



Facultat de Ciències Jurídiques
i Econòmiques · **FCJE**

**CREATIVITY AND INNOVATION IN CERAMIC
INDUSTRY AND TILE COMPANIES.**

CASE OF STUDY: TAU CERÁMICA, S.L.U

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TAU
cerámica

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1- INTRODUCTION

Currently, there are many ceramic companies in the market, since over the years new companies have been introduced in the sector, making the differentiation of the product by itself more and more complex.

This situation means that small companies have to survive with respect to large companies, because these last have a lot more resources to obtain a competitive advantage.

Usually, the competitive advantages that are obtained are made through creativity and innovation, since they are relevant aspects to be able to have an advantage in differentiation to be able to compete with the rest of the existing companies.

This situation is reflected in the province of Castellon, which takes over 93% of the ceramic sector, there are a large number of companies that develop their activity in a small area that we will call cluster and study later.

It is important for studying the ceramics sector because over the years it has had to introduce a several innovations in companies in order to supply the market demands.

So, this work will be developed as follows: Chapter 2 will present a theoretical framework, where we will talk about creativity and innovation in the ceramic sector. The influences and the strategies that will be carried out to implement them, as well as the concept of Cluster and its importance within the sector.

Chapter 3 will describe the concept of the ceramic sector, as well as its production process by studying the two types of ceramics, ending with a current and future analysis of the sector. As well as, an analysis of a case in the company TAU Cerámica that belongs to Pamesa Business Group, being this one, the largest group at sectorial level.

Chapter 4 will describe the concept and introduction of Inkjet technology within the sector, as well as the advantages, importance e implementation and therefore the changes and results that occurred when introduced in companies.

Chapter 5 will set out the final conclusions and limitations, as well as future research that can be carried out in the future.

2- THEORETICAL FRAMEWORK

In this chapter of the work, we will develop the concepts of creativity and innovation, as well as the types of influences and importance that they have regarding the implementation of these in the company, being creativity part of the history to innovation. This implies adapting to the new market trends and consumer needs.

Innovation together with creativity, make companies have positive results and consolidate success within the sector.

2.1. CREATIVITY

“Creativity is the human dimension transforming the being and the environment into an affective and energetic cognitive process for the generation and development of original, relevant and relevant ideas”, González, C. A (2012).

“Creativity is a confluence of cognitive processes, knowledge, thinking style, personality, motivation and environment”, Kerka, S (1999).

That is to say, it is a process by means of which the ideas obtained are exposed along with some concepts, obtaining the solution of the problem or the ability to generate ideas. These ideas are aimed at solving the problems that arise, giving way to a novel product that incorporates the necessary changes to carry out a favorable work in the company.

Finally, we proceed to develop the concept of creativity, as well as the types that exist, the influences and relevance that it has within the business scope.

2.1.1 CREATIVITY CONCEPT

At this point we will define the concept of creativity, where you will see the different studies that have been carried out by various authors over the years.



CASE OF STUDY: TAU CERÁMICA, S.L.U

The studies on creativity that have been carried out, focus in general on the definition of creativity in the field to solve problems in the different aspects that collect it, as well as a creativity related to art.

In this work, we will discuss the creativity that is responsible for obtaining the resolution of those problems that are reflected within a company to achieve this way a competitive advantage over its competitors. To this type of creativity, we will call it organizational creativity.

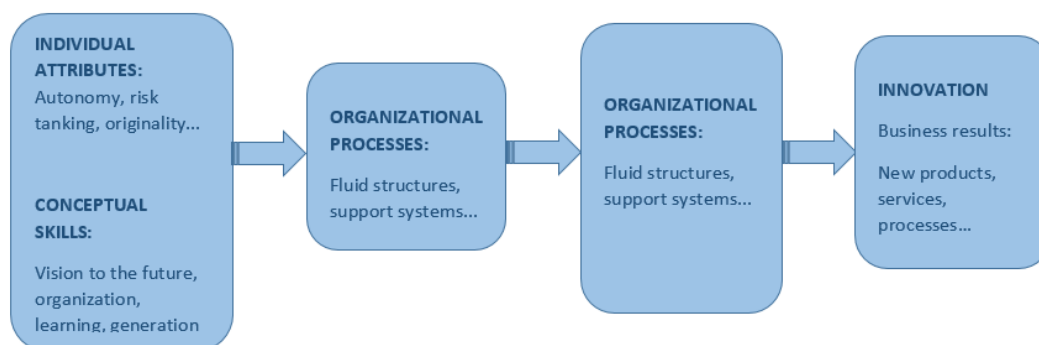
Regarding organizational creativity, we can define it as a way of generating new ideas, which are different from the rest of the ideas obtained by other members of the organization, giving rise to an innovative idea.

This general definition was obtained thanks to the study of the concepts of the different authors, such as Thurstone (1952) who defined the concept as *"a process to form ideas or hypotheses, verify them and communicate the results, assuming that the product created is something new"*.

And therefore, Guilford (1952), *"Creativity, in a limited sense, refers to the skills that are characteristic of creative individuals, such as fluency, flexibility, originality and divergent thinking."* The meaning of organizational creativity is important to observe this way, its evolution over time.

To obtain an organizational creativity that gives rise to an innovative idea, one must take into account a theory where the process of creativity is collected until it becomes innovation.

CHART 1: MODEL OF CREATIVE BEHAVIOIR



Source: Own Elaboration

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As we observe in chart 1, first of all we must take into account the attributes of the people who are going to participate in the organizational creativity, picking up those characteristics they have, such as creativity, originality and autonomy.

On the other hand, there are the skills that people express, where experience plays a big role, learning, and their ability to generate ideas, among others. The set of these two concepts give way to an organizational process where you start to generate a creative idea in front of a problem, experiencing a margin of failures and premeditated trials, leading to creative behavior.

In the phase of creative behavior, results of the idea raised in the workplace are begun to be seen, which, along with all the above, gives way to an innovative idea.

In creativity, the knowledge, intelligence and information that people have within a company plays an important role.

Human intelligence along with capabilities, such as memory, the search for problem solving, critical thinking or memory, are essential. All this together with motivation and personality, form an important context to achieve this way, a unique organizational creativity within the company.

Information and knowledge are two concepts that together are the main basis of creativity. For this, companies follow a knowledge management of a group of people, in order to achieve a creative and innovative result.

Within the management of knowledge models of artificial intelligence, processors of ideas, information systems, among others are developed so that creativity is generated and stimulated by stimulating the imagination.

It is essential in a company the potential of the creativity of individuals when you want to develop an innovative idea. To do this, several techniques are used such as analytical and intuitive, which we will see later.

In conclusion, we can affirm that creativity is essential in the company, since it can be the solution to different problems posed with successful changes, giving way to the innovation of products or services.

CASE OF STUDY: TAU CERÁMICA, S.L.U**2.1.2 TYPES OF CREATIVITY**

As we have seen in the previous section, in creativity it is important to take into account the information, knowledge, experiences, motivation and intelligence of the individual that is going to be subjected to a process of creativity.

On the other hand, we must bear in mind that creativity is the best competitive advantage that a company can have to differentiate itself from the rest of the companies.

There are two types of organizational creativity within a company, individual creativity or group creativity.

We will talk about individual techniques, when they are aimed at people in particular and help to reduce the fear of failing in situations that require creativity, and we will talk about group techniques, when they are directed to a group of people that require some organization and seriousness.

As to the benefits of carrying out processes of creativity in groups, there is an infinity of cultures, ideas, experiences, learning and increases the motivation to get an innovative idea as a result.

Even so, we must point out that there are several drawbacks in the creative process, since an excess of creativity in the long term can generate a loss of motivation of the people who make up the group.

These problems can be avoided if the company takes into account the personality and capabilities of the people who will develop the whole process of creativity, so that there are no clashes between them and the innovative idea.

A company is enriched by individual creativity, but if it is united forming a group, it can reach a competitive advantage impossible to imitate creating an added value.

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To obtain this creativity, several techniques are used, such as:

- Analytical techniques → they have a linear structure of thought or a sequence of steps, where the How must be specified; how much; when; where; who; what; why, being a technique to obtain specific results, with concrete information and different perspectives of the same topic.
- Intuitive techniques → they have a less linear structure and offer a concrete solution, being more useful for problems defined undefined or defined in a precise way.

There are also other techniques such as, for example, Brainstorming, Lotus Flower, checklists (Osborn), among others.

2.1.3 INFLUENCES OF CREATIVITY

The main characteristics that make a person creative can influence positively or negatively in the creative process are, intelligence, knowledge, thinking style, personality and motivation.

As for intelligence, it plays a very important role since it is necessary to have an analytical intelligence for valuing our ideas in order to be able to eliminate those that are not going to be successful.

Secondly, we will talk about knowledge. Knowledge is one of the most relevant characteristics of creativity, since if you do not know which specific topic is going to be treated in order to carry out the creativity process, you can use information media so that person has sufficient knowledge as to carry it out.

On the other hand, there is the style of thought that a person has, that is, how the person uses the knowledge he or she has. Personality also influences, since through the characteristics that the person has, their creative process will be defined.

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Last, but not least, is the motivation. For a long time, several authors have defined it as a desire to do something to achieve some objectives, either group or individual, such as the author Sexton (1977: 162), which defines motivation as *"a process of stimulating an individual to perform an action that satisfies some of their needs and achieves some desired goal for the motivator."* And Armstrong (1991: 266) *"the motivation of human resources consists fundamentally in maintaining cultures and corporate values that lead to a high performance"*.

It should be noted that there are several types of motivation, on the one hand is the intrinsic motivation, which is what the person has.

That is, it is formed through experiences, personality, the ability to solve problems and find solutions, or skills that the person has throughout the creative process.

It can also be affected positively or negatively by some aspects external to the person. For example, the resources it has to obtain the idea, the autonomy that the person has to carry out their ideas, and the pressures that may be felt throughout the creative process.

These pressures can affect negatively or positively, depending on the saturation or challenges that must be met in order to achieve the objective of obtaining the idea.

Another important aspect will be the workload that the person may have throughout the process. This situation makes it stop being beneficial for the company and instead leads to a decrease in motivation and creativity.

On the other hand the extrinsic motivation, which is what is produced by the interest in obtaining knowledge of a subject to be treated, in exchange for some kind of benefit.

When both intrinsic and extrinsic motivations are achieved, better results are obtained, thus producing ideas with high success.

All these characteristics are part of creativity, so once applied to the idea, it will have consequences in the next step, which is innovation.

CASE OF STUDY: TAU CERÁMICA, S.L.U

In conclusion, we can say that creativity is an essential element in a company, since owning a group of highly creative people, the innovative ideas that emerge from it will be a unique competitive advantage. So we will point out creativity as a preamble to innovation.

CASE OF STUDY: TAU CERÁMICA, S.L.U**2.2 INNOVATION**

In the world in which we live, innovation plays a very important role, especially in the field of business, where the tastes and needs of consumers are very changeable. Innovation is essential to exist within companies, as it means a change or improvement of a product or service with added value, in order to obtain a competitive advantage for differentiating itself from the rest of the companies in the sector.

In this section, we will see the concept of innovation, as well as the types of influences and importance that innovation has within a company. And we will also see examples of innovative companies worldwide.

2.2.1 CONCEPT OF INNOVATION

With regard to the concept of innovation, we can point out that it is associated with creativity, that is, it is a change or improvement of a creation, the result of a novel idea.

Schumpeter (1942), "understood innovation as one of the causes of economic development, as a process of economic, social and cultural transformation, and defined it as: the introduction of new goods and services on the market, the emergence of new methods of production and transport, the opening of a new market, the generation of a new source of supply of raw materials and the change in the organization in its management process".

The implementation of creativity within a company is carried out through innovation. This is mainly used to obtain:

- Increased productivity,
- Continuous improvement of the products or services offered,
- An increase in efficiency,
- High quality,
- Resource optimization.

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Innovations is favored by clusters, as companies are interrelated and constant improvements are being made to be able to stand out from the rest of the companies. This innovation will vary in companies, depending on the resources, capabilities and skills they possess.

PICTURE 1: STARBUCKS DRINKS



We give as examples two leading companies in their sector. Starbucks, which due to its high degree of creativity in writing the names of customers in the glasses and to be located in the most central areas of cities, makes it a unique leader in coffee shops.

PICTURE 2: IKEA STORE

Or for example Ikea, which through creativity designs furniture for any situation of a person, going through independence, the continuous state of being in a couple and then have children, thus covering the needs throughout the life cycle.



Ikea wants to love and retain the client with their new spaces.

2.2.2 TYPES OF INNOVATION

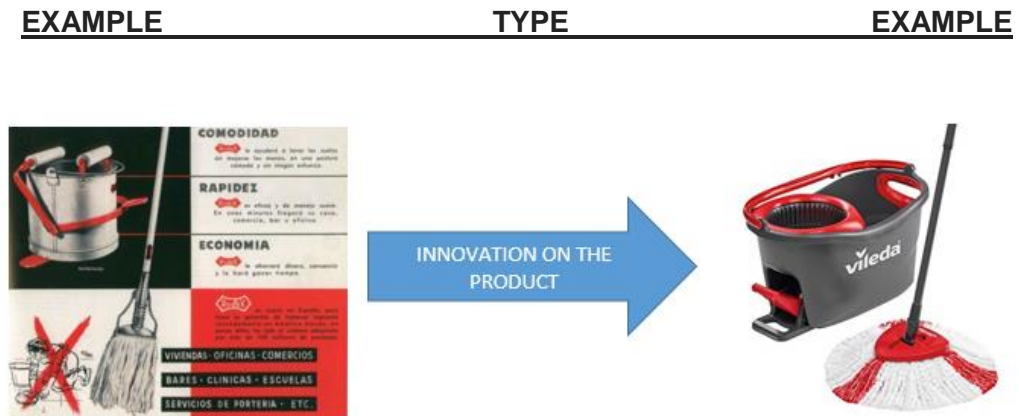
Once we have studied the concept of innovation, we will develop the different types of innovation that exist. Regarding the types of innovation that exist, we can differentiate between:

- Innovation on the product or services

We will talk about an innovation in products or services when there is a new introduction to the market of a technical improvement within its functional characteristics. That is, in components, in materials or in a software incorporation in the products or services.

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CHART 2: TYPE OF INNOVATION: PRODUCT OR SERVICE



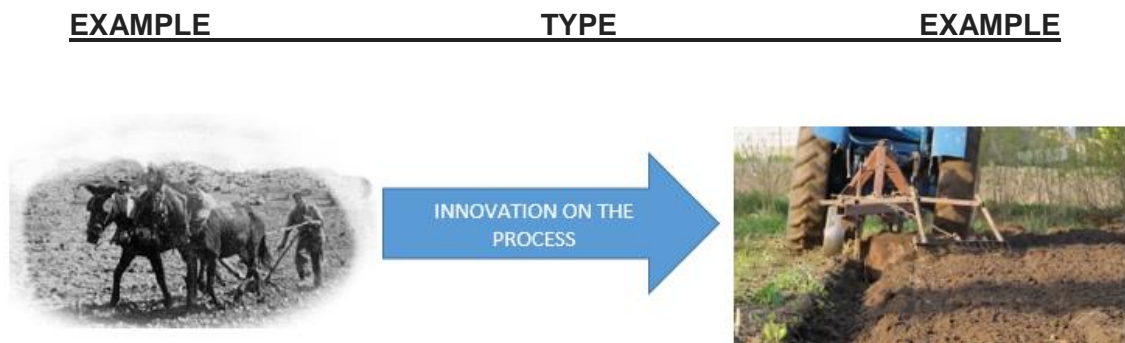
Source: Own Elaboration

For example, in chart 2, when the mop was invented thanks to the innovative idea of the Spanish Manuel Jalón. He observed how homes were cleaned and revolutionized the traditional way of scrubbing the floor with a mop.

- Innovation the process

It will be an innovation in processes when there is an implementation of new or improved manufacturing processes, as well as logistics or distribution.

CHART 3: TYPE OF INNOVATION: PROCESS



Source: Own Elaboration

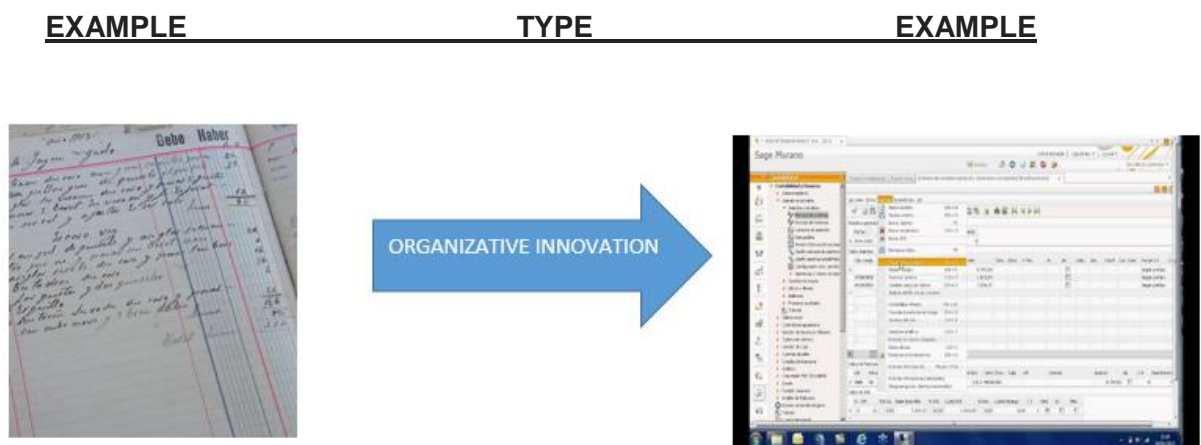
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For example, how can we observe in chart 3, the process of collecting wheat in the field has been significantly improved over the years. In the past, by donkeys or other animals with the help of a wooden platform and some stone chips the wheat was collected by passing over it several times. At present, there are harvesting machines that with one pass already collect almost 100% of the crop.

- **Organizative innovation**

We will refer to an organizational innovation when there is a new implementation for the management of a company in the organization of work with external relations. That is, those related to the quality system, the development of human resources, the management of the value chain, accounting, training, etc.

CHART 4: TYPE OF INNOVATION: ORGANIZATIVE



Source: Own Elaboration

For example, as we can see in chart 4 at the beginning, the accounting was carried out through daily books and major paper facts that were recorded once they were filled out. At present, an innovation has been carried out within the management of accounting through programs such as SAGE, making it a computerized accounting.

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And we will talk about radical innovation, when you create a product or service that is totally different from the one you were referring to for that innovation, with results that generate totally different changes in technology. This innovation creates uncertainty, since when dealing with a totally different product or service we do not know if it can have an impact of success in the market.

2.2.3 IMPORTANCE OF INNOVATION

Currently, we are in a market in which innovation plays a very important role in the development of a company. It is important to create solutions where there are problems and supply the main needs of consumers. As well as continue to progress by adapting the new trends that appear in the market.

Therefore, companies must be willing to see new ideas and not resist the change in their products or services, since their main objective is to enhance the characteristics of these to obtain a competitive advantage through transformation and growth.

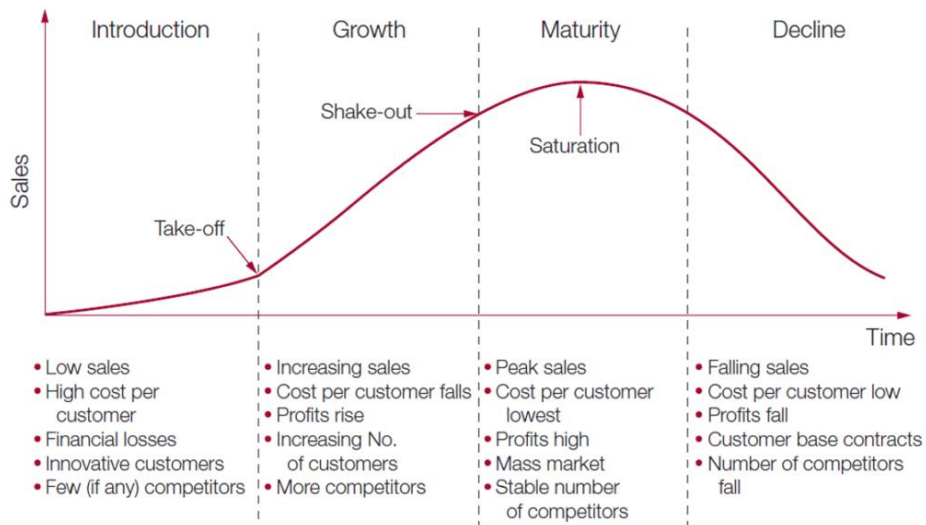
Generally, companies choose to innovate following a series of strategies by differentiating or reducing costs. If a company opts for differentiation, it must make a different product from the rest of the competing companies in the same sector. And if instead it decides to choose the reduction of costs should reduce some aspect of the production process of the product or service.

However, to apply these innovations, a series of elements must be taken into account, since it will depend on the life cycle in which the company is located.

Next, in graphic 1, the life cycle of a product is illustrated.

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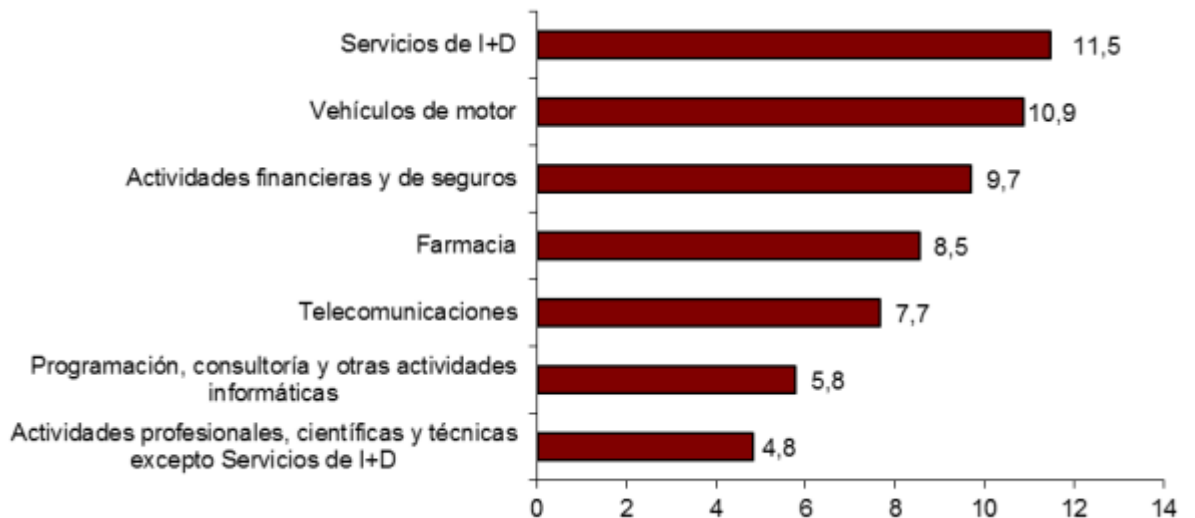
GRAPHIC 1: LIFE CYCLE OF A PRODUCT



Source: Marketing blog for the MBAs

In recent years, companies have been forced to innovate more and more to differentiate themselves from the rest of the market, opting for the introduction of new features in products or services or reducing costs of these. This situation has caused companies to have a significant expense in R+D+i to be able to reinvent themselves in order to meet the needs of the market.

GRAPHIC 2: DISTRIBUTION OF TECHNOLOGICAL INNOVATION SPENDING BY BRANCH OF ACTIVITY, AS A PERCENTAGE



Source: INE, 2016 Survey on Innovation in Companies.

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As we can see in graphic 2, the sector that dedicates 11.5% to spending on innovation is that of R+D+i services, followed by the automotive sector with 10.9%. On the other hand, those sectors of programming, consultancy and other IT activities allocate 5.8% of the expenditure followed by those that dedicate themselves to professional, scientific and technical activities with 4.8%.

2.2.4 INNOVATIVE COMPANIES

Innovation is the key to a competitive environment where there is a lot of competition, so that a company will not be enough to develop new products, but must also provide added value to the market.

For this, it will be essential to have a strategy to develop innovation, have a vision of market trends, have the capacity to obtain it, and process technological and economic information. And have an optimal aptitude in the internal and external cooperation, that is to say, that the structure of the company is well raised.

An innovative company must be aware of the changes in the market, since it is necessary to adapt to the new tastes or needs of consumers. Innovative companies have a series of drawbacks, since being in a situation of uncertainty, the change to be developed must be chosen well.

The main disadvantages that may appear in the innovation process will be that the result obtained is not the expected one that the objectives pursued, the high costs and investments involved in R+D+i, and the risks that are met will not be met. They must assume for it.

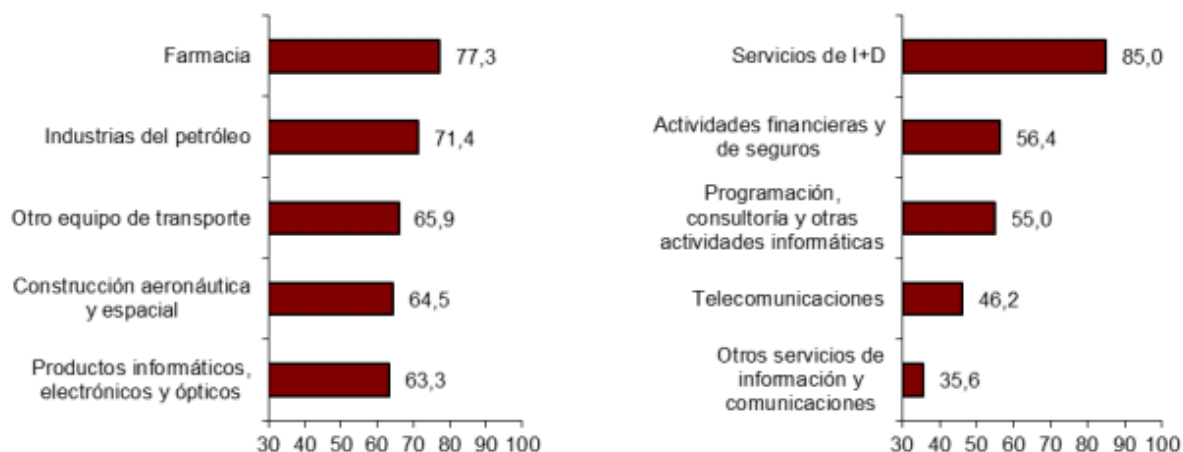
As well as carry out excessive innovations, since a company must be faithful to its products offered adapting to changes and a radical change can be the cause of a decline in sales.

Therefore, to follow a good innovation process, an innovative company must have a well-defined strategy to follow. This is important, since the main objective is to obtain a differential innovation from the rest of the companies in the sector in order to gain market share and obtain greater profitability.

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Next, there are two graphics showing the percentages of those innovative companies in the period between 2014 -2016 in both the industry and the services sector.

GRAPHIC 3: PERCENTAGE OF INNOVATIVE COMPANIES IN THE 2014-2016 PERIOD IN THE INDUSTRY AND SERVICES SECTOR.



Source: INE, 2016 Survey on Innovation in Companies.

In short, innovative companies must have a culture focused on innovation to be the main objective and their employees are motivated to carry out the entire innovation process. These seek market trends anticipating the rest of its competitors in order to achieve a competitive advantage over time.

2.2.5 STRATEGIES FOLLOWED IN INNOVATION

In this section of innovation, the Action Plan that the company has established in order to carry out the chosen idea will be launched, detecting positive aspects and possible improvements. Throughout the process, the company must measure the results through a constant process of monitoring and continuous improvement.

Once the company has created the idea of innovation, you must implement it within it. For that, it must take into account a number of aspects relevant to its implementation, such as the ease of other companies copying the product or service and that the company itself has the necessary resources to implement it.

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For this, we will have four categories of efficiency within the implementation of the innovation of a company. First, a product may be easy to imitate with few available resources. Secondly, it may be easy to imitate with many available resources. Third, it may be difficult to imitate with few resources and ultimately it may be difficult to imitate with many resources.

CHART 6: DEGREES OF EFFICIENCY

		AVAILABLE RESOURCES	
IMITABILITY	Easy to imitate with few available resources.	Easy to imitate with many available resources.	
	Difficult to imitate with few available resources.	Difficult to imitate with many available resources.	

Source: Own elaboration.

Once we have seen the degree of efficiency that an innovative company can have, we will explain the strategies that must be followed to protect and extend its profitability over time.

A company will opt for an association strategy when it has many available resources and innovations are easy to imitate. The profitability of this strategy is not long term since it consists in associating with another company, to obtain more resources and take advantage of them.

On the other hand, if a company has few available resources and innovations are easy to imitate, the strategy will be acceleration. This strategy is based on achieving a very relevant competitive advantage, against the competitors of the market to obtain a differentiation of the product or service.

And finally, if a company has many or few resources available and innovations are difficult to imitate, the strategy to be chosen will be blocking. This strategy makes the competitors have a level of difficulty to imitate the product or service very high. This happens because the characteristics of this are very complex, so the company that owns this innovation and strategy should protect them very well.

2.3 RELATIONSHIP BETWEEN CREATIVITY AND INNOVATION

As we have seen in the previous sections, creativity is the mother of innovation, so the attitude of the innovative entrepreneur will be relevant when carrying out the initiation of an innovation process through it.

We live in a society where there is a fluctuating market and the companies that live in it have to adapt to the changes in the sector to which they belong.

The stagnation in the comfort zone of a company can lead to a state of declining sales and create a future business bankruptcy. The market is in constant movement and new needs of consumers are appearing, and companies have to satisfy them.

Therefore, the importance of creativity and innovation in products and services within companies. The implementation of innovation in a company is the result of profitability and important competitive advantage in the long term.

In short, a good team of motivated people within a company to achieve an optimal innovation process is the key to obtain an innovative idea that can be implemented giving rise to a competitive advantage of difficult imitation in the sector.

2.4 CLUSTERS

In the previous points we have seen the importance of creativity and innovation in the sector in order to carry out the survival of a company. At this point we are going to study the relevant meaning that clusters have, since they are essential to carry out innovations in the sector.

The author Marshall, 1920, affirmed that the existence of industrial districts were the key to stimulate the economy. Marshall studied the grouping of companies in a territory and named it "*industrial district*". This defined the entire group of companies in a same territory that had similar characteristics and that, consequently, increased productivity.

On the other hand, Porter (1998) affirmed that the world economic map is dominated by what are called clusters or economic groupings, which have proven to be "*critical masses of unusual competitive success in specific fields, present at almost any geographical level*". That is to say, "*geographic concentrations that obtain advantages in their performance through joint localization*" (Doeringer and Terkla, 1995, p.225).

Subsequently, several authors were those who deepened in some studies and analyzed the closest clusters. These studies resulted in a series of terms. Within the clusters, different types can be distinguished:

- Territorial, when companies are geographically close
- Sectoral, when companies are linked by an industrial sector.
- Cooperation, when companies cooperate with each other to obtain complementary services.

Therefore, two different concepts were created, on the one hand, the sectoral organization. This has a sectoral focus and its geographical scope is through administrative divisions, whose objective is representation with a product or equal market.

CASE OF STUDY: TAU CERÁMICA, S.L.U

And on the other hand, the cluster, where its approach is multi sectorial, that is, it is given by the relationships between companies in the same territory. The objective is the interrelation between the companies of the same territory, as well as to follow a development or procedure of action between them. In addition, this means sharing the knowledge and experience of companies with the aim of creating a value chain and a competitive advantage.

This competitive advantage is due to the increase in productivity, since it is given by a high specialization of the tasks to be performed by companies. As well as the power of negotiation, and the reduction of costs in the transactions carried out.

This situation leads to an increase in the likelihood of innovation, as companies perceive, thanks to their experience and knowledge in the sector, the needs of their customers and improvements in existing technology.

With this, the entry of new companies into the sector is encouraged, as there are no barriers to entry and there is little risk. In addition, it benefits the non-existence of unfair competition by companies in the same sector within the district.

So, nowadays, the key to obtaining a competitive advantage within the ceramic cluster is not to compete at low prices, but to have the capacity for innovation on the part of the company itself. A company can obtain a competitive advantage through innovation through the modification or improvement in technology, process, organization, product or service and management.

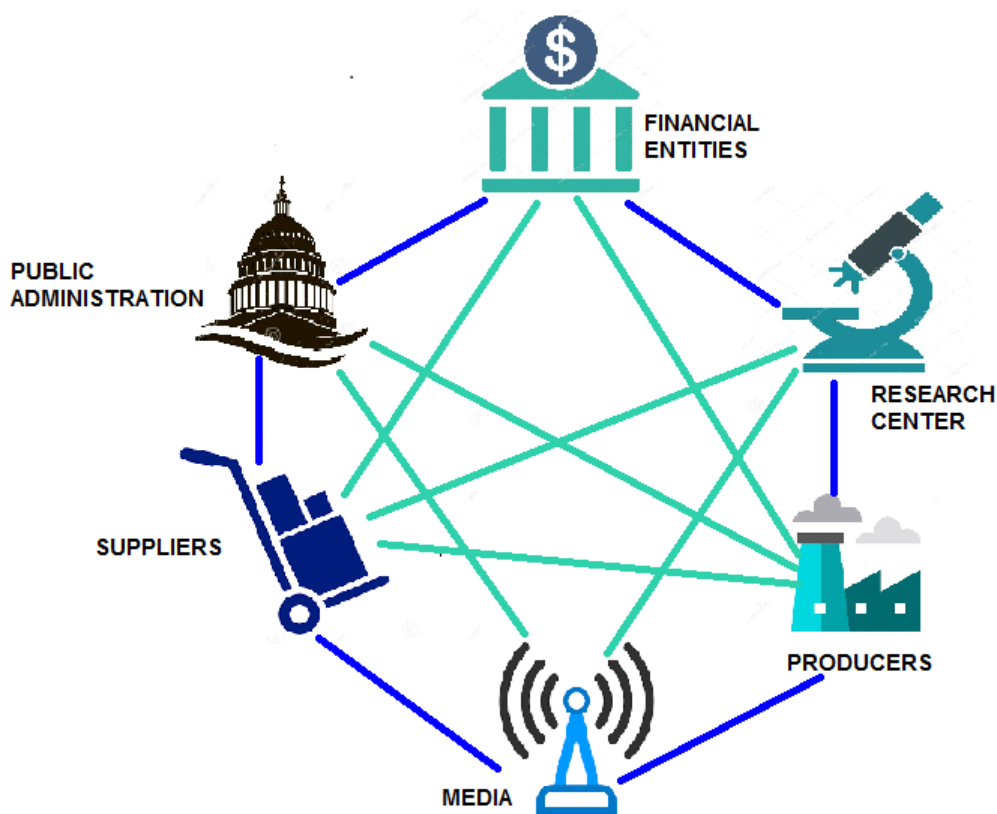
Clusters or industrial districts are perfect for obtaining a competition-cooperation. When companies compete against each other, competitiveness relations arise, it increases innovation to distinguish itself, reaching a new competitive advantage over the rest. This makes the sector more active in the implementation of innovations or improvements in the ceramic production process. With this, the Spanish market is positioned as a leader in the development of technologies, design and quality of service.

CASE OF STUDY: TAU CERÁMICA, S.L.U

Within the districts we can find relationships with horizontal and vertical clusters. We will speak of a horizontal cluster when *"they include companies that share a common market for final goods, or use the same technology or workers, or require a similar natural resource."* (Porter, 1998). That is, when there is a relationship between suppliers and buyers.

And we will speak of a vertical cluster when there is a relationship of purchase and sale, that is, groups that associate with the supply chain.

CHART 7: RELATIONSHIP BETWEEN THE ELEMENTS OF THE CLÚSTER



Source: Own elaboration

As we observe in Chart 7, the main relationships between the different elements of the cluster are the financial entities, the research centers, the producers, the media, the suppliers and the public administration.

CASE OF STUDY: TAU CERÁMICA, S.L.U

Among them there are contact flows to enable cooperation between competing companies, creating synergies and facilitating the entry of companies.

In the past, companies were located where they could extract the natural resources they needed to manufacture ceramics, since transportation was very high. Currently, companies seek to locate near other materials in a short time, through specialized personnel, reducing transportation costs. Porter (1998) affirmed that *"the cluster was a beginning of acquisition of a sustainable competitive advantage over time"*.

The more companies form a cluster, the more specialized labor exists and, therefore, the creation of new specialists, professionals, financiers...

This situation causes companies to interfere with each other, thus increasing networking. This networking is done to reduce logistics costs, improve negotiations, increase the specialization of practices and reduce uncertainty.

As for the companies that are engaged in the manufacture of glazes, chips, machinery and ceramic additives, it increases their capacity for innovation and therefore, their added value to the product, since they obtain a greater knowledge of the tasks they perform.

On the other hand, the objectives of the cluster with the relationships with R + D + i are:

- Share the knowledge and experiences they have.
- Share resources as is, for example, capital, time, knowledge and professional people, obtaining a performance to develop new products and services which individually would not be possible.
- Have relationships with stakeholders, administrators and clients in order to obtain aid.

And the main objectives with the business are:

- Increase sales by grouping so that competition decreases. With this grouping the probability of starting important projects is high.

CASE OF STUDY: TAU CERÁMICA, S.L.U

- Share knowledge, resources and experiences with the objective of reducing costs.

CLUSTER CERAMIC VALENCIAN COMMUNITY

The ceramic cluster is located geographically within the industry of the Valencian Community, exactly in the province of Castellón de la Plana. This province has an industrial district of more than 93% of the sector, being next to Sassuolo (Italy), the most competitive and innovative at European level. Among the towns of Castellón, Alcora, Onda, Vila-Real and Nules stand out. It is a territory with a long productive tradition of ceramic material, which thanks to this has settled in this territory. This caused an expansion of all functions and activities belonging to this sector at the provincial level.

For years, the province of Castellón, thanks to the tradition of ceramics, has been specializing in the manufacture of Wall tiles and floor tiles. Being a continuous production cycle, companies have chosen to specialize in any production line that occurs within the manufacturing cycle. This specialization leads to a decentralization of the industry, since the jobs are divided within the companies.

Another very important factor is the machinery that is used to carry out the production of the ceramic material. With the acquisition of glazes, frits, atomizers, etc., it makes many companies coincide with the same raw materials they use in their production process. As well as in the use of technologies, whether by single firing, double firing, etc.

Thanks to the ceramic industrial district, 80% of ceramic tiles are exported, 70% of which are companies dedicated to the manufacture of enamels and chips in general. This means growth in recent years, which, in annual terms, increases to 19% sales.

CASE OF STUDY: TAU CERÁMICA, S.L.U

The cluster has innovation support systems such as ASCER, ASEBEC, ANNFFECC, ITC, among others. Besides, it has important fairs such as CERSAIE and COVERINGS.

As for the most important innovations that have taken place within the ceramic cluster, they are:

- From double firing to single firing → moving from double firing to single firing was an industrial revolution within the ceramic sector. This saved production time and so, costs.
- The creation of porcelain stoneware → they carried out a series of investigations and developed a more resistant material than white paste. The porcelain, which has more hardness, durability and anti-stain properties.
- Inkjet Technology → a new technology that would change the decoration technique within the sector. It was created by Kerajet and awarded with the Jaume I Award in terms of entrepreneurship. With it, productivity was increased and the costs and packaging used during the whole process were reduced. In section 4 of the work, we will develop in more depth the revolutionary concept of Inkjet technology.

Once studied the meaning of cluster, the different types that exist and their objectives, we move to develop the ceramic sector with more depth.

3 CERAMIC SECTOR

In this section we will see the meaning of industrial ceramics, as well as the types in which the product, floor tiles or wall tiles can be manufactured. Also, we will analyze the entire production process of the tile, from the preparation of raw materials, past its pressing, drying, subsequent cooking and decoration resulting in an aesthetic product, sustainable and resistant over time.

And therefore, we will make a view of the current situation and a future forecast on the sector, taking into account macroeconomic values, such as transport and government tariff rates from different countries that make the transport of tile more higher.

3.1 INDUSTRIAL CERAMICS

3.1.1 INDUSTRIAL CERAMICS CONCEPT

We can define industrial ceramics as a continuous and complex process, which produces ceramic material for walls (wall tiles) and floors (floor tiles).

Over the years, traditional human energy has been replaced by mechanical and electrical energy. That is to say, all those works that people executed by hand, have been gradually disappearing by the introduction of industrial machinery.



CASE OF STUDY: TAU CERÁMICA, S.L.U

The mechanization of the tile manufacturing process has reduced the time to obtain ceramic products, thus allowing a considerable reduction in costs.

3.1.2 TYPES OF INDUSTRIAL CERAMICS: FLOOR TILES AND WALL TILES

Depending on the use of the tile, the manufacturing process will be determined by different characteristics.

Here the mechanical resistance ¹of the product plays an important role, since it will vary if its final use is to be placed on surfaces where it is not going to be stepped on or on the contrary, it will be.

We can differentiate between the floor tiles (material that is going to be stepped on) and the wall tiles (material that is not going to be stepped on), which will be based on their mechanical strength or geometry, taking into account their destination of use.

The floor tiles, also called as porcelain stoneware, is a resistant and compact material that has an almost non-existent porosity with a minimum water absorption of 0.5%. For the manufacture of this product, pure materials such as clay, minerals, among others, are used and have a high mechanical and chemical resistance. It can be manufactured non-slip, resistant to fire and ice.

It is a ceramic product resistant to external agents with a low porosity and which also has a high level of tightness to dirt. It can be manufactured with a variety of textures and decorative effects, making it easy to clean and excellently maintained.

And the wall tiles, being tiles with more porosity than the previous ones, are manufactured with the aim of placing them indoors or outdoors, which do not have to withstand cycles of ice or thaw, since otherwise they would break. These tiles have a mechanical and chemical resistance lower than those that are intended for floor tiles.

¹ **Mechanical resistance** is the ability of the tile to resist the forces applied to it without breaking depending on its material and its geometry.

CASE OF STUDY: TAU CERÁMICA, S.L.U**3.1.3 PRODUCTION PROCESS**

In this section, we will explain in detail the entire production process that takes place in order to obtain a ceramic tile.

The production process of ceramic tile manufacturing is a succession of stages that can be grouped as follows:

- Preparation of raw materials by dry or wet way
- Modeling in semi-dry state (pressing) or in plastic (extrusion) and drying of raw tile
- Cooking with or without enameling, with the possibility of second cooking
- Classification and packing in boxes and pallets.
- Storage of the tiles in the warehouse.

First, the raw materials (clays, sands, feldspars, carbonates and additives) are prepared and used for the manufacture of ceramic tiles.

Once the raw materials are in, we enter the first phase of the manufacturing process, where the size of the raw materials is reduced in a homogeneous mixture to mold it.

In this process, the preparation of raw materials can be in two ways:

- Dry way: where raw materials are mixed and then the size of these is reduced by mechanical processes without the use of water.
- Wet way: where the raw materials are mixed with water and go through the milling or milling process in rotating or ball mills. In this process, the excess liquid is subjected to a thermal process so that it loses part of the water used and is converted back into semi-dry raw material for future manufacture.

Once we have the raw materials, they are ground together with water in special rotating mills, stored in tanks to pump them in an atomizer that evaporates the water (humidity between 5% and 7%). Later it takes to think.

CASE OF STUDY: TAU CERÁMICA, S.L.U

In terms of molding, hydraulic pressing is used (Chart 8) eliminating the air spaces between the raw materials, making them a compact mass.

CHART 8: HYDRAULIC PRESS

Source: SITI B&T, 2019

This conformation process can be:

- Pressed in semi-dry (B): this pressing allows the manufacture of thinner tiles with greater uniformity. This process favors manufacturing by single firing, increasing the size of the pieces without affecting the quality or characteristics of the tiles.
- Pressing in extrusion (A): this pressing allows the manufacture of extruded tiles by propulsion of the clay paste to a matrix, which subsequently passes to a cylinder cutter to obtain individual pieces of the same size. The paste used in this pressing must have a water content between 14% and 20%.
- Other pressings (C): The casting process that is used to obtain tiles with a geometric complexity, by which liquid mud is poured into plaster molds to obtain a certain thickness.

CASE OF STUDY: TAU CERÁMICA, S.L.U

It is essential that ceramic tiles require water to take advantage of plasticity. However, the water that is used, it is important that it is eliminated through the drying process, after its formation, before undergoing the process of cooking the tile.

CHART 9: VERTICAL DRYING



Source: SITI B&T, 2019

CHART 10: HORIZONTAL DRYING



Source: SITI B&T, 2019

To avoid breakage and deformation of the tiles, uniformity in the drying process is important. This is achieved by the good use of hot air and the physical separation of the tiles in the drying of trays so that the air can circulate without problem and is a homogeneous drying.

After the drying process, the firing is carried out in a specialized roller oven (Chart 11), at temperatures between 850°C and 1250°C.

CASE OF STUDY: TAU CERÁMICA, S.L.U**CHART 11: ROLLER OVEN**

Source: SITI B&T, 2019

At this point in the manufacturing process, once the piece is dry, it can be stored in three different ways:

- It undergoes a single cooking with its subsequent selection, packaging and storage;
- It undergoes the process of a first firing for its subsequent enameling and decoration, finally giving a second firing before storage;
- Or, it is taken to the enameling and decoration process, with a final firing before its selection, packing and storage.

As for the process of enameling and decorating the ceramic pieces, it is done with an enameling line (Chart 12). This line has a conveyor belt, through which the cooked or raw pieces pass and the chemical enamels are applied with a total or partial coverage of the pieces.

CASE OF STUDY: TAU CERÁMICA, S.L.U**CHART 12. ENAMELLED LINE**

Source: SITI B&T, 2019

This technique allows the mechanization of the entire decoration process, thus obtaining a great productive capacity of decorated pieces.

In terms of selection and packaging, the classification of these will be based on:

- The raw materials used to make the ceramic tiles, which can be made of red, white or porous paste.
- Its modeling or conformation, whether it is a pressed tile (B), an extruded tile (A) or if they are tiles obtained by another type of forming or modeling (C)
- Cooking, which can have one, two or even three cooking's.
- The application of enamels, where it will differ in enameled tiles (GL) and unglazed tiles (UGL).
- Mechanical treatments applied to the final tile, which may be:
 - Polished, that is, the part that will be seen will have brightness
 - Rectified, that is, when it leaves the oven it is reduced to a +- 0.5 mm length and width
 - By means of a hydraulic cut, to obtain decorations in the form of mosaics or mesh headgear.

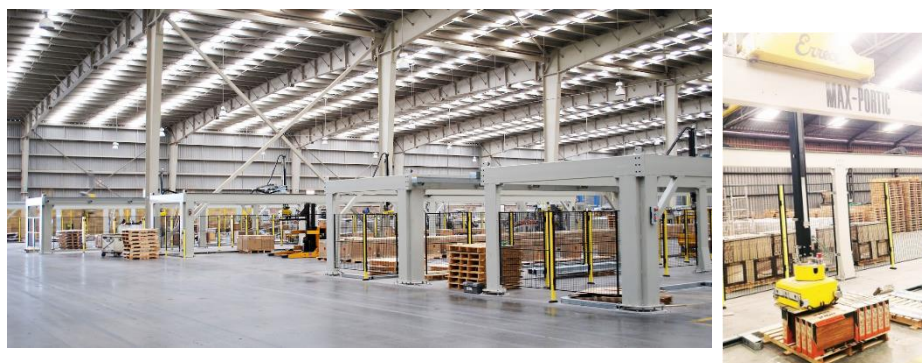
CASE OF STUDY: TAU CERÁMICA, S.L.U

- Destination of the tiles:
 - Wall tiles: those tiles that are going to be placed on a wall and are not going to be stepped on.
 - Floor tiles: those tiles that are going to be placed on the floor and therefore are going to be stepped on, so they must have more mechanical resistance.

- Special: they can be used for covering or paving to accompany those tiles that are going to be stepped on or not. For example, steps, corners, swimming pools, edges, listels, borders...

Finally, they will be classified and selected in boxes where in their packaging the abbreviated compositions of each embedded product will be detailed.

To make your storage more feasible and occupy the least possible place within the shelves and locations of the companies, the palletization of the boxes (Chart 13) is carried out by models in pallets.

CHART 13: ROBOT PALLETIZER

Source: Errecce, 2019

Depending on the measures that the pallets have, they will be placed on shelves or on the ground, either covered or uncovered. In the companies, generally, they store material of first in locations with roof to cover, and that material that is of export, second or commercial they locate it in the ground to shortage.

CASE OF STUDY: TAU CERÁMICA, S.L.U

3.1.4 CURRENT SITUATION OF THE CERAMIC SECTOR

In 2018, the ceramic sector reached a total of 3,600 million euros and 530 million m², which represents an increase of 2% compared to 2017 in sales and production according to ASCER.

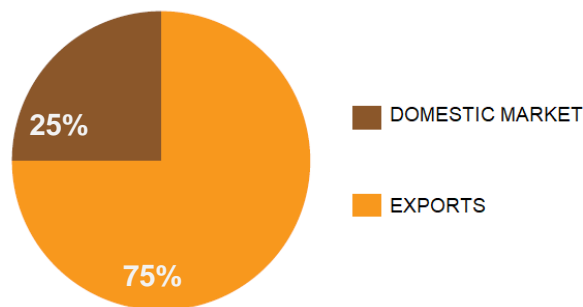
The ceramic products that are manufactured in the province of Castellón have become by far the best merchandise of the entire industry, accounting for 37% of the total sales made.



Regarding domestic and export sales, ASCER reports that the domestic market has increased between 7% and 8% reaching around 890 million euros. And exports, being record figures, have increased by 1%, reaching 2,710 million euros to 187 countries worldwide.

As shown in table 15, 75% of sales of ceramic products are made abroad. However, Europe is still the area in which it is most exported, with 49.1%, which means an increase of 5% over last year.

CHART 14: DOMESTIC MARKET VS EXPORTS



Source: ASCER

CASE OF STUDY: TAU CERÁMICA, S.L.U

Comparing last year with 2019, ICEX Spain Exports and investments developed some reports that reflected a growth of the tile of Castellón in a 1.7% of the sales in exports with respect to 2018. This situation led to the invoicing of around 236 million euros, with respect to the 232 million euros invoiced in 2018.

The growth was possible due to the increase in domestic and foreign demand, as well as the presence of international companies. This growth was due to the increase in expenditure invested in innovation and technology for the incorporation of novelties in terms of materials and design.

CHART 15: PRODUCTION AND SALES OF THE SECTOR IN 2018

<i>Year / mil €</i>	<i>2014</i>	<i>2015</i>	<i>2016</i>	<i>2017</i>	<i>2018</i>
<i>Production</i>	425	440	492	530	530
<i>National market sales</i>	574	647	746	820	890
<i>Export</i>	2328	2452	2570	2700	2710
<i>Total sales</i>	2.902	3.100	3.316	3.520	3.600

Source: Adapted from ASCER, 2018

(*Sales in millions of euros and production in millions of square meters)

As we observed in Chart 15, 530 million square meters were produced in 2018 compared to 425 million square meters in 2014. With this figure we observe a slight increase in sales and a state in which the economic recession has given a respite to the ceramic sector.

Although we compared it during all the periods, sales have been increasing gradually in the national market, reaching 890 million euros in 2018, compared to 2014 where it reached 574 million euros.

In terms of exports, in the course of 2014 to 2018 an increase has been seen both in terms of exports and in terms of national sales, exceeding each year around 124 million euros.

CASE OF STUDY: TAU CERÁMICA, S.L.U

And therefore, total sales in 2018 have been about 3,600 million euros, a situation that shows the movement of tile marketing and the improvement of the economy.

TILES OF CASTELLÓN DE LA PLANA



The existence of clusters favors companies since there are hardly any barriers to entry and facilitate the incorporation of competitive new companies into the sector. Suppliers have many companies that need the same or similar materials nearby, a situation that makes the waiting time for supply and logistics to decrease.

Another important aspect is competition-cooperation, since they use the resources and resources necessary to innovate among them and have a long-term competitive advantage.

The cluster of the Valencian Community is composed of Castellón de la Plana, Alcora, Onda, Vila-Real and Nules. The ceramic cluster is composed of around 220 companies that are dedicated to the production of ceramic tiles.

**CHART 16: SECTORIAL RANKING OF COMPANIES. Sector CNAE: (2331)
Manufacture of ceramic tiles**

POSITION	COMPANY NAME	BILLING	PROVINCE
1	PAMESA CERAMICA, S.L	414.170.000€	CASTELLÓN
2	ARGENTA CERAMICA, S.L.	179.149.095€	CASTELLÓN
3	PORCELANOSA S.A.	175.541.598€	CASTELLÓN
4	COMPACGLASS,S.L.	169.917.000€	CASTELLÓN
5	KERABEN GRUPO, S.A	129.665.000€	CASTELLÓN
6	HALCON CERAMICAS, S.A.U	128.984.493€	CASTELLÓN
7	VENIS, S.A.	119.638.983€	CASTELLÓN
8	CERAMICA SALONI,S.A	101.732.246€	CASTELLÓN
9	AZULMED,S.L.	98.682.864€	CASTELLÓN
10	GRESPANIA, S.A	91.216.453€	CASTELLÓN

Source: Adapted from *elEconomista*, 2019

CASE OF STUDY: TAU CERÁMICA, S.L.U

Castellón is one of the provinces that leads the sector the most, thus occupying an export demand of 13.2%, followed by Valencia with 1.5% and Alicante with 0.4%, according to a study by the *INE and Bankia, Panorama of the Valencian Community*.

ENERGY AND ENVIRONMENT

The associations around the country warn of a possible situation that can affect the competitive advantages of many companies in the ceramic sector. This warning is an increase in gas costs.

In Spain, 62% of the total national gas is consumed, which means high bills of around 4,700 million euros. This situation has been getting worse for years, increasing gas prices between 20% and 25% higher than the rest of European competitors.

Tolls in Spain are above the European average with 45%, which means that Spaniards pay almost twice as much as France, triple as the British and sextuple as Germany.

The possible increase of gas within the industry would cause an important differential before the competitors of the sector, damaging the profitability of several sectors.

To solve the problem, Gas INDUSTRIAL will gather ten sector associations to



obtain a regulation that regulates this situation. Associated with this idea are associations such as ACOGEN, ANFEVI, ANFFECC, ASPAPEL, AOP, ASCER, CONFEVICEX, FEIQUE and UNESID.

An important fact to be taken into account by companies is the energy cost that encompasses the entire production process of the tile. This accounts for 13% of the value of ceramic sales, which is why it is the key to maintaining competitiveness in the face of lower-priced markets.

CASE OF STUDY: TAU CERÁMICA, S.L.U

In Annex 1, documentation is needed where we can find a series of graphs and tables which specify the use of different primary energies used from 2016 until now.

Gas is an indispensable fuel for the tile production process. So, if you increase the price of gas by up to 35%, companies will have to start looking for other competitive strategies against their competitors within the sector.

This problem has led the Government to establish measures that support the government and promote its competitiveness in the sector, since it is important that a recovery in the economy is established in this regard.

MARKET IN USA, CHINA AND ITALY

In the last year 2018, sales of Spanish ceramics in the USA have increased in 21.1%. This percentage is below countries such as Japan and Brazil, which increased their exports by 22% and 30%, according to the USA Department of Commerce.

Spain was a pioneer in sales in the USA in 2018, if we compare with Italy, our main competitor, which decreased its sales by 4.4% and China increased them by 2.5%.

The turnover of Spanish ceramics in the USA was 306 million dollars, Italy invoiced 604 million dollars and China around 507 million dollars.

The main competitive advantage to obtain sales in the US It has been the price of the tile. This strategy has allowed to grow in terms of volume and, consequently, billing.

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CHART 17: SQUARE METER PRICE IN USA

COUNTRY	DOLLARS / SQUARE METER
Italy	21,20
Portugal	14,10
Spain	12,38
China	9,00
Turkey	5,00
India	6,00

Source: Adapted from the newspaper Levante

According to the National Association of Home Builder (NAHB), sales in the USA continues to increase, reaching growth rates of 1.2% with 288 million m² in 2018. Data that, if we compare them with 2017 and 2016, increased more in these years than in 2018, with 6%.

MARKET IN AFRICA

Algeria, Nigeria and Morocco have high political and economic instability, which leads to a high number of conflicts. On the other hand, the protectionist tendencies that exist in the countries, make it appear business opportunities for companies from other countries.

In the last 12 months, business in these countries has gradually increased. According to ICEX España Importación e Inversiones, from 2018 to 2019 ceramic products have been exported to Algeria by 60.7% more. During this period, the Castellón products have reached a total sales of 280 million euros. This is due to the reduction of tariffs that are so damaging to the business of the ceramic sector.

Followed by Algeria, exports to Morocco have increased by 13%, which means 238 million euros in 2019. Morocco is in an economic growth around 7%.

CASE OF STUDY: TAU CERÁMICA, S.L.U

This growth is due to the increase of the SMI and social improvements increasing consumption. Morocco is a country that is close to Spain, which means a reduction of logistics costs to export merchandise and with it a competitive advantage.



The increase in sales in Angola in 2018 was 187 million euros. Angola has become one of the countries in Africa with significant growth, reaching 11.1%.

The situation in Libya causes Nigeria to import ceramic materials to it because the country is constantly at war.

In general, the market has always been dominated by China, which introduced aggressive policies of competitiveness in the sector. This situation meant that other countries did not have sufficient resources to compete.

This situation has led companies to start to conduct business in the western area, such as Senegal, Cameroon, Cote d'Ivoire and Ghana.

DUMPING

Between 2017 and 2018, the Persian Gulf countries had waged a war against the ceramic sector through *dumping*² investigations. This situation caused that the protectionist drift of countries like the Arab Emirates, Saudi Arabia or Qatar, descended around 40% the demand, being a relevant factor in terms of the paralysis of international demand.

According to ASCER, the European Commission renewed in 2018 anti-dumping measures of both imports and exports of ceramics belonging to the country of China, maintaining the same measures in massive imports until the year 2022. These anti-dumping measures serves to observe whether countries accused of exercising these practices actually comply with market obligations.

²**Dumping**, commercial practice consists of selling a product below its normal price, or even below its production cost, with the immediate aim of eliminating the competing companies and finally seizing the market.

CASE OF STUDY: TAU CERÁMICA, S.L.U

In 2018, Morocco, seeing the triumph of Spanish tile sales, accused Spain of practicing dumping in the ceramic sector. This situation was limited, since Spain was able to demonstrate that it did not do any type of this practice, as it happened with Pakistan in 2013.

3.1.5 FUTURE FORECAST ON THE CERAMIC SECTOR

Once analyzed the current situation of the ceramic sector, we will make a future forecast on the sector. For this, we will have the challenges that will be presented and the strategies that companies must follow to overcome them.

If we talk about the maturity of the market, it is foreseen in the short term a growth of the national internal demand of 25% (growth approximately 30% to 35%) and of the international demand of 75% (growth approximately 60% to 65%).

Regarding the control of the channels of distribution of tiles, in general they are not their own (except for Porcelanosa). Almost the entire sector works with a distribution of sub-distribution type that are usually multi-brand stores, where you can find ceramic products from different producers of ceramic tiles. The control can be carried out in the sales made, as well as if the sale objectives exposed at the beginning of the year are met or not. In the case of own distribution as is the case of Porcelanosa, the physical stores of the brand are where the product can be found and then the acquisition of products be made.

EMERGENCE OF NEW PRODUCING COUNTRIES

The tariffs that have been agreed for China to sell its products in the European Union are between 30.6% and 69.7% until 2020, according to ASCER and the European Federation of Ceramic Tile Manufacturers.

This measure is adopted in order to monitor dumping practices in China, following an expiration investigation. And, had not it been for this, the sale of ceramic products in Spain would have had an impact on more than 60,000 jobs at a

CASE OF STUDY: TAU CERÁMICA, S.L.U

European level, 15,000 of which are within the ceramic cluster of Castellón de la Plana.

It should be noted that, China produces around 17,000 million m², of which 35% are still in permanent stock, since the situation in which the Asian country is is an economic recession.

This measure has been adopted for five years, which must have a continuity of review in the measures so that the sector continues to have equality of conditions.

In 2017 an Execution Regulation (EU) 2017/2179 was published, where anti-dumping measures are set out in order to regulate imports of ceramic products from China to the European Union by expiration.

In my opinion, those countries that try to compete with countries like Italy or Spain, if their product is of low quality and have a standard design, although they compete in costs, will not achieve a market share comparable to those of these two countries.

On the other hand, if you buy Spanish products, the customer takes home quality, durability, design and innovation. These products require time and cost to produce tiles with good quality and aesthetics. In addition, the customer can visit the stores where they can touch and see the product they are going to buy, an important factor at the decisive time of purchase. If there is a physical store where you can claim, that reassures the customer, since it does not involve customs or logistics costs.

On the other hand, a study of the internalization of the ceramic sector has been carried out in countries such as the United States, the Middle East and Asia, where it is intended to sell ceramic products.

Short and long term growth is expected in the economies of China and India of 3%, and in economies of Russia, USA and other countries of the European Union of 1%.

CASE OF STUDY: TAU CERÁMICA, S.L.U**ENERGY DEPENDENCE****- GAS AS MAIN DEPENDENCE**

Currently, the most used energy in the production process of ceramic products is gas, as explained in the previous section.

For 2019, an increase in the energy cost is expected, which ranges between 5% and 10%, which would mean an increase in the total cost of around 464 million euros. If we compare the evolution of gas prices from 2016 to 2019, in 2019 it will be 120% more expensive than in 2017, which was the year with the lowest price of gas. This situation causes the price of gas to increase up to 35%, according to a study prepared by the energy consultancy Ayming.

Within the manufacturing process, innovation is important, exactly in the process of water reduction used. This is a measure of energy saving, making ceramic products more sustainable and versatile over time. And on the other hand, they must establish new strategies to improve competitiveness within the ceramic sector through the purchase of energy and risk management, which means savings between 3% and 8% of gas consumption.

Due to the expected increase in the energy used to produce the tile, the Pamesa Group has invested 15 million euros in a larger self-consumption photovoltaic installation in Europe. The future lies in these innovations and implementations, which is why Pamesa has chosen to invest successfully in the environment.

- COGENERATION OF ENERGY

The province of Castellón tile has 28 cogeneration plants, which give a power of 240 megawatts. But, the problem is that in 2012 a life expectancy of 25 years was estimated, but no type of investment was regulated to extend it. This situation, gives uncertainty, since not prolong the life of the plants, the production process of the tile could cost between 25% and 30%. This situation means that more than 22% of the plants are about to expire the regulation and ask it to be extended until the year 2030.

CASE OF STUDY: TAU CERÁMICA, S.L.U

If it is not regulated, Spain would make its production system more expensive by stopping the cogeneration plants and increasing the price of gas. Which would cause a decrease in competitiveness with Italy.

There are several reasons why the life of cogeneration plants should be extended. According to the president of Acogen, Javier Rodríguez, in the newspaper Mediterráneo, it is *"a technology that improves the environment by its efficiency of up to 90% and that fosters the competitiveness and reindustrialization of the country"*.

In addition, an agreement with Iberdrola is being studied, in order to increase the power of the energy and with this access to a higher energy quality and, consequently, a reduction in the electric bill.

ENVIRONMENTAL ISSUE

A very important point in this section is the CO₂ emission rights.

According to the Ministerio para la Transición Ecológica, the trade of emission rights *"is a market instrument, by means of which an incentive or economic disincentive is*

created that pursues an environmental benefit: That a set of industrial plants collectively reduce the emissions of polluting gases to the atmosphere".

In 2005, the European Union carried out a CO₂ emissions initiative involving thermal power plants, cogeneration plants, combustion plants that did not exceed 20 MW, steel, ceramics and cement sectors, among others. This means that around 45% of emissions, with more than 2,000 million tons of CO₂ creating the so-called greenhouse effect, according to the Ministry of Ecological Transition.

CASE OF STUDY: TAU CERÁMICA, S.L.U

In 2008, the European Union created a policy against climate change and energy, in order to meet certain objectives proposed for 2020. These objectives are based on having a sustainable future by reducing carbon emissions and energy consumption. With this objective, it is proposed to reduce by 20% the gases that create greenhouse effect, as well as the reduction of energy by making these needs, renewable energies, in the same percentage.

In Annex 2, we can find in more detail a series of graphs and tables of gas emissions that cause greenhouse effect of any gas emitted into the atmosphere from 2008 to 2012. As well as energy consumption by the industry, environmental efficiency, the generation of energetic waste...

However, the Régimen de Comercio de Derechos de Emisión (RCDE) of the European Union may be altered in the future due to the impact of Brexit. The European Union emission right agreement with the United Kingdom will remain in force until it expires in 2020. Thus, the participation of the latter and the facilities located in the country will follow the obligations of European Union regulations, which must notify and deliver the CO₂ emissions made until the end of the transition.

After the transition, UK facilities will no longer be automatically subject to the RCDE of the European Union. The flights from the United Kingdom to any European destination, emissions will not be included, so they must notify flights to the States of the European Economic Area.

One of the main consequences of Brexit, is that European Union law will no longer apply to the United Kingdom, so it will not serve the European Union regulations to the RCDE. Therefore, as of 2019, the emissions that are made in the United Kingdom will not have the emission rights covered by the RCDE.

Another way to contribute to the environment is through the reuse of inert waste and water in the production process. For example, the tiles that are broken in the production process are crushed and subsequently reincorporated in the same process.

CASE OF STUDY: TAU CERÁMICA, S.L.U

And, to take advantage of sunlight, many companies are looking closely at solar energy. Spain has a point in favor from the rest of the different countries in the world and its Mediterranean climate favors this type of energy, since exactly in the Valencian Community it is where there are more hours of sunshine.

NEW TECHNOLOGIES

According to the Asociación Española de Fabricantes de Azulejos y Pavimentos Cerámicos, a series of technologies will be incorporated in the future to favor the environment and optimize resources and processes.

In the case of TECEM, a study is being carried out to develop an application that allows to manage and analyze the production of the kilns taking into account their energy consumption. Here is the innovation in the analysis of renewable energies, as well as a system to recover the residual heat caused by the production process. And with it, a membrane system to capture CO₂ emissions, looking for a better performance in terms of energy-production value.

CASE OF STUDY: TAU CERÁMICA, S.L.U**3.2 CASE OF STUDY: TAU CERÁMICA**

In this section, we will see the innovations that Tau Cerámica has carried out, as well as the implementation of them, their history within the sector and the results obtained.

Tau Cerámica is a company that currently belongs to the business group Pamesa that is dedicated to the production and marketing of ceramic products of different characteristics and formats.

This company is divided into two parts, on the one hand we have the producer that is Tau Porcelánico, S.L. (Ridder Corporate) where the company produces the m² of Porcelain stoneware products. And on the other hand the marketer, which is Tau Cerámica Solutions, S.L., where the sale of these products with the trademark Tau Cerámica takes place.

PICTURE 3: MAIN BUILDING TAU CERÁMICA SOLUTIONS



The company is divided into three parts, in Onda it is located the building where the offices are, carrying out sales relations, as well as accounting and other management work. And in Castellón de la Plana it is the production company and the logistics center 6 that belongs to the Pamesa Group led by Fernando Roig.

The company has 343 workers since Fernando Roig decided to acquire Tau. With the acquisition, it has increased 80% of employees, which make it possible to invoice around 55 million euros and produce about 21,352,800 million m² annually.

CASE OF STUDY: TAU CERÁMICA, S.L.U**▪ HISTORY OF TAU CERÁMICA**

TAULELL S.A. was founded in 1967 as an Association of Companies by several independent entrepreneurs of the Ceramic Sector.

In 1977 it began to grow and went from having a tunnel-type kiln to having four, becoming the biggest ceramic tile producer in Europe, with a production of 25,000 m²/day.

CHART 18: PLANT OF TILE BODY TAUGRES

Source: Design Department TAUGRES, 1967.

All the product was still sold in national territory, 50% to the founding members and the rest to other businessmen of the region and Navarra, where an important tile industry also started to flourish.

In 1981-82 the technique of single firing appears as a clear threat to the company.

In 1984, the first roller furnace was put into operation, producing 3,000 m² / day of floor tiles glazed by single firing (red-bodied tiles), which implied important changes in the structure of TAULELL, S.A.

CASE OF STUDY: TAU CERÁMICA, S.L.U

CHART 19: PLANT 1 (TILE BODY) AND PLANT 2 (FLOOR TILES)



Source: Design Department TAUGRES, 1984.

In those moments, the sales were local, and with the appearance of the stoneware it would happen to sell in all the national territory. Subsequently, a sales department was created to support the organization and position itself within the market.

Currently, TAU CERAMICA has been established as the brand of representation worldwide in the company.

In 1986, the sales and design department realized that they did not meet the needs of the customers 100%, so they started working on wall tiles. It was a very important investment and manufacturing process, and at that time, there were few companies that manufactured this type of product. This situation led to the creation of the third manufacturing plant for wall tiles by porous single firing (red-bodies tiles).

CHART 20: PLANT 1 (TILE BODY), PLANT 2 (FLOOR TILES) AND PLANT 3 (WALL TILES)



Source: Design Department TAUGRES, 1990.

CASE OF STUDY: TAU CERÁMICA, S.L.U

Over the years, new furnaces were added and in 1988 a production of 4,000,000 m²/year was achieved, becoming a leader in the national market.

In 1990, TAUGRES was one of the three companies in the ceramic sector that produced the highest number of meters (12,500 m² / day of floor tiles and 6,500 m² / day of wall tiles.) Later, it was equipped with the best technology in the market and included new lines of research to improve processes and differentiate products from the competition.

In 1994 it continued its expansion and acquired a fourth plant, manufacturing 12,000 m²/day.

CHART 21: PLANT 4 (PORCELAIN STONEWARE)

Source: Production department. TAU PORCELÁNICO. 1995

In 1998, the company launched the third porcelain stoneware kiln, as well as a new storage, dosing and weighing system for raw materials on the fourth floor.

In 1999, a policy for energy saving was adopted, since in the start-up of the manufacturing lines the energy costs were increased considerably.

And it would not be until 2000, when a new atomizer was implanted in the fourth plant, expanding the productive capacity of the company.

Everything was going well until Tau Cerámica had a progressive sales loss, caused by the economic recession in the construction sector.

CASE OF STUDY: TAU CERÁMICA, S.L.U

But in 2016, Fernando Roig bought Tau Cerámica for 17.5 million euros and started working as a company within the Pamesa Business Group.

CHART 22: INSTALLATIONS TAU CERAMICA.

Source: Valenciaplaza Newspaper. 2016

Tau Cerámica belongs to the Pamesa Business Group and has more than 40 million euros invested in Tau Cerámica, this being the company with the highest quality in the whole group.

Currently, the entire Pamesa group bills more than 80 million euros, which represents an increase of 6.4% for the purchase of Tau and the workforce increases by 11.7%, according to the Valenciaplaza newspaper.

- **VISION, MISSION AND CULTURE**

Tau Cerámica, is consolidated in the sector to be a brand known worldwide for the technical quality, innovation, constant development, aesthetics of the product offered and the commitment to its social and environmental environment.

With this, we can say that the mission of Tau is *"to meet the needs of customers with ceramic products in the maximum possible territory, as our products offer high innovation, quality and aesthetics at a medium-high price, with the aim of get more market share than our competitors"*.

CASE OF STUDY: TAU CERÁMICA, S.L.U

The vision of Tau, is to be a leader in the ceramic sector, betting on the quality and innovation and development of its products. As well as, the excellent attention and loyalty with the client, the good deal with the suppliers and workers and the reputation of the brand with the internationalization of the products.

Tau is committed to the constant training of the worker, creating value in all the actions



he performs. Cuenta con un protocolo de seguridad en el trabajo, una Política de Calidad y tiene un serio compromiso por el medio ambiente. The values of Tau, have a strong culture, where the rules are followed firmly and taken into account when making decisions. The company has a professional culture, where workers are specialized in the tasks they will perform and are

able to cope with those tasks that are not routine.

▪ **ESTRATEGIAS COMERCIALES**

The company Tau Cerámica follows a strategy of ceramic product differentiation. Bet on exclusive designs full of creativity and innovation, with a high quality recognized worldwide. It has a service to the client and excellent provider. Its objective is to supply the customer by limiting delivery time by having enough material in stock available.

The fruit of a good strategy is for example, the star product of Tau Ceramics is the well-known Corten A. This product is from a series called Metallica, which was in the catalog before the crisis of 2008. The Corten A, has a great reputation worldwide, as it had a "boom" in sales never seen in the sector. He has sold millions of m² and continues to do so today. We can say that it has not gone out of fashion, the opposite has happened in different ceramic products.

Tau has another strategy, that of betting on large-format pieces. In 2017 he expanded his catalog of ASCALE focusing on a productive strategy in large formats such as 60x60, 60x120, 75x75, 120x120 and 90x180 centimeters.

CASE OF STUDY: TAU CERÁMICA, S.L.U

In terms of marketing strategies, Tau collaborates in television, in specialized magazines of interior design, ceramics, and is positioned in SEO. Betting on a secure online channel, as more and more customers buy through devices and for this, we must capture marketing strategies on new market trends.

▪ **INNOVATION**



The company Tau Cerámica has always been a benchmark for innovation in Spanish ceramic products.

Tau, always looking for technical and aesthetic excellence of the product, which has decided to innovate in new textures and finishes, which means an investment in technology to carry it out.

Last year's innovation for the current one was to bet on the big ones in the ASCALE line. Through this product you can build a countertop or any surface either horizontally or vertically. For this purpose, new channels such as marble workers, kitchen shops and decoration stores are sought, with a specialized and experienced sales team, as it is a differentiated product on a sectorial level.

However, the most important innovation was to expand the offer with pieces of 320x160 with 12 mm and 6mm thick.



Another innovation was in 2018, when he presented the first countertop with invisible kitchen. It was in CEVISAMA where he presented it and many of the clients were left with the desire to acquire one for their home. And is that Tau

CASE OF STUDY: TAU CERÁMICA, S.L.U

Ceramics, continues to innovate more and more to make ceramics a safe product in the future.

▪ **DISTRIBUCION CHANNELS**

Tau Cerámica has many stores that distribute their products nationally and internationally. Do not sell retail directly from the marketer, but to acquire a quality product must be in a specialized store.

▪ **COMPETITION AND MARKETS**

Tau is well positioned within the market of the ceramic sector and is increasingly increasing its sales. Tau exports its products worldwide, especially in countries such as Italy, France, Morocco, United Kingdom, Switzerland, and Belgium.

In addition, Tau wants to continue studying markets where little pottery is sold. That is, continue with market research to increase sales in those less development countries. Countries like India and Africa.

▪ **PRIZES AND SPONSHORSHIPS OF TAU CERAMICA**



In June 1994, the Certificate of Company Registration of AENOR was obtained based on the UNE 66901 standard, today UNE-EN-ISO 9001.

The company has been awarded in the years 1995, 1999, 2002, 2005 and 2009 with the Alfa de ORO, this being a major award at the Cevisama Exhibition Fair.

The prizes related to the field of sport were: in the Basket of Tau Cerámica, Baskonia and Barco in the boat regatta of Tau Cerámica (by Javier Banderas, brother of Antonio Banderas).

CASE OF STUDY: TAU CERÁMICA, S.L.U

- **PROPOSAL FOR THE FUTURE**

In this sense, the future proposal that exists is the increase in production in white paste, since it allows the production of large formats (ASCALE line). These formats will be a great competitive advantage against the Italians, since they do not manufacture the formats that are estimated to be produced by Tau. These formats will be excellent for use inside buildings, as well as hotels, shopping centers, big houses...

4 INKJET TECHNOLOGY IN THE CERAMIC SECTOR

4.1 INTRODUCTION OF INKJET

4.1.1 CONCEPT OF INKJET

At the end of the 70s, images began to be reproduced using a digital printer that was like a coding system and product marker. In 2000 the first digital Inkjet printer for the ceramic sector was introduced in the market, revolutionizing the entire traditional production system of companies.

PICTURE 4: MACHINE OF TECNOLOGIA INKJET



The Inkjet technology consists of an injection of different inks without touching the material by means of heads, exerting a force in the peak liters that vary according to the pump and brand of each machine. It allows to decorate 100% of the piece before it is cooked.

This technology stands out for its quality in terms of image, reliability, sustainability, versatility and productivity.

With it, you can give an impeccable finish, as well as capture different drawings, textures or reproduce some type of relieve giving the feeling of realism, without having the need to make an investment in molds.

CASE OF STUDY: TAU CERÁMICA, S.L.U**4.1.2 ADVANTAGES AND DISADVANTAGES OF THE TECHNOLOGY**

The advantages of Inkjet technology are the following:

- The exact ink is used for each tile avoiding leftovers that can contaminate the environment.
- Costs are reduced because the amount of ink applicable is decreased, the number of tests performed in the laboratory and less time is spent in the decoration phase.
- Combine different inks to achieve the required color, avoiding the use of several colors of enamels separately to achieve a single one.
- The number of materials and containers used is reduced. The average material used in other technologies is 120 g / m² (55 g / m² serigraphy, 5 g / m² pigment, 60 g / m² organic vehicle). In comparison to Inkjet technology that is 3 g / m² (1 g / m² pigment, 2 g / m² organic vehicle). And packaging other technologies use 10% of inks (12 g / m²) and Inkjet a 0 g / m².
- By injecting the ink directly into the tile without touching it, the risk of breakage in this phase of production is reduced to 100%. This aspect is very important, since it improves the percentages of product quality and decreases the creation of ceramic waste.

The disadvantages of Inkjet technology are the following:

- With the entry of new technology, companies have been pressured by the needs of customers in the ceramic market to invest in printers with Inkjet technology. This is an investment whose cost is high and mostly in Spain, there are more SME (small and medium enterprises) than large companies, so SME have more problems when they invest.

CASE OF STUDY: TAU CERÁMICA, S.L.U

- With this, workers must be trained to carry out their use in an efficient manner. To solve the problem, several companies carry out short courses so that the development in the workplace is effective.
- The consumption of the ink depends on the composition of the enamel and the subsequent cooking cycle, so the composition and deviations of the production must be optimal and controlled so as not to be constantly arranging the graphic files used.
- During the phase can appear the risk of "banding", where a high number of ceramic products suffer in fact scratched. This happens because of the clogging of the print heads.

4.1.3 COMPARISON BETWEEN DIFFERENT TECHNOLOGIES IN THE SECTOR

Over the years, technology has been changing through the introduction of innovations, making the production process easier and faster. Therefore, in this section, we will take a look back at the oldest technologies.

On the one hand, compressed air is used in aerography to spray the enamel on the tile. It is used by pressure, gravity and suction of the liquid. They can be manual, automatic or through a continuous flow.

CHART 23: TYPES OF AEROGRAPHY. PRESSURE, GRAVITY AND SUCTION



Source: Manual MAINCER, p. 2

CASE OF STUDY: TAU CERÁMICA, S.L.U

On the other hand, the enamel bell, by means of which an enamel veil is created that falls on the tiles so that the ceramic pieces are impregnated in a firm and unimpeded manner. It is used to obtain brilliant finishes with a high quality of stretched, since it is anti-bubbles, providing a consistent enameling base.

CHART 24: ENAMEL BELL



Source: MAINCER. Machinery and industrial automation

Thirdly, in the serigraphy, an insolation of any chosen image on a screen is used. On this screen you can create different patterns to transfer them to the tile using a film, if it is a raw piece, with paper to transfer, if they are tile body pieces, or with a fabric with a fine weft.

CHART 25: SERIGRAPHY



Source: Marphil Web

CASE OF STUDY: TAU CERÁMICA, S.L.U

Fourth, the rotocolor, which was one of the most expanded processes within the ceramic sector. This process reached much more production decorated to the minute, with a greater durability of the matrices, as well as the possibility of being able to decorate the ceramic pieces without having to cook them.

This process decreased the number of breaks. It raised the quality of the product, its ability to make various matrices and tones with continuity. It is a silicone roller, where the enamel forms a gravure decorating a smooth and variable cylindrical shape. In this process, the excess of enamel was deposited in the matrix, which mixes the enamel and is used again.

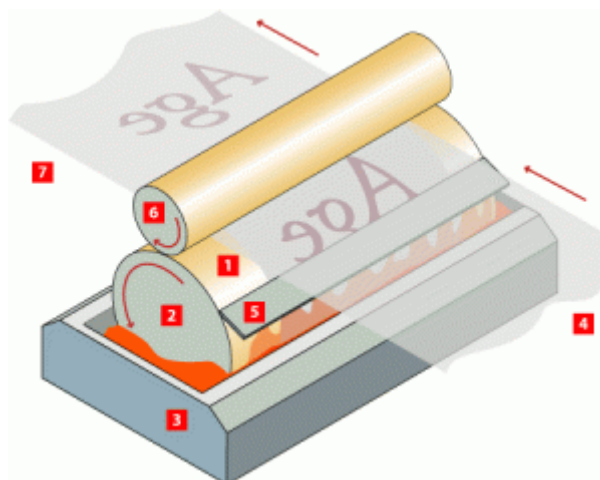
CHART 26: ROTOCOLOR

Source: System Ceramics Web

And in fifth place, gravure, is a printing mechanism where some cylinders take the ink and then print directly to a plastic support, passing one cylinder to another in a mechanized way. The cylinder rotates inside a bucket where the ink cells are filled to seal the tile. As the cylinder comes out, the excess of ink is removed.

CASE OF STUDY: TAU CERÁMICA, S.L.U

CHART 27: GRAVURE



Source: Journalistic Production Blog

Over the years, several technologies have been introduced, reaching the most efficient and fastest ones. The previous technologies resorted to high costs in ink cartridges and rollers that were used for the production process. To realize the tests with different colors of inks caused many containers and templates to capture the selected drawing.

It is important to look at the costs in terms of traditional and current technology. With the current technology, just the right ink is injected into the tile avoiding leftovers, and in the others, more ink is wasted, which was later used again, reducing the quality compared to the current one.

The current technology uses a mechanism of ink transfer in drops to the substrate without contact with the tile, making tiles identical or totally different.

CASE OF STUDY: TAU CERÁMICA, S.L.U

Investment in a traditional technology was lower, but as it was produced, it became more expensive to acquire ink and templates to be replaced by others. With this, a larger warehouse was needed to store all the components. In addition, at each design change, the company incurred costs of cleaning personnel to change the templates, rollers, ink and start the new decoration line.

It is no longer relevant in terms of costs, but of time. Producing a large number of ceramic pieces in less time means an increase in the production of m² and consequently, a significant reduction in costs.

The manufacturers of the traditional technologies were the same ones that sold the spare parts. Currently, there are many suppliers that facilitate the acquisition of machinery and materials.

In short, the technology has evolved and with it, the way to decorate the tiles, using less time and increasing the quality of the product.

4.1.4 IMPORTANCE OF THE TECHNOLOGY

If we look back, we see that the introduction of Inkjet technology, takes a step towards the future in terms of sustainability, flexibility, optimization of time and increased productivity.

The development of the technology gives way to the development of new products with a higher quality and design at a competitive price.

With Inkjet technology, many companies have managed to produce many products with different designs, textures and excellent surfaces, which with traditional technologies would not have achieved at the same time.

CASE OF STUDY: TAU CERÁMICA, S.L.U

This innovation not only has important advances in innovation in the production process, but has meant the simplification and reduction of many factories to be able to produce ad-hoc, with the aim of improving all the working capital of the company.

It is important to highlight the consciousness with the environment that this technology gives, since by not squandering leftover ink or packaging that later has to be thrown away, it makes it a pioneering technology in the sector.

4.2 IMPLEMENTATION OF THE INKJET TECHNOLOGY IN THE INDUSTRY

In this section we will talk about the implementation and the meters that are produced in the company TAU Cerámica through Inkjet technology.

The innovation of Inkjet technology in the design process has benefited companies in a significant way in production, time and costs.

The company TAU Cerámica produces around 8 million m² per month, maintaining the agreed strategies at the beginning of the year 2019. This situation is given thanks to the constant effort of all the workers who belong to the department of research and development (R+D+i), which follow the process closely, considering innovation as its main objective.

The implementation of Inkjet technology has been progressively made, since the investment of these machines is high and the ship of Tau Porcelánico, had to be conditioned for new technologies.

With the purchase of TAU Cerámica by the Pamesa Business Group, Tau has incorporated a fifth furnace, which increases its production and thus, the m² decorated by this technology. Tau produces through five production lines, so all the tiles that are manufactured in Tau Porcelánico go through Inkjet technology.

As this technology has progressed, productivity in the company has been increasing. TAU Cerámica produces thousands of meters per year and is sold worldwide. This makes it one of the best companies in the ceramic sector, being the implementation of this technology an essential innovation to be able to finish covering the entire market.

Through this technology, the company can get up to date with the needs and trends of the market, since at international fairs such as CEVISAMA, CERSAIE and COVERINGS, they give ideas of the innovations that are going to be carried out.

In Annex 3, we can see the pages of the programming of the five production lines that Tau Porcelánico has. We put for example the first four days of the month of May 2019, changing the original name of the tiles by product A, B, C, D ... In which they are produced and going through Inkjet technology daily.

To finish this section, we can say that Inkjet technology has been essential within companies, since it saves time and increases the production of ceramic products, obtaining completely innovative designs.

5 CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCH.

As for the realization of the work, it has been a rewarding experience since my knowledge related to the ceramic sector has increased.

In the first place, I wanted to expose the relationship between creativity and innovation, whose joint result has led me to the conclusion that both concepts are the key to achieving a competitive advantage. In today's business world, it is essential to differentiate yourself from the rest of the industry's competitors through an innovative product or service. For this, as has been studied in the previous section, clusters are essential for the birth of innovations.

The research of the clusters, has made me understand the importance that they have within the sector and that thanks to them, really important innovations are carried out. Clusters have been essential within the sector, since they have favored relations between companies and their suppliers, as well as the rest of the entities that link them. In the work, it has been possible to see a heterogeneity among the companies of the ceramic cluster, favoring the relationships between them. As well as the existing cooperation between the companies that form it, it helps to solve difficulties that may appear. This is due to the existence of many companies in the same sector geographically and to distinguish one from the other, we must create an added value on the product, service or production process.

After the study of the clusters, it can be concluded that, thanks to them, important innovations such as Inkjet technology have been made. This technology revolutionized the process of ceramic production, since when introducing the exact ink avoiding surpluses in the tiles, it was considerably reduced in costs. Thanks to the existence of clusters, innovations such as the Inkjet, are increasingly approaching a sustainable future protecting the environment from harmful chemicals. Therefore, as we have seen, many companies have an R + D + i department through which they carry out innovation research to reach an advantage over other competitors.

CASE OF STUDY: TAU CERÁMICA, S.L.U

If a company manages to differentiate itself from its competitors, it increases its profits and thus its market share. For this, I think that a company should raise its cost in R + D + i to obtain a different result from the rest of the sector's competitors.

Regarding the tile of Castellón, we can say that it leads the sector, occupying the first place in exports. This situation is thanks to the geographical grouping of companies which generates more than seven thousand jobs. For Spanish tile companies, it is essential to increase production in less time and thereby reduce costs.

Concerning the study of the ceramic sector, I have been able to study and understand the competitiveness that exists within it and thus, the millions of substitute products that exist. I believe that companies must carry out innovations and meet the new needs of customers through a differentiation in quality and design.

With regard to the current situation of the ceramic sector, I think that it is expected that there will be years of increased production and sales, with a high percentage of exports and domestic demand. But, on the other hand, I believe that the sector is sensitive to suffer another economic recession, since it is one of the sectors that suffers the most when there is a decrease in the demand for construction.

Currently, people are renting houses in addition to buying them, so the sale of tiles is demanded practically if there is a reform. I consider that a tile is a product "for life" if it is not broken. This situation causes people to buy tiles to change them, either by renovation or because they have been broken, since the tiles once placed in a house last for years.

Regarding the realization of the work, I had a series of limitations. The search for more concrete information has been more expensive, since it is difficult to find reliable sources of information. With this, it has not been possible to find data closer to 2019, since almost all data has been from 2008 to 2016, approximately. But, I have been able to find several web pages and sources of information, for which, the information related to the study of the sector has been relevant.

Regarding future research, this work could be continued by comparing the sector in previous years in two companies. As well as, a study of how the innovation impacts on two comparable companies and what aspects could be improved in them.

CASE OF STUDY: TAU CERÁMICA, S.L.U

Regarding the study of the company Tau Cerámica, I think it is a pioneer in the ceramic sector in terms of innovation. For years it has continued to innovate in products and production process and makes it a leader in innovation. I consider it a good company to continue researching points related to innovation.

Another point that would add to the work would be the study of several alternatives to favor some part of the production process. That is to say, to continue with investigations that can favor the environment, increasing the production and reducing costs.

In conclusion, I believe that a company has to be open to change, to the introduction of new technologies to meet the needs of consumers and face market trends. For this, innovation will not only serve, but must adapt to the constant changes in the market.

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6.2 WEBGRAPHY

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CASE OF STUDY: TAU CERÁMICA, S.L.U

6.3 ANNEXED

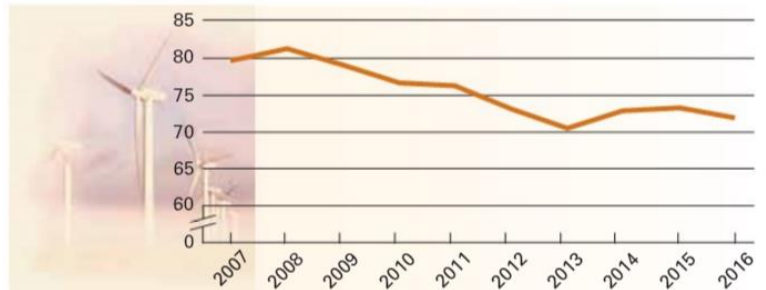
- ANNEXED 1:

Energía renovable sobre consumo de energía final. 2016

	%
Suecia	53,8
Finlandia	38,7
Letonia	37,2
Austria	33,5
Dinamarca	32,2
Estonia	28,8
Portugal	28,5
Croacia	28,3
Lituania	25,6
Rumanía	25,0
Eslovenia	21,3
Bulgaria	18,8
Italia	17,4
España	17,3
Grecia	15,2
República Checa	14,9
Alemania	14,8
Hungría	14,2
Eslovaquia	12,0
Polonia	11,3
Irlanda	9,5
Chipre	9,3
Reino Unido	9,3
Bélgica	8,7
Malta	6,0
Países Bajos	6,0
Luxemburgo	5,4

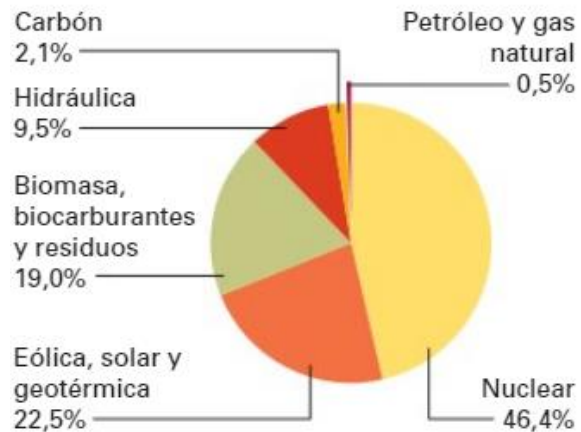
Fuente: Eurostat

Dependencia energética* (%)



* El indicador muestra la proporción de las necesidades energéticas interiores totales que son satisfechas por las importaciones procedentes de otros países Fuente: Eurostat

Producción interior de energía primaria. 2016



Fuente: Mº de Energía, Turismo y Agenda Digital

Consumo de energía primaria. 2016

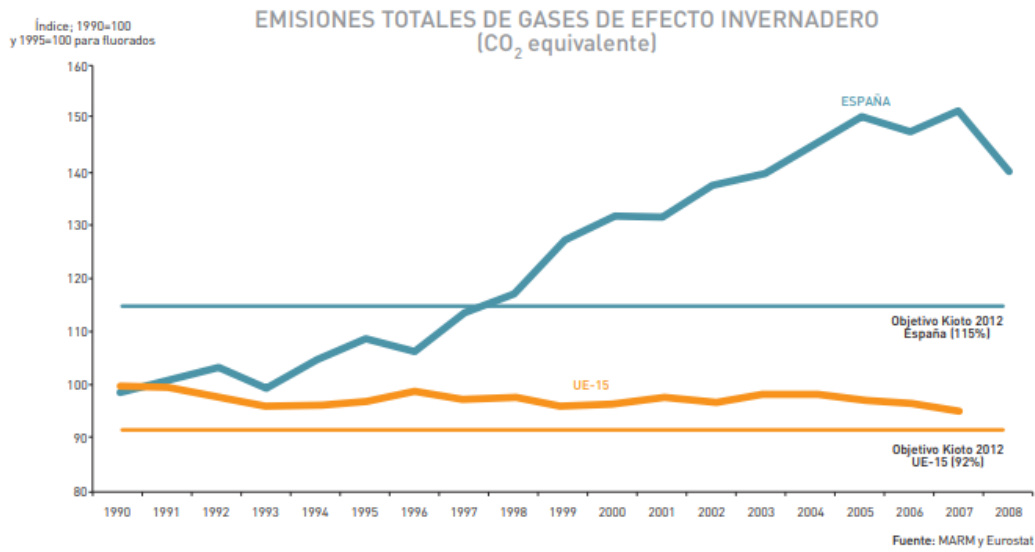
	Consumo		Variación interanual %
	ktep*	%	
Total	123.484	100,0	0,2
Petróleo	54.633	44,2	2,7
Gas natural	25.035	20,3	2,0
Nuclear	15.260	12,4	2,2
Carbón	10.442	8,5	-23,7
Eólica, solar y geotérmica	7.394	6,0	-1,1
Biomasa, biocarburantes y residuos renovables	6.688	5,4	-1,5
Hidráulica	3.130	2,5	30,6
Residuos no renovables	243	0,2	-3,7
Saldo imp-exp electricidad	659		

*ktep: miles de toneladas equivalentes de petróleo

Fuente: Ministerio de Energía, Turismo y Agenda Digital

CASE OF STUDY: TAU CERÁMICA, S.L.U

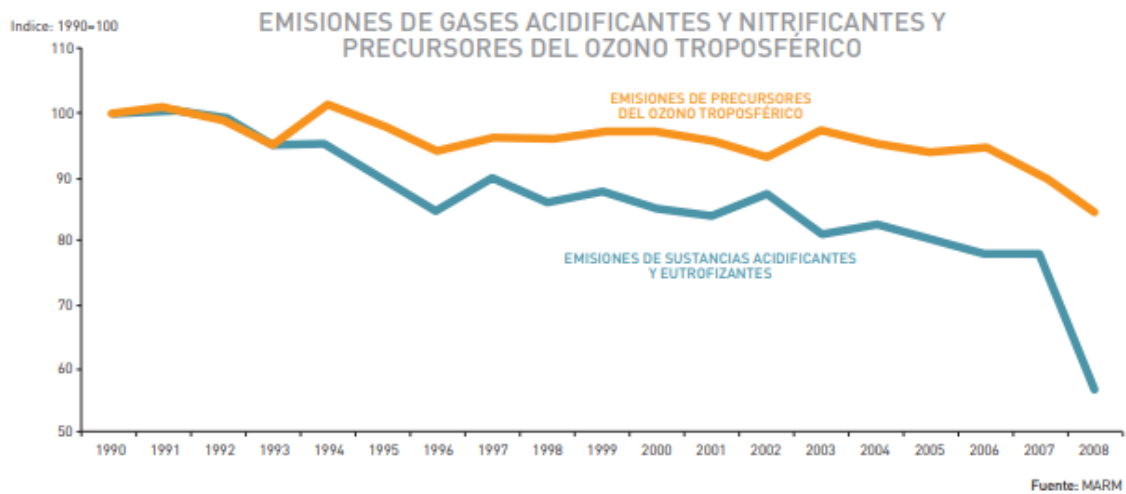
- ANNEXED 2:



PROYECCIONES DE EMISIÓN DE GASES DE EFECTO INVERNADERO MEDIA 2008-2012

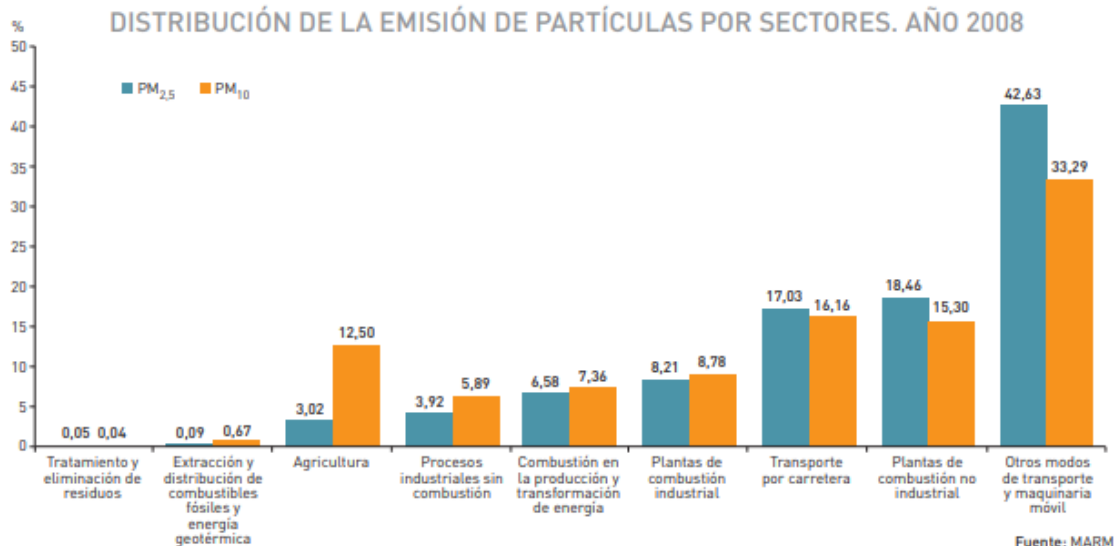
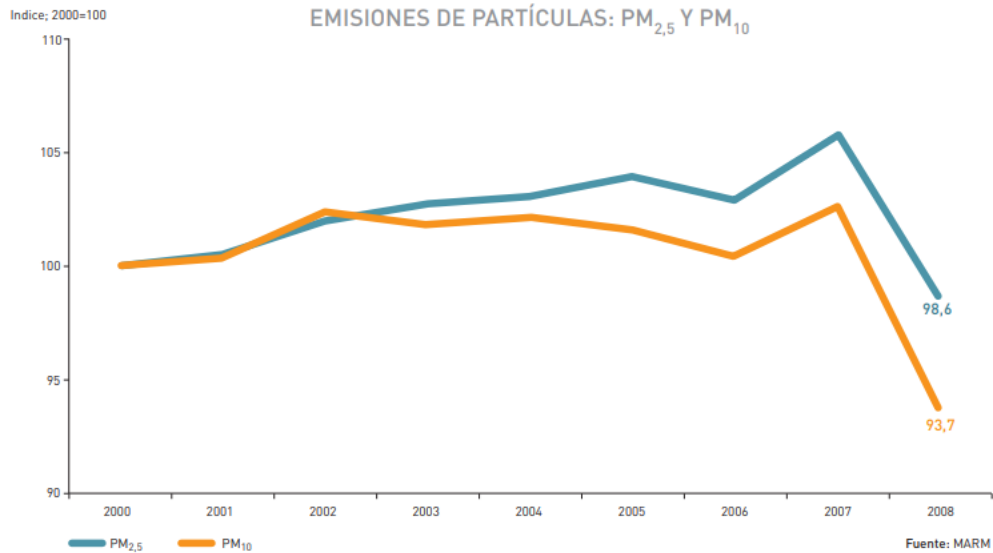
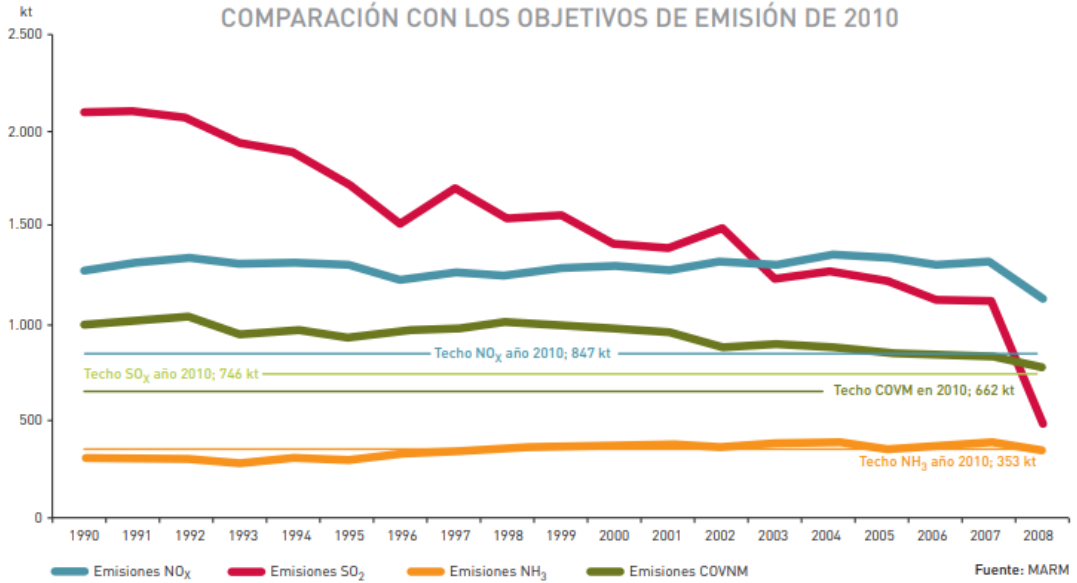
ESCENARIOS	Tendencial (sin medidas)	Base (con medidas)	Objetivo (medidas adicionales)
GEI [kt CO ₂ -eq]	494.761	389.595	390.295
GEI [% frente año base]	70,74	34,45	34,69

Fuente: MARM

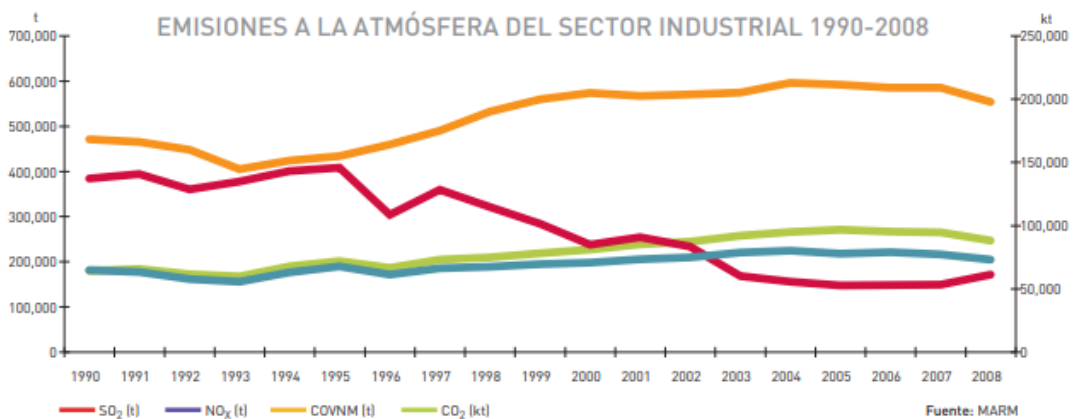
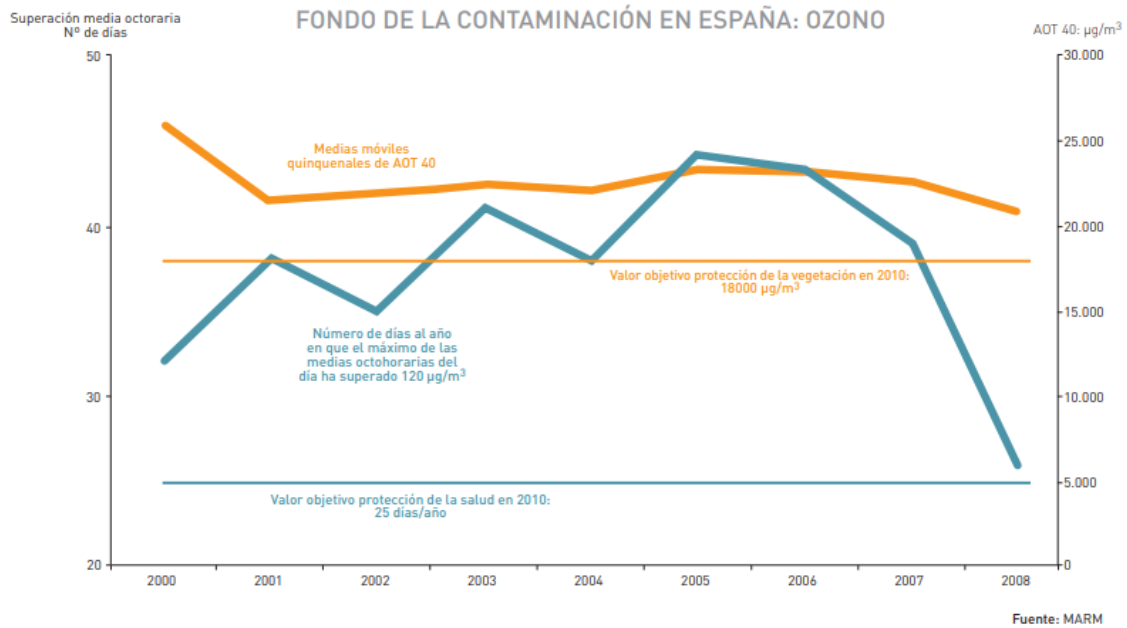
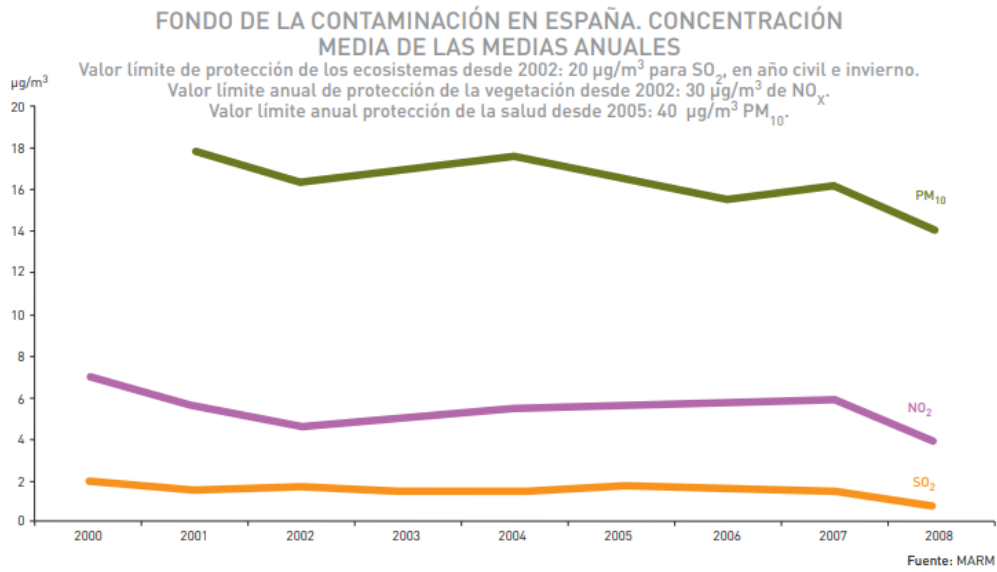


CASE OF STUDY: TAU CERÁMICA, S.L.U

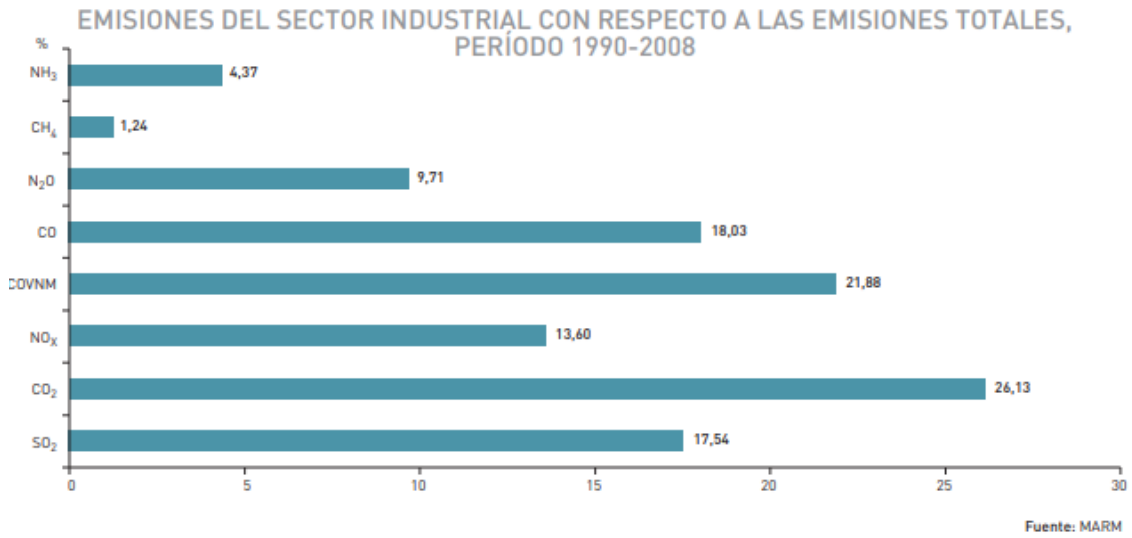
EVOLUCIÓN DE LAS EMISIONES DE SO₂, NO_x, NH₃ Y COVNM EN EL MARCO DE LA DIRECTIVA 2001/81/CE SOBRE TECHOS NACIONALES DE EMISIÓN. COMPARACIÓN CON LOS OBJETIVOS DE EMISIÓN DE 2010



CASE OF STUDY: TAU CERÁMICA, S.L.U



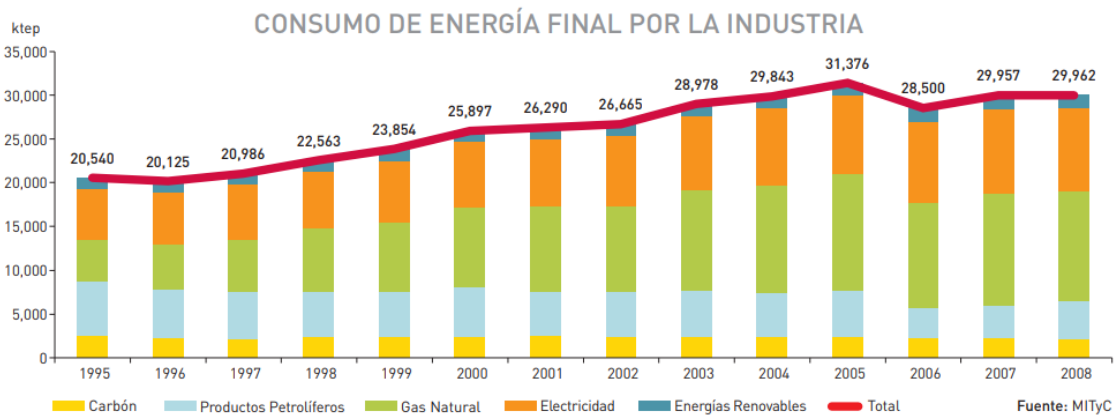
CASE OF STUDY: TAU CERÁMICA, S.L.U



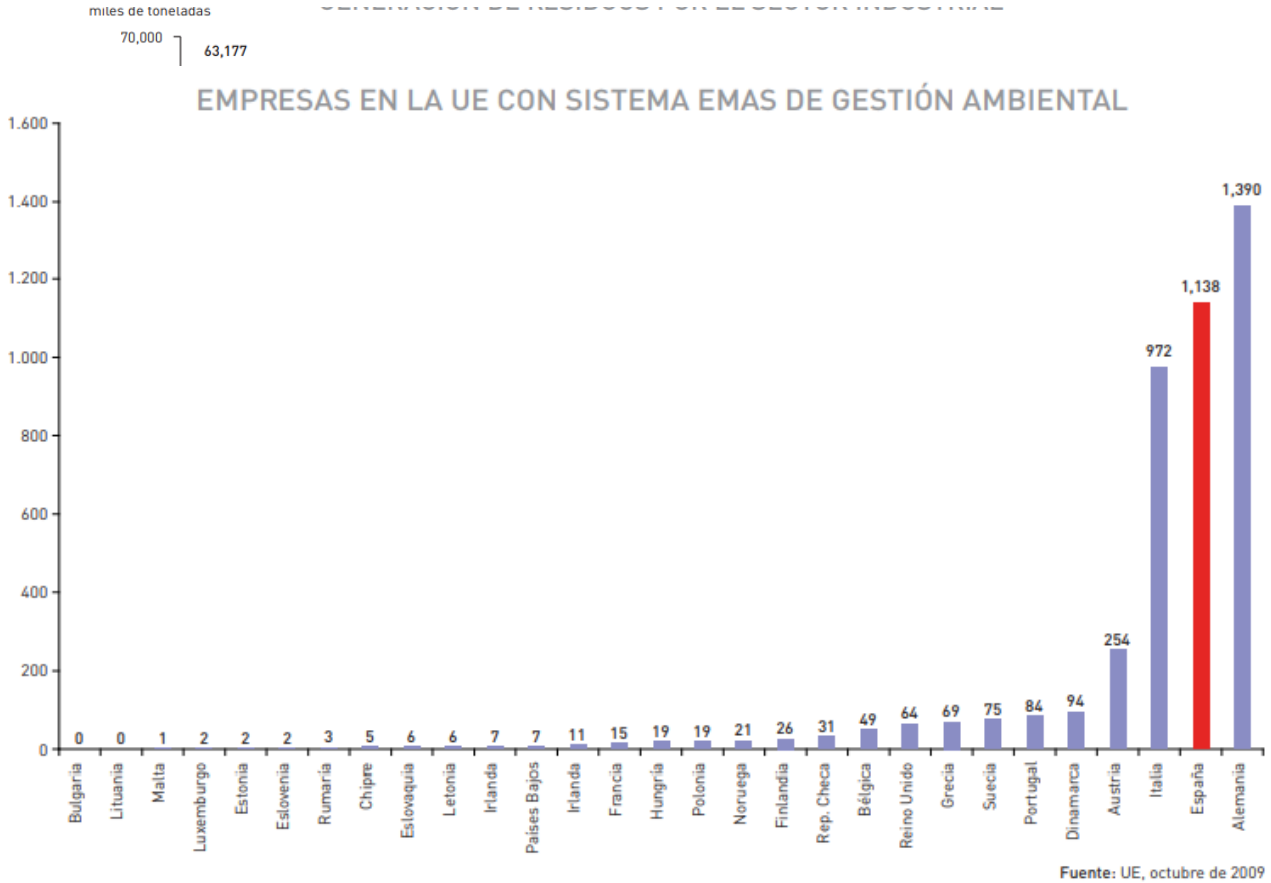
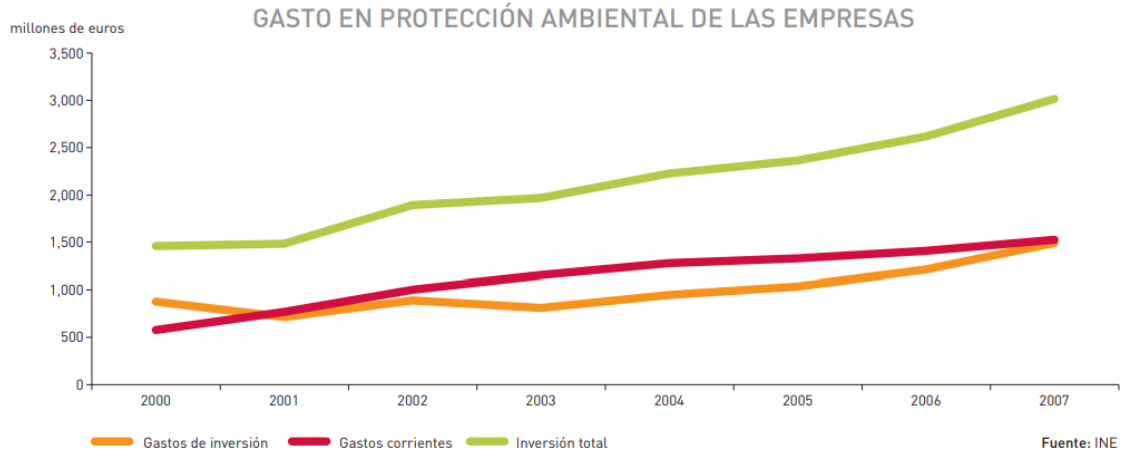
EMISIÓN DE GASES FLUORADOS (kg)

	1990	2003	2004	2005	2006	2007	2008
SF ₆	2.800	8.689	10.628	11.365	13.541	14.225	14.814
HFC	205.400	1.813.521	2.052.598	2.250.498	2.406.353	2.579.749	2.742.910
PFC	131.825	39.430	40.073	35.943	36.324	36.514	37.480

Fuente: MARM



CASE OF STUDY: TAU CERÁMICA, S.L.U

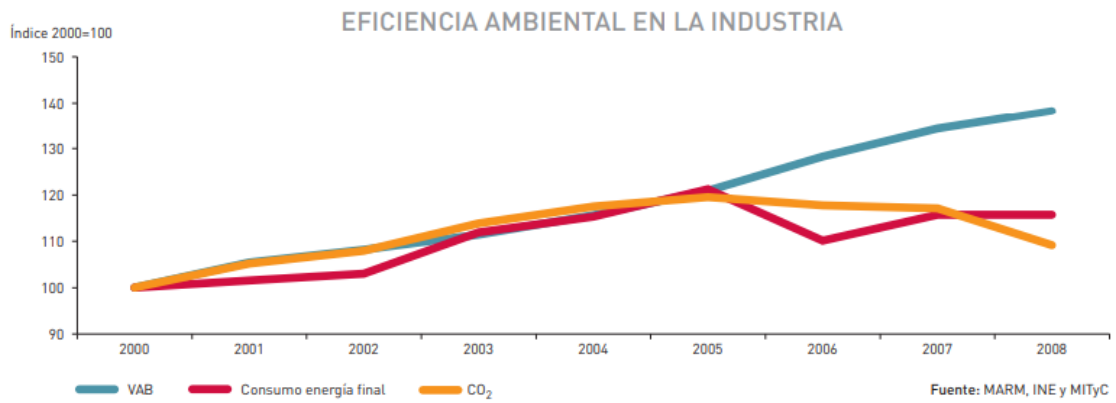


EMPRESAS INDUSTRIALES EN ESPAÑA ADHERIDAS AL EMAS 2003-2009

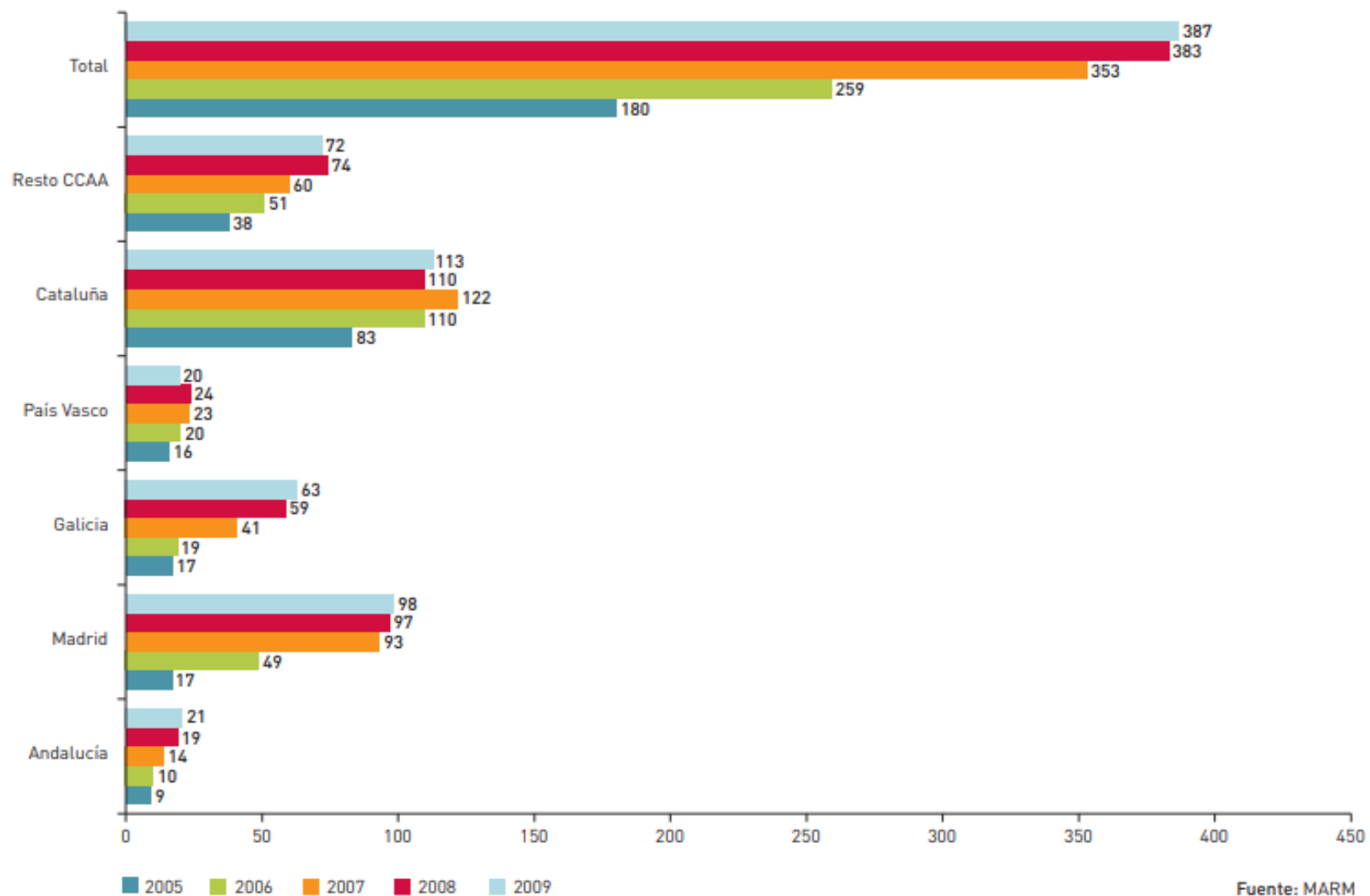
2003	2008	2009	Incremento 2008/2009	Incremento 2003/2007
136	383	387	1 %	184 %

Fuente: MARM

CASE OF STUDY: TAU CERÁMICA, S.L.U



EMPRESAS ESPAÑOLAS INDUSTRIALES ADHERIDAS AL EMAS



CASE OF STUDY: TAU CERÁMICA, S.L.U

- ANNEXED 3:

TAU Cerámica		HOJA DE PROGRAMACIÓN LÍNEAS																	
DIA	LÍNEA 1	nº modelos = 12				m2/modelo = 6.000					LÍNEA 2	nº modelos = 13			m2/modelo = 5.770				
	FORMATO: 60X120	m2 totales	REC	SP	PUL	20X120 REC	20X120 SP	20X120 PUL	30X120 REC	30X120 SP	FORMATO: 60X60	m2 totales	1A	REC	SP	PUL	30X60 REC	30X60 SP	30X60 PUL
		72.000	3.000	0	69.000	0	0	0	0	0		75.010	8.500	31.900	3.000	24.365	2.445	0	4.800
01-may	PRODUCTO A	4.000			4.000						PRODUCTO B	4.500	4.500						
	PRODUCTO B	4.000			4.000						PRODUCTO I	6.245	4.000	1.500			745		
02-may	PRODUCTO A	3.000			3.000						PRODUCTO C	2.000			2.000				
	PRODUCTO D	2.000			2.000					PRODUCTO D	1.000			1.000					
	PRODUCTO F	6.000			6.000					PRODUCTO B	8.500		4.000		3.000				1.500
	PRODUCTO B	1.500			1.500														
03-may	PRODUCTO A	5.000	2.000		3.000						PRODUCTO E	3.000		1.500		1.000	500		
	PRODUCTO B	3.000			3.000					PRODUCTO I	4.000		700		1.300	700			1.300
										PRODUCTO J	2.000		700		1.300				
04-may											PRODUCTO H	3.140				1.140			2.000
	PRODUCTO F	4.000			4.000					PRODUCTO B	1.450				1.450				
	PRODUCTO H	2.000			2.000					PRODUCTO B	2.175				2.175				
	PRODUCTO I	3.000			3.000					PRODUCTO H	1.500		1.500						
	PRODUCTO J	2.000			2.000					PRODUCTO A	2.500				2.000	500			

CASE OF STUDY: TAU CERÁMICA, S.L.U

TAU Cerámica		HOJA DE PROGRAMACIÓN LÍNEAS														
DIA	LÍNEA 3 FORMATO: 75X75	nº modelos = 21				m2/modelo = 3.273				LÍNEA 4 FORMATO: 90X90	nº modelos = 23				m2/mo delo = 2.848	
		m2 totales	REC	SP	PUL	37X75 REC	37X75 SP	37X75 PUL	25X150 REC		m2 totales	REC	SP	PUL	20X120 REC	25X150 0 REC
		68.725	31.185	360	36.800	380	0	0	0		65.500	65.500	0	0	0	0
01-may	PRODUCTO A	2.400	400		2.000					PRODUCTO A	2.000	2.000				
	PRODUCTO B	2.227	1.847			380				PRODUCTO F	2.000	2.000				
	PRODUCTO C	2.500			2.500					PRODUCTO B	3.000	3.000				
02-may	PRODUCTO B	4.200	1.200		3.000					PRODUCTO A	2.500	2.500				
	PRODUCTO D	3.000			3.000					PRODUCTO B	4.000	4.000				
	PRODUCTO A	3.000			3.000					PRODUCTO D	3.000	3.000				
03-may	PRODUCTO E	4.000			4.000					PRODUCTO B	4.000	4.000				
	PRODUCTO F	4.000			4.000					PRODUCTO H	4.000	4.000				
	PRODUCTO C	3.000			3.000											
04-may	PRODUCTO A	5.000			5.000					PRODUCTO E	3.000	3.000				
	PRODUCTO B	3.010	710		2.300					PRODUCTO E	2.500	2.500				
										PRODUCTO H	3.000	3.000				
										PRODUCTO A	3.000	3.000				

CASE OF STUDY: TAU CERÁMICA, S.L.U

		HOJA DE PROGRAMACIÓN DE LÍNEAS								
DIA	LÍNEA 5 FORMATO: 60X120	nº modelos = 9				m2/modelo = 7.944				
		m2 totales	REC	SP	PUL	20X120 REC	20X120 SP	20X120 PUL	30X120 REC	30X120 SP
		71.500	0	0	0	71.500	0	0	0	0
01-may	PRODUCTO A	6.000				6.000				
	PRODUCTO B									
	PRODUCTO D									
02-may	PRODUCTO B	4.000				4.000				
	PRODUCTO J	4.000				4.000				
03-may	PRODUCTO A	15.000				15.000				
	PRODUCTO C									
04-may	PRODUCTO C	10.000				10.000				
	PRODUCTO J	7.000				7.000				

