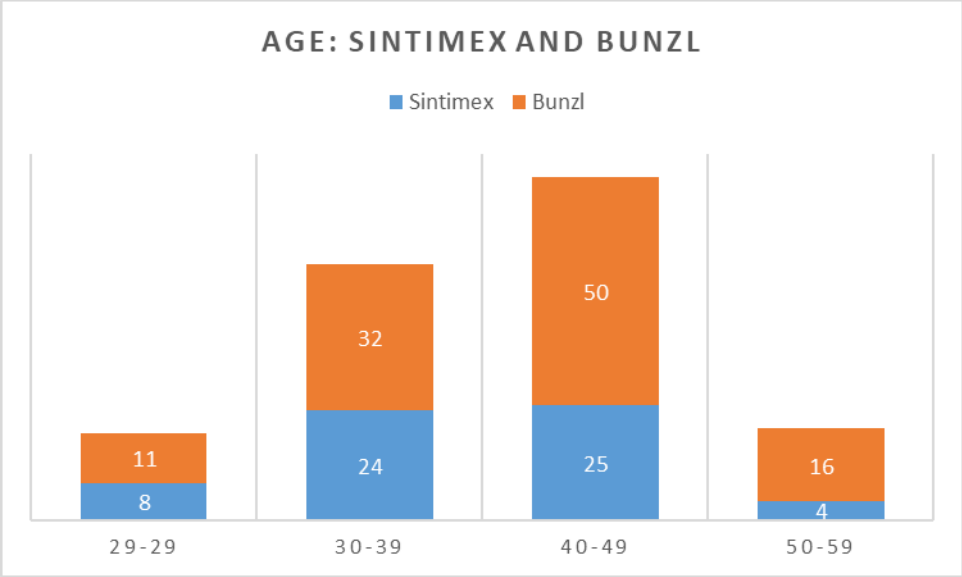
In Bunzl, as can be observed in Graph 2, from 109 responses in total, 11 are between 20 and 29 years old. Five of these are women and 6 are men. 32 people are between 30 and 39 years old, which includes 18 women and 14 men. From 40 to 49 years old, we have 28 men and 22 women, which are 50 in total. Finally, 16 people are between 50 to 59 years old. From these, 5 are women and 11 are men.



	29-29	30-39	40-49	50-59	TOTAL
TOTAL	11	32	50	16	109
WOMEN	6	18	22	5	51
MEN	5	14	28	11	58

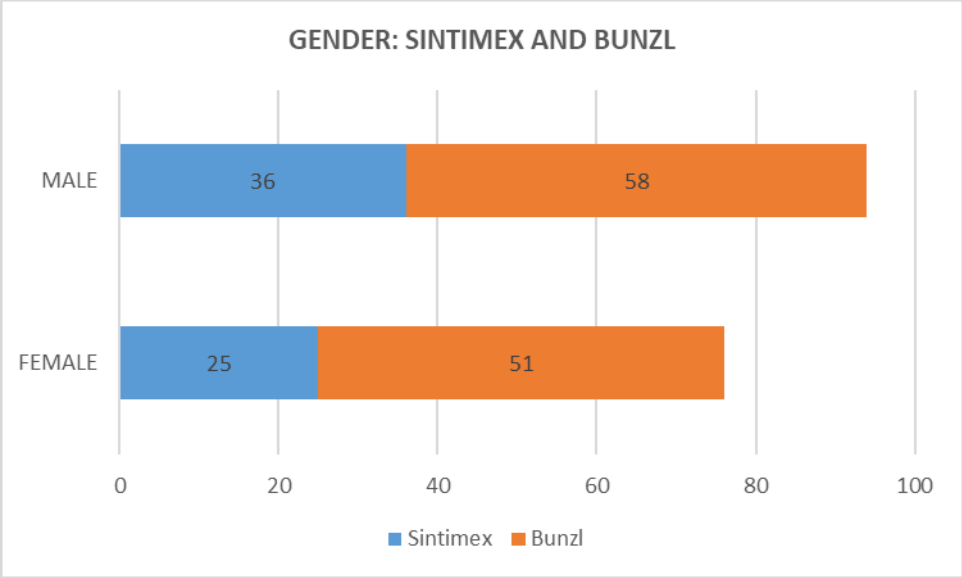
Graph 2: Age and Gender - Bunzl

In summary, as can be seen in Graph 3, with 29-39 years old, 8 people participated from Sintimex, and 11 from Bunzl; with 30-39, 24 from Sintimex and 32 from Bunzl; with 40-49, 25 from Sintimex and 50 from Bunzl; and with 50-59 years old, 4 people from Sintimex and 16 participated from Bunzl.



Graph 3: Age Sintimex and Bunzl

Regarding the gender of the participations in both companies (Graph 4), Sintimex registered 36 males and 25 females; while Bunzl registered 58 males and 51 females.



Graph 4: Gender - Sintimex and Bunzl

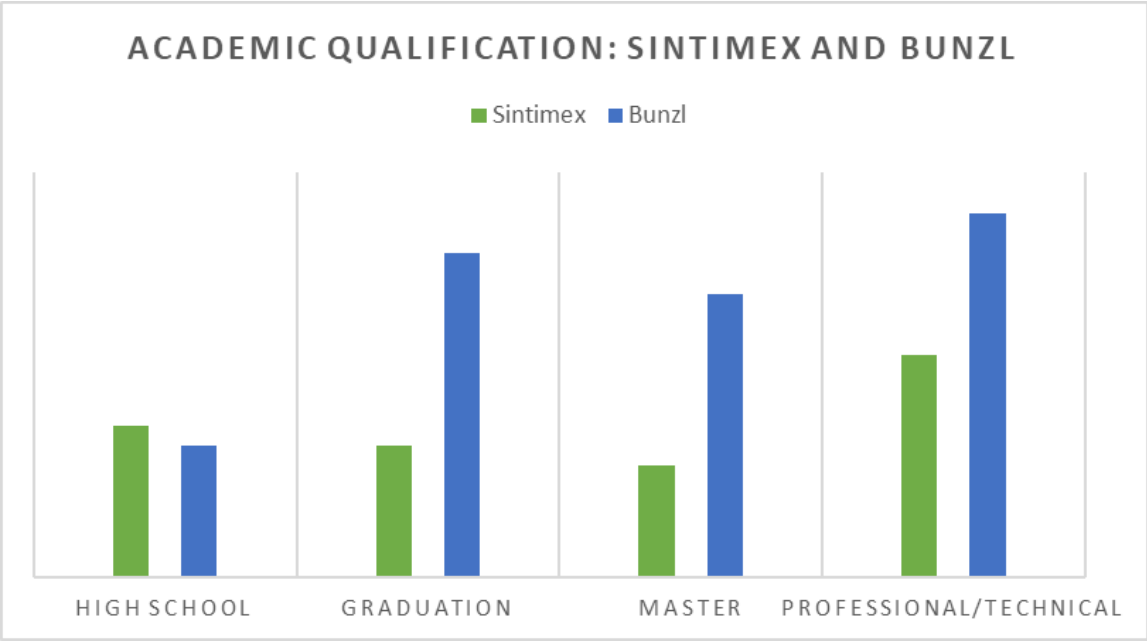
b) Academic qualification

Regarding the academic qualification in this questionnaire, were included four stages: high school qualification, graduation, master, and professional or technical qualification.

In Sintimex, 15 people completed high school, while in Bunzl 15 people completed the same level of academic qualification. 13 people in Sintimex have a graduated degree, and 11 have completed or are enrolled in their master.

In Bunzl, 32 people have completed their graduation, and 28 have a master degree. Lastly, 22 people in Sintimex have technical or professional qualification; while in Bunzl 36 people have concluded this type of education.

The academic qualification registered in both companies is summarized in Graph 5.



Graph 5: Ademic Qualification - Sintimex and Bunzl

c) Role in the company – by departments

In the questionnaire, five different departments were included for each company:

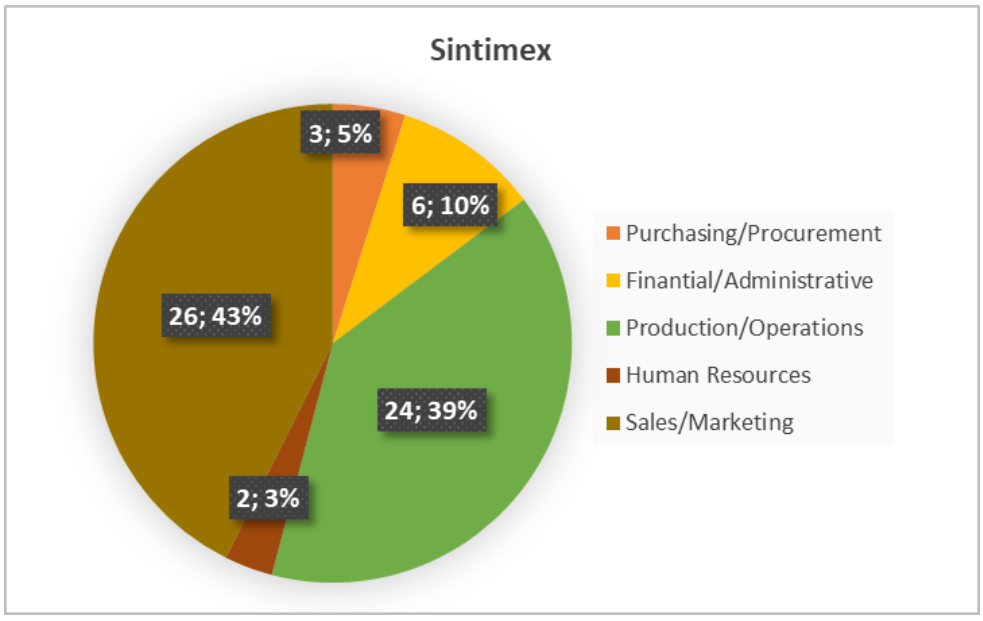
- Purchasing and Procurement;
- Financial and Administrative;
- Production and Operations;
- Human Resources;
- Sales and Marketing;
- Quality and Product Development;

The objective of including these six areas was to be able to divide the company in six sectors only, and be able to understand with the results if the replies were connected to a single one or many departments.

The different departments included were chosen in order to evaluate this type of companies in the PPE market. In other markets or industries, other departments will be also important to the construction of the conclusions. For the two companies that were included in this research, these are the biggest divisions of the whole team.

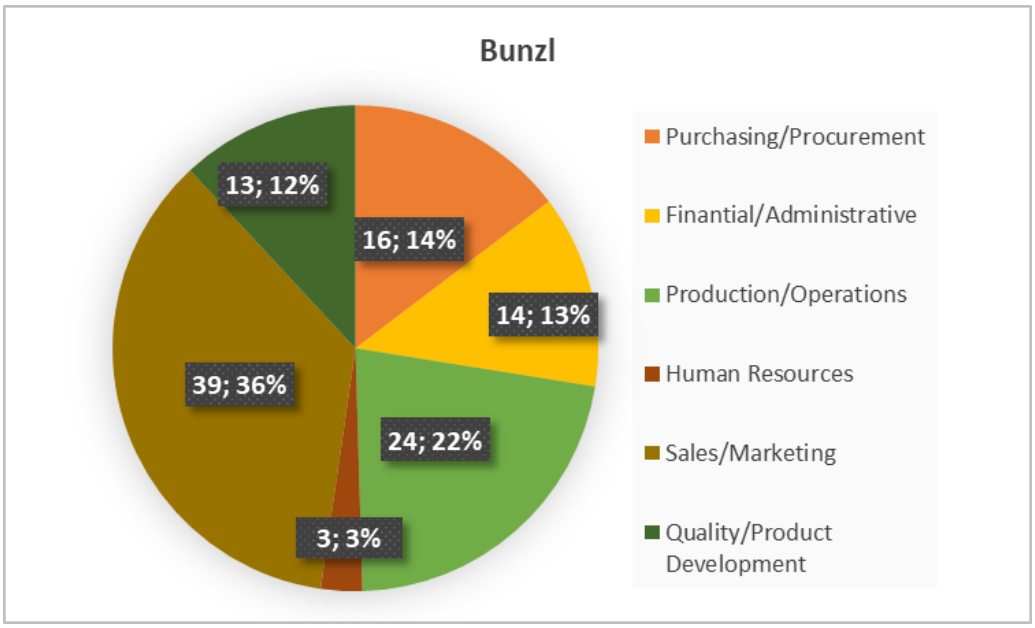
It is also important to refer that Sintimex does not have a quality and product development department because the company only distributes and sells brands from suppliers and manufacturers; while Bunzl, as a manufacturer, needs to be in control of their product characteristics. For this reason, Sintimex has zero employees in this department.

In Sintimex, as it is summarized in Graph 6, there are 3 employees in the purchasing and procurement department, 6 employees in finance and administration, 24 in operations, 2 employees in Human Resources and 26 in sales and marketing. Sales is the biggest department in the company, with the biggest number of employees (26,4%).



Graph 6: Participants by Departments in Sintimex

In Bunzl (Graph 7), which includes three companies, 16 employees in purchasing and procurement replied to this questionnaire, also 14 employees from the finance department and administration, 24 people from operations and production, 3 from human resources, and 39 from sales and marketing. Bunzl has also 13 employees in the quality and product development department. Also here, the biggest department is sales, with the biggest number of participants in this questionnaire.



Graph 7: Participants by Departments in Bunzl

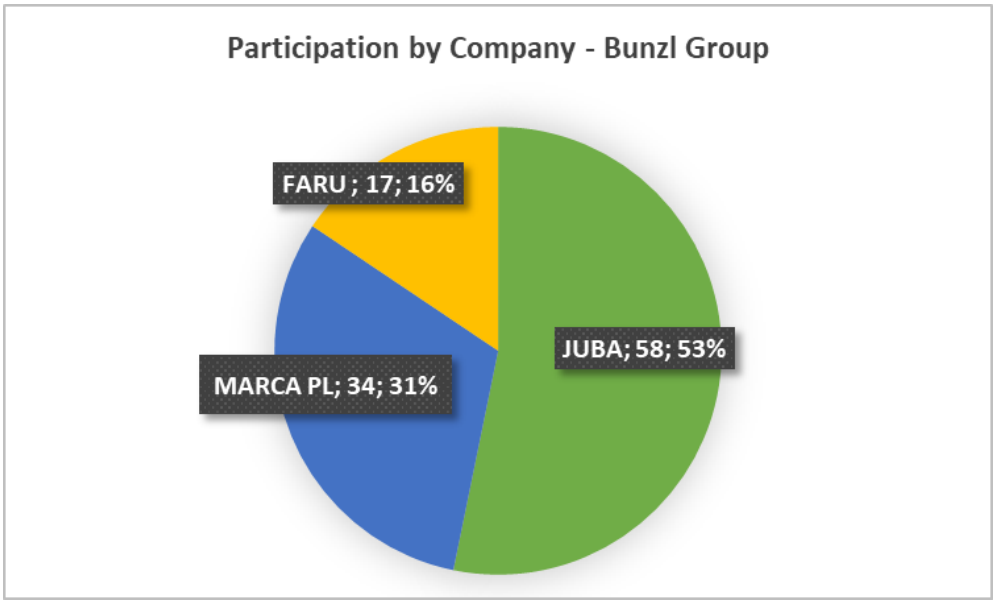
d) Companies in Bunzl Group

Bunzl Group is a multinational company present in 32 countries, with more than 16000 employees. In this research, Bunzl Group in Spain was invited to participate. The group in Spain includes seven companies in different sectors: cleaning and hygiene, disposables for food industry, industrial packaging, health and safety.

The questionnaire was sent to three companies of the group, which are the companies in the safety sector, related with worker's protection and PPE.

The companies are JUBA, MARCA PL and FARU. It was included in the questionnaire for the workers to specify the company where they are included.

As we can see in Graph 8, out of 109 answers received, 58 are employees are from JUBA, 34 are from MARCA PL and 17 are from FARU, which revels the real size of each company, being JUBA the oldest and biggest company of the group, and FARU the most recent one.



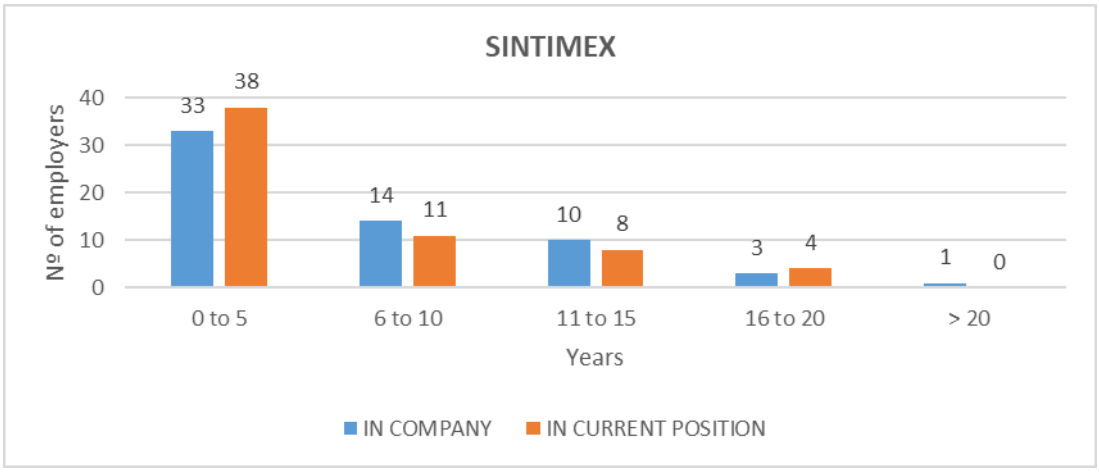
Graph 8: Participants in the Research - Bunzl Group

e) Time in the company and in the present position

Sintimex and Bunzl have been in the market for more 60 years. In this research, it was also analysed for how long the participants were in the company and for how long they were in their current position.

In Sintimex, as it is summarized in Graph 9, we have 33 employees with less tan 5 years of work, 14 employees between 6 and 10 years, 10 employees with more than 11 but less than 16, three employees within 16 and 20 years, and one person with more than 20 years working for Sintimex.

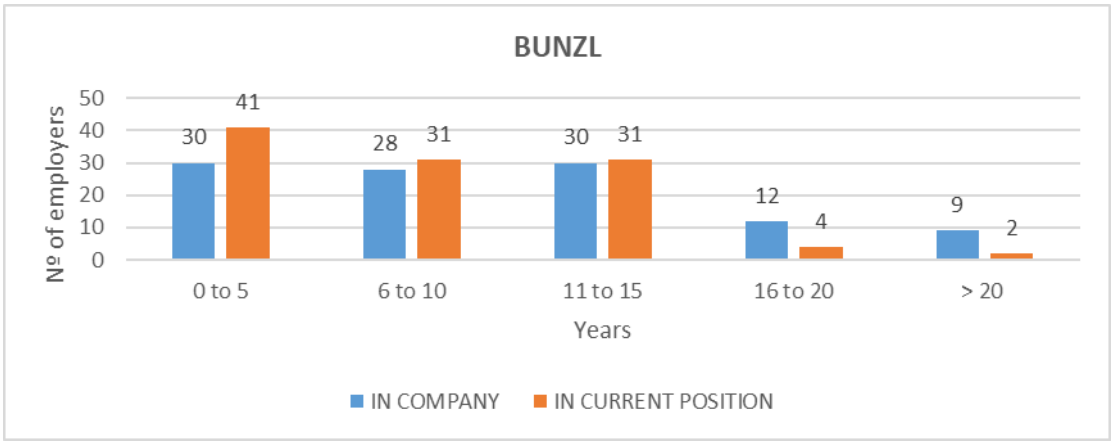
From these employees, 38 people have less than 5 five years in the same position, eleven people are between 6 and 10 years, eight are working between 11 to 15 years in the same position and only four are within 16 to 20 years with the same tasks.



Graph 9: Time in Company - Sintimex

In Bunzl Group (Graph 10), 30 employees have 0 to 5 years in the company, 28 employees have been working for more than 5 and less than 11, 30 employees are in Bunzl for more than 11 years and 12 employees are working for more than 16 years in Bunzl. Nine people have more than 20 years of experience in the company.

Regarding the positions, 41 people have started the current position in the last 5 years, 31 employees have between 6 to 10 years and between 11 to 15 years of work, four employees have more than 16 years in the same position and only 2 people have more than 20 years.



Graph 10: Time in Company – Bunzl

Chapter 5: Discussions and findings

After analyzing the sampling that participated in this research, the results will be discussed in order to answer the research questions established in the beginning of this dissertation. The results will be related to the literature studied during the time of this research.

The objective of the research questions is to discover new findings about the effects of COVID-19 and to understand how this pandemic affected the daily life of companies in the PPE industry.

Starting with the first research question, "Are the employees of the analyzed PPE companies negatively influenced by COVID-19?", we can conclude that COVID-19 affected every department of both companies, and most of the workers felt negatively influenced by this pandemic while doing their jobs.

In Sintimex, 63,9% of the workers that participated in the questionnaire pointed they have difficulty keeping the threat of COVID-19 out of their minds, while in Bunzl 72,4% said the same. According to new research "this pandemic has change personal interaction and made working from home become a new normal. People need to focus on their health and do physical distancing by staying at home" (Nediari et al., 2021). The COVID-19 pandemic has affected human behavior in many ways and it brings changes to many aspects of life.

We can conclude as well that 67,6% of the 170 workers in both companies admitted that the threat of COVID-19 enters their minds very often. 59,4% feel frequently preoccupied thinking about COVID-19. The virus entered in our homes every day since march 2020, with the media, friends, family and colleagues, and it was one of the hot topics to talk about for the last two years in every country of the world.

We can see from other replies that most of the participants believe there is little they can do to protect themselves against COVID-19, even with all the safety measures applied in both countries. In Bunzl, 47,7% of the workers believe they cannot do much to protect themselves from the virus. Also, 52,5% of the participants in Sintimex believe COVID-19 will get worse as time passes, while in Bunzl this result represents 64,2%.

56% of the participants in Bunzl believe the future is dark regarding the pandemic, while in Sintimex the workers seem to be a little bit more positive, even if 41% still believes the next

years will not be easy.

According to The World Happiness Report (2021), we all have changed our way of working and living as a consequence of this pandemic, and the virus had a huge consequence on the economic activity, employment and our habits of working. As per the International Labour Organization (ILO), "global working hours declined by 17.3 percent in the second quarter of 2020" (*Work and Well-Being during COVID-19: Impact, Inequalities, Resilience, and the Future of Work | The World Happiness Report*, 2021). This is in line with the answers obtained in the questionnaire.

There are two different ideas among both countries studied. Even if the results are quite similar, we can see a difference: workers in Portugal believe (55%) they can improve their behavior and it depends on them to protect themselves against COVID-19; while in Spain most of the workers (47%) think there is not much they can do practically. This can reflect the approach each country had and what information people received, since it was different in both countries. Also, the Portuguese workers felt they are in control of protecting themselves, while in Spain they feel they lack control about their own protection.

Regarding the second research question "Do the companies allow the employees to get involved in innovation during the pandemic (March 2020 to January 2021)?", we can confirm, with the results obtained, 77,9% of participants in Bunzl think the company challenges them to make new decisions and to innovate; while in Sintimex, 50,8% think the same.

Bunzl company approves new ideas in innovation department and it is a company that challenges the employees regarding innovation during the period of the pandemic, for 84,4% of the participants. In Sintimex, the "no answer" or neutral rate was higher than any other question, with 34% of people deciding not to answer. Although, 50% of the employees also think they often acquire approvals from the company to invest their time and skills in innovative ideas.

In Bunzl, 78,9% of the employees think they often contribute to innovation, and often make important organizational members enthusiastic for innovation and new ideas. While in Sintimex, 47% think the same, and 39% decided not to answer this question or answered they are neutral about this.

This is an important question because specially during difficult times, like a world pandemic, most people, even if they have new ideas and innovative approaches, tend to keep them for themselves or their department and tend to not reach the management of the company. In difficult times, people were worried about their health, life and families, a lot of them were probably infected with COVID-19 at some point, and these results are really positive, considering the situation.

Regarding the challenge about innovation, even if the majority of the workers felt the same, there was a difference registered in both companies. We can conclude that, in Bunzl company, the workers felt more challenged (the replies were always between 77% and 84%), while in Sintimex a lot of employees decided to keep neutral or not answer the questions (only 47% to 50% affirmed they felt challenged by the company to improve their ideas and be innovative). This can be justified with the business model itself: Bunzl is a manufacturer company, and Sintimex is a distributor. Bunzl has to continually improve their own products, and even has a quality and product development department, because they have to improve and make their own brand last longer in the market and sell. While on the other hand, Sintimex is a distributor, selling other brands, so they innovate really less in product. Sintimex can innovate in the business model, processes, reaching the clients, service, but the percentage of product innovation can justify the different between both companies in this topic.

Analyzing the third research question, "Have the employees made the effort to do what is best for the company during the pandemic (March 2020 to January 2021)?", we can see from the answers of 170 employees, that 82.9% think they have made an effort to contribute and do the best for the companies they work for. In both companies, only 5 people replied they haven't made the best possible, which represents 2,9% of the total participants.

In Sintimex, 62,3% think they undertook actions to protect their companies from potential problems during the times where the pandemic was more present in the business, and 32% of the people decided to stay neutral regarding this.

In Bunzl Group, 94,3% of the people think they have made their best to protect the company and think they contributed as best as possible to avoid problems during this time. Only 2 employees think they didn't do their best and only 4 employees decided to stay neutral.

These replies show the importance given by the employees to the company where they work, and it shows a reliable effort done by the employees during the pandemic to protect the

companies. Both of them had results showing the same conclusion.

Getting to the last research question of this dissertation, “The uncertainty created by COVID-19 affected the innovation departments of both companies?”, the biggest conclusion is yes, it affected in a positive way. To reach this conclusion, we have taken into consideration many of the answers given in the questionnaire.

62,9% of the workers in Sintimex, and 88% of the workers in Bunzl think they mobilize support for innovative ideas, so they feel they have an important contribution to the innovation in the company they work for.

In general, the majority of the participants believe they contribute to new processes, new products and new ideas, and they enjoy doing it. For example, in Bunzl, 88% of the workers believe they often create new ideas for improvements, which means the employees got involved in innovation, through new ideas or techniques, even during COVID-19 times (March 2020 to January 2021). In Sintimex, and in Bunzl, only 4 people in each company felt they didn’t (6,5% in Sintimex and 3,6% in Bunzl).

In Sintimex, 65,5% of the workers said they search for new working methods, techniques or instruments in order to improve their work, their products or the company processes. Also, 70,4% of the workers in Sintimex and 88,9% in Bunzl think they have generated in the last year, original solutions to problems.

More specifically, only 7 people, in both companies (total of 170 people) don’t enjoy finding solutions to complex problems. These 7 workers represent 1,6% in Sintimex and 3,6% in Bunzl. 141 workers enjoy coming up with new ideas for products, which means 82,9% in both companies. Adding to this, 142 participants (83,5%) said they enjoy creating new procedures for work tasks and 145 workers (85,3) enjoy improving existing processes or products. All of these examples are important points in the innovation departments or innovative tasks of a company: find solutions, come up with new ideas for products, create new procedures, improve existing products and processes.

93,5% of the workers in Bunzl admitted to having confidence in their ability to produce new ideas. In Sintimex, 77% of the workers said the same. These two last positive scores in both companies reflect that people are into innovation, and in each company only 2 people said they don’t have the confidence for it (total of 4 people in 170 employees).

Chapter 6: Conclusion

With the replies to RQs, we can conclude that most of the workers don't feel entirely safe and are worried about the virus since the beginning, and even with the improvements and adjustments in society, it is difficult for them to believe that the situation will get better soon. This shows the importance of COVID-19 in the beliefs and behaviors of the workers in the two companies, and proves that people are negatively affected by COVID-19.

The two companies, in their own way, contribute and challenge the workers in getting involved in innovation, and workers felt, most of the times, challenged to contribute and to get approval for new ideas.

There is an importance given to the innovation departments in the PPE areas. The replies obtained made it possible to conclude the PPE area is under development and improving itself every day, since the two market leaders in distribution and manufacturing in Portugal and Spain and giving a big importance to this side of the business.

This research also exposed a determination and an effort given by the employees during difficult times of a worldwide pandemic.

We can conclude there are two sides analyzed in this research: the company side and the employee side, and both of them had results showing the same conclusion. COVID-19 affected the innovation of the PPE companies in a positive and healthy way, and ended up motivating the workers to contribute better, and the companies to give more opportunities to contribute as well. The employees got more involved in innovation, through new ideas or techniques, and became more part of the companies, in these two cases.

In the end, the innovation departments got affected by the uncertainty of the pandemic, but this negative period in time affected innovation in a positive way in the two PPE companies analyzed. The replies obtained showed both companies got affected by the pandemic, but in a healthy and positive way regarding the innovation field.

The results of this research contributed to the literature on this topic and made it possible to step forward in the information and knowledge about the PPE industry and how it got affected by COVID-19. The three topics chosen (Innovation, PPE and COVID-19) were analyzed and a relation was created between them, which added to the existent information explored in the

literature review. It was possible to create interesting conclusions and comparisons and to construct a theory regarding the topics.

Limitations

While conducting this research, there were two major limitations that emerged.

First of all, the questionnaire was sent to the companies while the pandemic was ongoing and a part of the daily life of the employees. More questions included regarding the company's behavior before the pandemic, could have led to more conclusions and other interesting considerations. Since the questions were asked bearing in mind the eminence of the virus, some opinions could have been influenced by that factor.

For new research and a more complete one, it would have been interesting to analyze how the companies acted before the virus, and if the workers had the same opinions as they do now.

The second limitation found is regarding the quality and product development department, completely related to innovation in the safety industry. If a company needs to improve their product, like Bunzl, which is a manufacturer, there will be immediately more innovation involved and the workers might be more familiar with the topic. On the other side, if you are a distributor, and this means selling all the manufacturer´s products, like Sintimex, the innovation might be in a second stage, and might not represent such a huge impact in the business overall. Innovation in Sintimex is present, but it could be seen to a few workers as an internal mean of improving only the internal processes.

Since the companies are in two different phases of the supply chain for PPE products, it could have been interesting to analyze two companies in the same one: two distributors or two manufacturers. Two equal companies regarding supply chain phase could have given a different approach to the conclusions, and could also have created interesting new theories.

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