Situation and challenges of the Spanish ceramics cluster

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INDEX

INDEX OF ILLUSTRATIONS

0.INTRODUCCIÓN

The current environments in which companies develop their activities are completely changing and totally globalised, therefore, locating the company within a cluster, where the companies that develop the activity within it are geographically delimited, can be a great competitive advantage, which adds value and is really capable of making the difference between several companies.

The subject of this work is related to some of the subjects that I have studied during my university studies and that have attracted my attention in order to carry out the work on this topic. In addition to being subjects that I have enjoyed in the classroom, I wanted to know more about them and that I like to learn about these subjects.

The subject that is most related to the selected topic is Industrial Analysis and Business Networks (AE1043), where we have constantly worked on the concept of cluster and we have seen different examples of how it is developed throughout the world.

In addition, other subjects that have helped me to choose the topic are Macroeconomics (AE1006, AE1015), because I have always been interested in how the economy moves globally, Microeconomics (AE1004, AE1020), seeing for example what would be the optimal situation of the markets or the exact number of companies that lead to the maximum efficiency of the market, the subjects related to history (AE1008, AE1017), where we saw how certain definitions that we will see in this work were developed, or the subject of Migrations and Globalization (AE1046), where we see how countries trade and the consequences that this has for the economies of the different countries.

Although the fundamental point of my choice has been the university internship (AE 1048) within a tile commercialization company. When I started to do an extracurricular internship in a company in the sector in the summer, to begin to discover the world of work, I realised the vital importance of the sector for the territory where it operates and where we live, so seeking to learn more about it has been fundamental for the choice of the subject.

The main objectives of the first part of this work are to specify the definition of the cluster concept, its development throughout history, the advantages that companies can find by locating themselves within one of them or to establish a comparison with a similar concept such as the industrial district, highlighting the differences and similarities of both concepts.

In addition to these more theoretical objectives, later in Chapter II we will see what the ceramics industry consists of and understand the production process in a simple way.

Other objectives in Chapter II are to get to know the ceramic cluster in Spain and Italy, to understand how current global problems have a direct impact on them and to find out the advantages and disadvantages of the process of acquisition of companies in the sector in the Castellón cluster by foreign investment funds.

The objectives of Chapter III are to decipher the position that the cluster will adopt in the coming years with the ecological transition that it will have to make and what the best options will be for changing its energy model.

At this point we will also be able to see what position the states should adopt on this issue, whether they should be more permissive with polluting industries until they find a real alternative or whether they should start demanding reductions from now on, with all that this entails.

In order to carry out this work, I am going to carry out various research projects using scientific articles that develop the subject of the work, as well as certain journalistic articles on more current topics in order to obtain the most up-to-date data possible. In addition, with the help of the tutor to establish the topics to be dealt with, correct mistakes and help me to obtain sources of information and to direct the work in an appropriate way. At some points of the work, I will also develop my opinion on the topic being dealt with.

The choice of the topic for the work was very simple for me, because the tile sector attracts my attention as it is so much a part of the culture of the province and so important at both territorial and national level, as it is an industrial sector with high added value and for which we are known around the world.

Another important reason for my selection is that I am currently working in a company in the sector and I am very interested in how it is developed internally. In addition to working in a company in the sector myself, having both family members and close friends working within companies in the sector in multiple positions has also helped me to become familiar with and interested in my chosen subject.

One of the things that most strikes me is that tile production is so geographically concentrated in this area, because I like to investigate and learn why this concentration could be an advantage when it comes to developing the activity, instead of being

geographically delocalized like other industries and how in a globalized economy, it still makes sense to have certain industries geographically concentrated in one area.

Finally, I am very interested in researching innovative projects that seek to decarbonise industry and achieve global targets for the reduction of pollutant emissions, as this is a problem that concerns us all, and to see how we can make these projects come to fruition.

To start introducing the chapters, I am going to summarise the points that we are going to see throughout the work.

In Chapter I we find how to define what a cluster is, the factors that lead to its successful development, examples of successful clusters, the differences and similarities with the concept of industrial district, how competition helps the correct development of the companies.

In chapter II, we will work on the ceramic industry, its functioning and history in two of the main producing countries, Spain and Italy, and we will also delve into the current problems of rising production costs that both territories are suffering, such as the rise in fixed production costs that increase the price and make them lose competitiveness and the current situation of the properties of the tile companies in the Castellón cluster, where the ownership of the companies is increasingly centralized in more hands, tending towards an oligopoly, and we will also see a very simple explanation of the production process.

In Chapter III of the work, we will see the great challenge facing the ceramic industry in Castellón, as it is an energy-intensive industry, it is highly polluting, so it will have to look for new sources of renewable and environmentally cleaner energy. Moreover, these innovations must be capable not only of generating, but also of storing and transporting all this energy on an industrial scale.

I will also highlight several projects that are being carried out to become less dependent on gas and to reach the long-term goal of decarbonising energy production. These projects are mainly based on green hydrogen, its production and implementation.

To conclude this point, we will highlight the importance of becoming one of the main developers of new, cleaner energy sources for the environment.

To conclude, we will see a final reflection on the work where I will highlight the points that have most caught my attention, possible works that may arise after carrying out this

work, whether the objectives set out in the introduction to the work have been met and, finally, a small personal reflection on the work as a whole.

CHAPTER I: THE INDUSTRIAL CLUSTER

In the first chapter of the paper, we will look at a theoretical definition of cluster and industrial district. The aim of this chapter is to show the reader the convergence of both definitions and to explain how competition between firms is fundamental to foster innovation within the cluster.

1.1 Cluster

Throughout this chapter of the work we will go through different points to understand the concept of cluster in a simpler way, through some sections such as the definition of the concept of cluster, the life cycle and the factors that can make the cluster develop its activity successfully, the evolution of the concept through Porter's definition, the differences and similarities with similar concepts such as the industrial district and how competition is a fundamental part of the internal development of the companies that make it up and that it is an inherent part of it in order not to decline.

1.1.1 Cluster Definition

The basic definition of the cluster concept is based on the concentration of a number of companies and institutions in a limited geographical area that tend to converge in objectives and are connected to each other in a particular sector.

The geographical and sectoral limitation means that firms have to both compete with each other and cooperate in innovation.

Clusters are made up of a main industry and may have several complementary industries among them, as several sub-industries may arise around a main industry that provide their products and services so that the main industry can develop properly.

Among the sub-industries that can emerge to support the cluster, we can find those that provide components, machines or specific services focused on the main industry.

1.1.2 Cluster Life Cycle

As we will see below, the cluster goes through different stages until it reaches the end of its journey, where we will highlight 3, the initial stage, a growth stage and a maturity stage. Finally, we will integrate a stage of decline in order to explain what happens to the clusters that cease to be competitive and are out of the market, finally having to abandon their activity.

In the initial stages we can see that the cluster is not yet established, as the companies are very small and the technology found in the cluster is of low value and hardly differentiated from other industrial areas. As a consequence, the networks that are woven between companies are still very unstable.

The first stage that we can highlight is the growth stage, in which, after an initial stabilization stage, the market expands and new companies enter the cluster.

It is in this stage that the companies in the cluster innovate more and in a more radical way, which means that the cluster loses heterogeneity at the beginning, but it helps the companies to expand more quickly.

In the second stage we see maturity, where the cluster manages to stabilize, the companies leave aside the process of product innovation and expansion and tend more towards heterogeneity. It should also be noted that in this stage innovation is more focused on processes and where the barriers to entry into the cluster are very high. After this, the companies that operate within the cluster begin to compete on price, leaving the less competitive companies out of the market and finally having to abandon their activity.

In the final stages of the cluster's development, we can see that the companies that make up the cluster have a high degree of heterogeneity, as hardly any new companies enter the cluster and the degree of innovation is very low.

The stage of decline is when the companies that make up the cluster cease to be competitive, do not manage to produce the goods that the market demands and the location of the cluster is no longer important, as it does not provide any advantage. When this happens, if it is not possible to reactivate the companies through radical innovation, the companies will tend to reduce their productivity and the less competitive ones will be driven out by the market.

Finally, it is important to highlight the great importance of temporary location within the cluster, since a company that has been integrated into the cluster for years will have obtained all the benefits that the territory offers and will have had much lower or no barriers to entry, and will have been able to position itself more easily within the market.

1.1.3 Cluster success factors

According to the Revista Gallega de Economía and the University of Santiago de Compostela, the most important factors for a cluster to develop successfully are the following:

- Research and development capacity: The existence of a constant force within R&D&I, whether through public or private centres, that is capable of carrying out valuable research that will both solve their problems and help to further develop the sector.
- Knowledge and skills: The workers that make up the companies must have the appropriate knowledge to carry out the work.
- Proximity of suppliers: Suppliers, whether primary, secondary or raw material suppliers, should be located close to the cluster to increase the ease and speed of doing business with them.
- Availability of capital: banks in the area understand how the industry works and know the key players in the cluster and are able to provide them with seed capital and access to venture capital to exploit new opportunities.
- Access to specialized services: access to specialized services both public, such as technology centres or business centres, and private, such as those provided by consultants, accountants or lawyers.
- Innovation: that technological advances are conceived, developed and adapted quickly and that products, processes and services using these new advances are also developed quickly in order to be able to adapt to new demands more quickly and thus to be able to move faster in the market and have a competitive advantage.
- Machine and tool manufacturers: that the companies that design and manufacture the machines, tools and software used by cluster members are located close to the cluster and that there is also a good working relationship that allows for interactive promotion of different improvements.

- Shared vision and leadership: that the companies in the cluster see themselves as a system, that they share common plans and objectives, that they have a vision for the future and that they also have leaders who maintain their competitiveness and sustain them.[1]

[1] This section of the paper has been elaborated through the Revista Galega de Economía, vol23, núm.2, May-August, 2014, pp.179-198.

1.2 Evolution of the cluster concept

The concept of cluster is defined by the theorist Michael Porter and we will see what it is about in the following. In addition, we will look at examples in the real economy of clusters that everyone has heard of, but are not clear whether they are clusters or not.

1.2.1 Michael Porter

Michael Porter began to develop this concept in the studies he carried out (Porter, 1990) and gave an initial definition: "clusters are geographical concentrations of interconnected companies and institutions operating in a given field".

Porter (1998) broadened the definition of his original analysis to take into account the local environment, in order to identify, define and delimit the clusters and where his main objective was to explain the competitive nature of the companies that make them up.

For this Porter developed several systems over the years, first with the value chain model (1980), then the well-known Porter's diamond (1990) and finally the one that was developed within the framework of the cluster (1998).

Clusters are developed within a global economy where everything is interconnected and therefore represent a different way of organising companies, where the concentration of these companies in a specific geographical area and sector is the key to success.

Another point to which Porter attaches great importance and which will be developed later in the paper, is that the concentration of companies makes them compete strongly in order not to fall behind their competitors, so that there is strong competition within the cluster, but also a comparison between them, which helps them to compete with companies located outside the cluster and gain market share.

It also highlights that the cluster helps firms to compete as a group and that they can take advantage of economies of scale and ancillary industries to carry out their tasks more easily. In addition, they have access to technical and competitive information,

where members can have preferential access to it, and this, together with personal relationships and links, facilitates the flow of information.[2]

[2] This section of the paper is based on the article: Ortega-Colomer, Javier & Molina-Morales Frances Xavier (2010). Debate on the concepts of cluster and industrial district. EASST 2010 Conference. University of Trento, Italy 2-4 September 2010.

1.2.2 Cluster examples

In recent years, through the development of this concept, we have found clear examples of consolidated clusters that are of great importance and relevance on a global scale, including the following:

- Silicon Valley: Located in the San Francisco Bay Area, it is one of the most important clusters in the world, being mainly made up of technology companies such as Twitter and Google and having a strong link from its beginnings with Stanford University.
- Bangalore Technology Cluster: The companies in this cluster are mainly focused on the development of information technologies and before being known as the Asian Silicon Valley, it was integrated within the aeronautics industry. The companies that make up this cluster are of Indian origin, due to being one of the countries with the greatest technological development, as well as foreign companies that have established themselves there in search of qualified employees, but with lower salaries.
- Riviera Maya: This is a tourist area located in Mexico where a large number of companies in the tourism sector are concentrated, such as hotels, restaurants and excursion companies, which are dedicated to the economic exploitation of the Yucatan peninsula.
- Detroit: In the American city we find a strong automotive industry, since we can find 3 of the most important companies in the industry, such as General Motors, Ford and Chyrsler. It also has auxiliary industries that help the correct development of the automobile industry, one of the most important since 1 out of every 10 Americans works directly or indirectly in the automobile industry.
- Paris: The fashion industry in the French city is one of the most important clusters in France, with an annual turnover of around 150000 million euros and employs a large number of people, ranging from garment manufacturers to designers and models.[3]

[3] This section of the paper has been developed from Yavendra.com (2022). 10 Examples of clusters. Retrieved 14 April 2022.

As we have seen throughout this point, clusters can develop in different locations all over the world, in completely different environments, be they fully developed or developing countries, and regardless of whether they are industrial or service sectors.

1.3 How cluster companies compete

At this point, we will focus on explaining what the concept of competition is and how it helps to develop business projects within the cluster in a more optimal way.

1.3.1 Concept of competition

According to the RAE (Royal Spanish Academy) competition is the "dispute between two or more people for something" and in the field closer to companies we find a different definition from the same source "Situation of companies that compete in a market offering or demanding the same product or service".

When rivalry exists between companies, they will seek to increase their productivity and innovate constantly. This will result in better products and services, lowering the price and increasing the number of products or services offered, which is a great advantage for the final consumer, so that domestic demand can increase considerably.

The antithesis of competitiveness is the monopolistic practices found in some business sectors. Monopolies do not encourage innovation and reduce the supply of products or services, furthermore, by having sole control of the market, they can set the price that suits them and will depend on the elasticity of demand of the market to set a price.

1.3.2 Cluster competence

Clusters tend to make the companies that make up the cluster tend to compete and at the same time cooperate. Competition between companies makes them innovate and have to maintain and improve the products they market in order not to lose market share to the competition, and at the same time they tend to cooperate with each other in order to obtain much greater vertical growth.

Competition today is closely related to the productivity that a company is able to generate, no matter what field they are focused on, whether it is a simple production

industry such as textiles or a more complex production industry such as robotics, in all of them advanced methods and technology can be used to be more productive.

Aspects of the cluster environment are also crucial for the proper development of economic activity, since, for example, a good road and transport network is essential for a good logistics service.

Clusters help companies to compete more efficiently in different ways, such as increasing the productivity of companies, imposing a high pace of work and a route for the companies that make up the cluster and encouraging the creation of both main and auxiliary companies within the cluster so that it can strengthen and expand. The possibility of being able to measure your results with companies that are close to you and that have similar objectives to yours, makes the vision of the companies located in the cluster clearer than that of companies in the same industry that act alone.

Belonging to a company that is established within a cluster has some advantages for developing its activity in that particular geographical area. These advantages include easier access to specialized employees and suppliers who have experience in the sector, specialized and specific information on activities or processes to be developed and access to public institutions that help the development of the cluster or by obtaining tax credits or subsidies.

The companies that make up the cluster will try to increase their productivity constantly, therefore, the productivity of the companies will increase, so that the price and quality of the same will have a positive impact on the final consumer, as well as increasing the supply of the same. In addition, when companies become more competitive and productive, business will increase, so companies will be able to grow and achieve higher profits. The growth of companies will have a positive impact on the labour market, as companies will demand more workers, usually from the area, which will help to increase the internal demand in the area where the cluster is established.

Finally, the importance of the cooperation of the companies that make up the cluster is fundamental for its correct development, taking advantage mainly of the economies of scale and the value of the benefits that the companies can find. For example, if a company that is integrated within the cluster receives an award for the product or service it is offering, it helps to increase the value and prestige of the cluster, which benefits the rest of the companies that make up the cluster.

To conclude this section, I would like to stress the importance of competition and innovation within the same sector, as it is vital for companies to invest in innovation in order to remain competitive.

1.4 Industrial district

In this section we will learn about the definition of an industrial district, after which we will learn about the main similarities and differences between this concept and the previously described cluster.

1.4.1 Definition of industrial district

An industrial district is a concept that began to be developed by Marshall in the 19th century in order to explain concentrations of factories, where productive operations were centred in the same place. Marshall's main approach was later developed by other theorists (Porter 1992, Becattini 2002).

This approach was used again in the second half of the 20th century, where it was intended to explain how the industrial district model could help innovation, because the high turnover of demand did not allow time for firms to adapt and small firms that shared information to adapt to new realities.

As Becattini (1990) points out:

A socio-territorial entity characterised by the active presence of a community of people as well as a population of firms in a natural and historically delimited area. In the district, unlike other environments, such as manufacturing cities, the community and firms tend to merge.

In addition, the author coined the term sense of belonging (factors such as territory, culture or history) as a sociological criterion to classify companies belonging to the district.

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1.5 Comparison between concepts

The concepts of cluster and industrial district are very similar, so it is very convenient to clarify the possible differences between the definitions of both concepts, so now, after knowing the definition of industrial district, we will focus on the similarities and differences between both concepts.

These concepts have very similar roots, so that in the definitions of both we find very similar characteristics, such as the concept that companies have to develop their industrial activities within a specific geographical boundary and also the concept of a sense of belonging to the grouping of companies.

Another of the similarities that we find between the two concepts are their relations with the outside world, these being auxiliary activities to the activity carried out by the main industry and which significantly help the development of the latter

The concentration of companies in a limited territory means that they have to compete fiercely, so the constant innovation of companies within both concepts is another point in common between the two concepts.

The last similarity that we are going to develop is the importance that the industries of both concepts have within the place where they are developed is of vital importance for the territory, so that this can be completely reflected in it and so that the industry that is developed can become something that is incorporated into the culture of this territory and the people have much greater implications.

After highlighting the most important similarities between the two concepts, we now move on to explain the most relevant differences, among them we find the starting point of both definitions: for Becattini, the industrial district is a method of analysis of the economic reality and where the relationships that are made with the environment lead to local development.

Meanwhile, Porter sought to explain that the performance of companies could vary depending on their location through what he coined as the theory of the firm.

Thus, we can observe very similar starting points (use of the territory as the centre of the analysis) but there are some concepts such as objectives, development or final proposals that differ significantly.

Another point of difference between the two concepts is the relationship between the companies that make up the cluster or the industrial district and the institutions around

them. The industrial district is described as a system-supporting asset and as a provider of real services to firms, whereas in the cluster, institutions and governments act by improving or supporting firms, such as subsidies for firms to develop new products.

The way of understanding and describing both concepts is also different, as the definition of industrial district is more difficult to understand due to its lack of clarity, while Porter's definition of cluster is much easier to understand, although it also has some inaccuracies such as the description of the geographic boundary: "the geographic scope of a cluster can be a single city or state or a country or even a network of neighbouring countries" (Porter 1998, p.199).

Finally, the objectives of industrial districts and clusters differ. While Becattini tries to understand how some Italian areas have reached higher levels of development, I have tried to explain how a community of people can become integrated into a population of firms and seeks to generalize the results to other countries. Whereas Porter focuses more on trying to explain the business aspect and considers that countries will enjoy higher levels of welfare if companies manage to develop their activities in a more competitive way and that for this to happen the company must be located in an optimal location in the value chain.

As a final conclusion to this point, it should be noted that both concepts are very similar, but for the scientific community, depending on the social reality and the author's environment, they can be conceived very differently from each other, so comparing both concepts is of great value.

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[4] This section of the paper is based on the article: Ortega- Colomer, Javier & Molina-Morales Francesc Xavier (2010). Debate on the concepts of cluster and industrial district. EASST 2010 Conference. University of Trento, Italy 2-4 September 2010.

CHAPTER II: CERAMIC INDUSTRY AND CLUSTER

During this chapter of the work, I am going to work on several points of the ceramic industry, we will first see a definition, the production process of the tile and its development throughout history. We will also highlight the importance of the Spanish and Italian clusters and we will see the current problems they are going through.

2.1. Ceramics industry

In this section of the paper, we will see what the ceramic industry is about, how it has come to our days, the vital importance and the emergence of the Castellón cluster and a comparison between the Spanish and Italian ceramic clusters, both world leaders in the sector. In addition, we will see the current situation of both, which has been seriously affected by the rise in prices of materials and fixed costs of production, which makes both lose competitiveness in a globalised market. Finally, we will look at the current situation of the Castellón cluster and how, over the years, it is tending towards oligopoly.

2.1.1 Industry definition

The ceramics industry stands out for the production of ceramic materials that are used for floor coverings, known as flooring, or wall coverings, known as cladding. In addition, there is another type of more artisanal ceramics, which consists of the production of simpler utensils such as plates, cups or tiles.

The mechanisation of production allows for faster production and at the same time allows you to lower your production costs in the long run.

Industrial ceramics (floor and wall tiles) are produced continuously and on a large scale, requiring very powerful machinery and considerable resources, both in terms of money and personnel, while handmade ceramics are usually produced in discontinuous cycles and have fewer resources for their production.

For the production of ceramics, it is also important to highlight the type of raw materials that are used for production, highlighting two types of clay for this purpose, white and red. Although the difference between the two is not of great significance, ceramics made

of white body have a much higher prestige, so that brands that seek to focus on adding value to their products, use them more often.

2.1.2 History and development of the industry

Although it is difficult to date exactly the first samples of ceramics applied to architecture, it is known that the Egyptians, more than 4600 years ago, were already using it.

In the 13th century, due to the Islamisation of the peninsula, the first tiles appeared in Andalusia, which can be seen in their use in the Alhambra in Granada (13th century).

In the 14th century, ceramics entered the Valencia region for the first time and began to be exported to other countries such as Turkey and Syria.

The Valencian industrial area was consolidated at the end of the 19th century. This process became even more accentuated at the beginning of the 20th century, when Valencian production was centred in Manises and Onda, towns that had a training centre since 1916 and 1925 respectively.

From 1981, with the arrival of gas in the factories, changes of vital importance began to take place in the sector, as it allowed direct contact between the tiles and the gas for better firing, as well as more dynamic transport processes, which increased quality, reduced waiting times and therefore increased production.

With the passage of time and a large number of innovations, such as new material transport systems inside the kiln or improvements in the quality of the products, such as the increase in models and sizes of the pieces, the cluster was consolidated at world level, thus becoming the first European producer and second at world level, becoming, together with the Italian cluster, the leaders in design, quality and trade.

5

[5] Esta sección ha sido elaborada a partir de la *Historia de la cerámica, ASCER.*

2.1.3 Production process

The production process of the tiles begins with obtaining the raw materials, choosing the most suitable type of clay for the manufacture of the product. This is followed by a sieving process to eliminate the coarsest particles and washing and grinding to eliminate other impurities. In addition, another kneading phase is carried out in order to achieve a much greater homogenization.

Illustration 1: Ceramic company silos

Source: Web Decoración y Cerámica (2015)

After this first part, which focuses on taking care of the raw material, a moulding phase begins, where the dough known as "sponge cake" is moulded to obtain a homogeneous shape in all the units, choosing the format of the piece, for example, 45x45 or 20x120.

After this operation, the pieces will start to go through different machines, the first one will be the drying machine, to remove all the humidity and to harden the mass, then it goes to a glazing area where it receives the engobe and the glaze, where we will gradually see the final result of the tile.

Illustration 2: Ceramic drying machine

Fuente: Web Decoración y Cerámica (2015)

The next operation is digital printing, where we will give colour and design to the product, depending on the model chosen previously, where they will finally fall into wagons to be transferred to the baking section.

Illustration 3: Digital printing machinery

Source: Web Decoración y Cerámica (2015)

The pieces will be deposited in the ovens with rollers that transport the piece autonomously so that they finish "cooking", where the pieces are moved inside the ovens and pass through different temperatures, reaching temperatures of around 1200 degrees, where the last zone of the ovens is the lowest temperature zone so that the

piece cools down and can be handled. In this operation, a small error can mean that the piece comes out with a tare and the process has to start again from zero.

After this, the parts are placed on rollers to be transported to a quality recognition software to check that the parts are not defective, where the correct ones go to the final stage, where they can undergo further processes or go to the storage area, where they are placed in boxes and organised on pallets waiting to be sold.

To conclude this point, we have seen how tile has gone from being a more traditional industry carried out by hand, in an artisanal way, which limits its production, to being a very heavy industry but much more scalable, as we have seen with the production process. This also means that companies have to make greater investments in order to carry out this activity.[6]

2.2. The Castellón ceramic cluster

In this part of the work, we are going to see the history and evolution of the Castellón ceramic cluster, from its beginnings to the present day, we will also see data to verify the vital importance of this sector for the economy of the province of Castellón and how it has become part of the culture of the territory.

2.2.1 History and evolution of the ceramic cluster

The Spanish ceramics industry is concentrated in the province of Castellón, a province of around 570000 habitants, located on the Mediterranean coast in the Valencian Community.

- The Castellón ceramic cluster is made up of various elements, such as large companies and public institutions that help the industry to develop correctly. Among these components we can highlight some of them:
- Pamesa: located in Vila-real and presided over by Fernando Roig, Pamesa is one of the most recognised companies in the sector worldwide, with the highest turnover and production of square metres and the largest number of employees. This institution has been acquiring other factories of very important brands such as TAU or Navarti, thus increasing its market share.

[6] This section is based on an article from the magazine Revista Decoración y Cerámica (2015).

- Porcelanosa: this company located in Vila-real, with a turnover of around 806 million euros in 2018 and which is consolidated as one of the world's premium brands in ceramics, is another major player in the sector.
- STN: located in Nules, STN is one of the most important ceramic groups that make up the cluster, with more than 1000 employees, it is able to supply products to customers in more than 120 countries around the world.
- Halcón Cerámicas Group: located in Onda, a town within the cluster, it is one of the most powerful tile manufacturing companies in the world, with a production capacity of 50 million square meters, thanks to its 21 production lines, which results in an annual turnover of nearly 250 million euros through its 3 brands (Halcón Cerámicas, Cicogres and Emotion Ceramics).
- Baldocer: founded in 1994, Baldocer is another of the province's ceramic companies with a great international reputation, exporting to more than 130 countries and consolidating its position as one of the most prestigious brands on an international level.
- Supplier companies: companies that help the correct development and support for ceramic companies, such as glazes, colours and machinery companies. Among these companies we find some like Altadia, a very powerful glaze company worldwide or companies focused on the production of industrial machinery focused on the tile, among them we find companies like Kerajet or Maincer, all of which are united in their association ASEBEC.
- Service companies: service companies include, for example, transport companies, whether sector-specific and focused on the sector or of a general nature.
- Marketing companies: companies that serve as a link between the producer company and the end customer, provide a sales support service and charge a commission for the service. This type of company is becoming very common in the sector, since, for very small markets, large companies do not have their own sales representatives and work with this type of company in order to be able to sell in these markets.

And among the public institutions that support the cluster we can highlight:

- Training centres: among which the Jaume I University of Castellón stands out, which is a public institution that is also integrated within the cluster, as it develops research projects focused on the sector and offers degrees (Chemistry, Chemical Engineering and Industrial Engineering) with subjects focused on the sector or a master's degree focused entirely on the sector, such as the Master's degree in

Ceramic Technology. It is also worth mentioning the Alcora School of Ceramics, which specializes in training in various branches of the ceramics industry.

- City councils: At this point we would like to highlight the projects carried out by the city councils of the cities where the activity is carried out, such as Vila-real, which in 2021 launched a plan to modernise the industrial estate and among the most outstanding proposals we find that of providing a quality public transport service from the city to the industrial estate, also improving the accesses to the estate.
- Technological centres: among the most outstanding technological centres we can find the ITC (Institute of Ceramic Technology) which was founded in 1969 and which later became part of the Jaume I University.
- Business associations: Here we highlight 3 associations, such as ASCER (National Association of Manufacturers of Ceramic Frits and Glazes), ANFFECC (National Association of Manufacturers of Ceramic Frits, Glazes and Colours) and ASEBEC (Spanish Association of Manufacturers of Machinery and Equipment for the Ceramic Industry).
- Trade unions: UGT and CCOO, although these are more transversal in nature, their function is to provide workers with the best possible working conditions.

To conclude this point, I would like to highlight the importance of the cluster in generating employment within the cluster and outside with auxiliary companies, which is of vital importance for the economy of the province of Castellón.

2.3. International comparison. The cases of Italy and Spain

The leaders in tile production, quality and design worldwide are Spain and Italy, so we will see in this point how both industries develop, the points where each one stands out and we will compare them to know the differences and similarities between them

In addition, we will deal with very topical issues that endanger the normal development of both industries, such as the problems of inflation in production costs that are affecting all markets and are reflected in product prices, or the growing concentration in the management of companies in the Castellón cluster, which could lead to an oligopoly.

2.3.1 Spain

The Spanish ceramics sector is practically concentrated in Castellón, with around 94% of the national production and 80% of the companies dedicated to tiles at national level. It should be noted that, although they do not occupy an important share of the sector, there are also ceramic production companies in Madrid, Toledo and Teruel.

After closing the accounts for the year 2021, the trend that has been marked during the year is positive, with a considerable increase of 20% in turnover and where production is also estimated to be 20% higher than last year, as this was a period very affected by the health crisis of the coronavirus. In addition, exports grew by 19% with a balance of 3022M€ and where the main markets are the European market with a share of 48%, where markets such as France stand out with an accumulated growth of 41.5%, the United Kingdom (45.4%) or Italy (50.3%) and the American continent with 22.5% compared to the previous year. Among the other geographic areas, the Americas (22.5%) and the Middle East (14.2%) also stand out.

Illustration 4: Sales data by geographical area

Por zonas geográficas
millones €

	Datos acumulados del año			
	2020	2021	21/20	cuota
Europa	1.201,7	1.449,3	20,6%	48,0%
Unión Europea - UE27	916,9	1.097,9	19,7%	36,3%
Zona euro	765,5	918,4	20,0%	30,4%
Este de Europa no UE	119,7	144,2	20,4%	4,8%
Oriente Próximo	374,1	429,8	14,9%	14,2%
América	462,9	680,7	47,1%	22,5%
América del Norte	344,5	442,8	28,5%	14,7%
EEUU	290,9	368,7	26,7%	12,2%
América Central	69,5	134,0	92,8%	4,4%
América del Sur	48,9	103,9	112,6%	3,4%
Asia	463,3	521,5	12,6%	17,3%
Asia del Este	71,4	73,1	2,3%	2,4%
Sudeste asiático	21,5	20,8	-3,2%	0,7%
África	258,9	340,7	31,6%	11,3%
Magreb	146,6	181,7	24,0%	6,0%
Oceanía	25,6	30,2	18,0%	1,0%
Total mundo	2.412,6	3.022,4	25,3%	100%

El total mundo es la suma de los totales por continentes

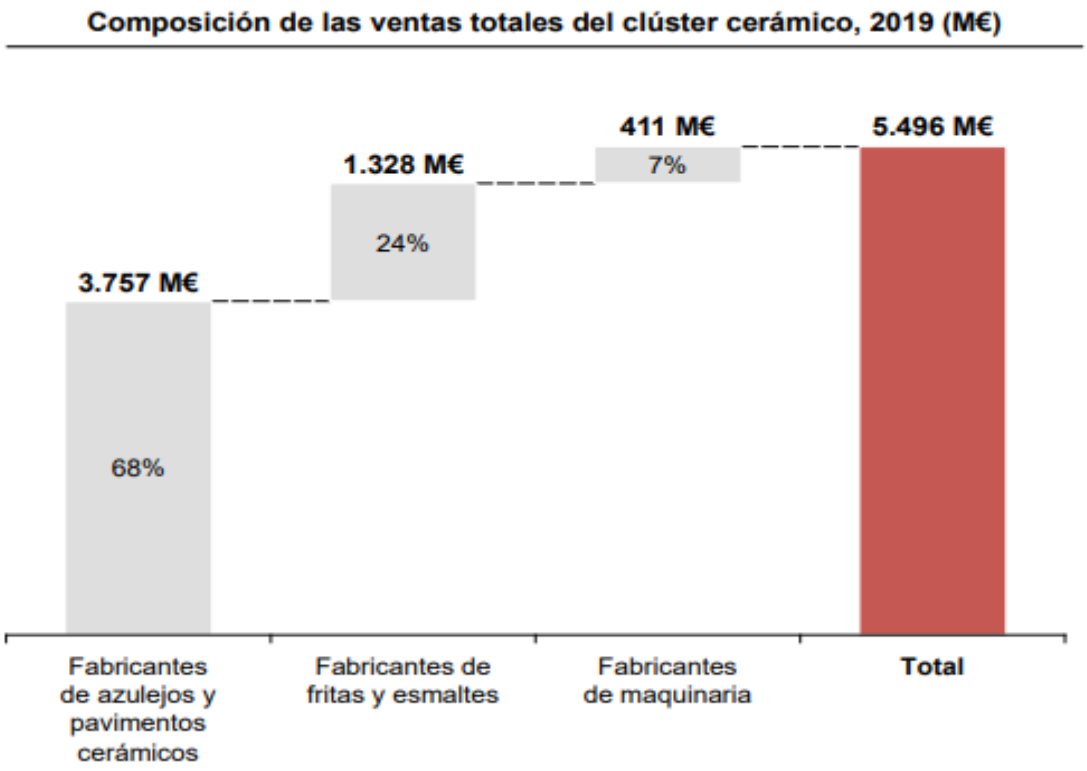
Fuente: INE, (2022)

Despite the current crisis in the sector, we note that the Spanish market is still very strong and has great prestige and recognition around the world, which is why we are able to

offer a wide range of products and services that it is able to withstand this situation and start to reverse it by increasing its turnover again.

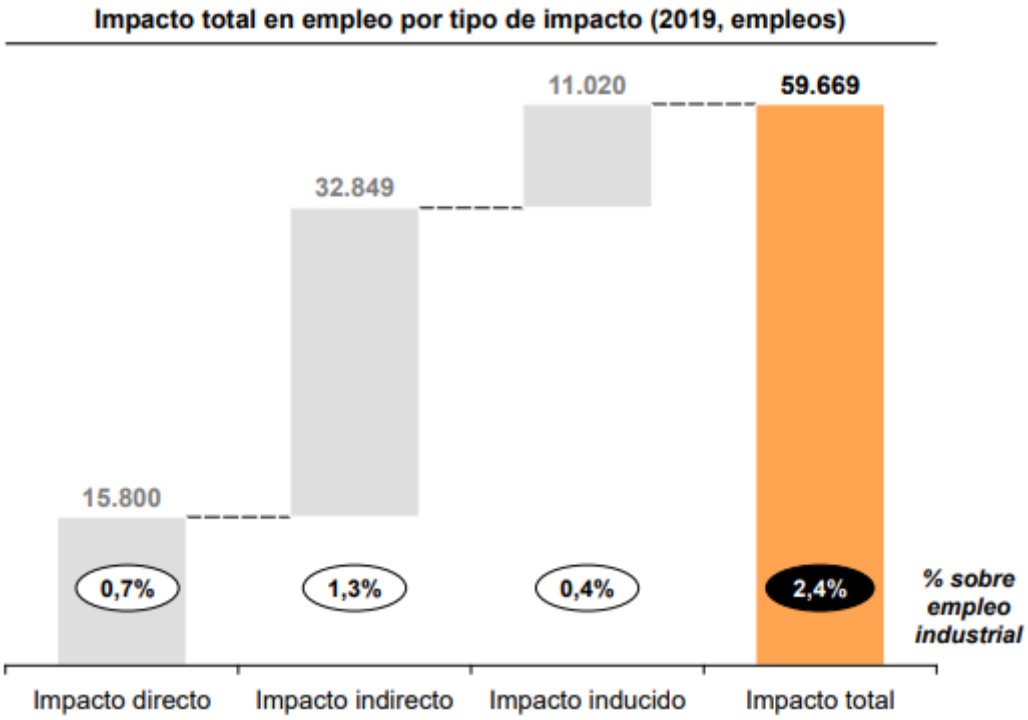
The development of tile activity has led to the creation of auxiliary companies in the geographical area, such as glaze companies, transport companies and machinery manufacturers, thus increasing the cluster's sales, as can be seen in the following graph (Illustration 2) and creating a large number of jobs, which we will find a more detailed breakdown in Illustration 3, showing that the employment generated within the cluster is 2.4% of industrial employment in Spain.

Illustration 5: Composition of total cluster sales (2019)



Source: ASCER (2019)

Illustration 6: Composition of total cluster sales (2019)



Source: ASCER (2019)

The Spanish cluster develops its activity within an ultra-competitive sector at a global level, so it has to face competition and problems from all over the world, in spite of this, it still enjoys a high recognition for its technical and process quality.

2.3.2 Italy

The Italian ceramic sector is mainly located in Sassuolo, a small city of around 40,000 inhabitants, situated in the Emilia-Romagna region, one of the most prosperous regions of the country, has managed to triple its population in the last 50 years due to the development of the tile industry within its territory.

It is one of the world leaders in tile production; in fact, it manufactures more than 80% of Italian ceramic production and remains one of the leaders in Europe, together with the Spanish ceramic district of Castellón.

Tile production in Sassuolo grew out of the earthenware industry, whose history dates back to the 13th century. After World War II there were only a small number of manufacturers in the area and they exclusively served the local market.

In the post-war years and due to the need to rebuild the country, the demand for tiles increased considerably, so that the tile industry grew considerably in Sassuolo, from only 14 ceramic companies in 1955 to 102 companies in 1962.

The appearance of industries related to ceramics helped considerably to be able to increase production, and they went from importing machinery from countries such as Germany or the United States to creating their own specialized ceramic machinery industry, such as kilns or presses.

The geographical concentration led to the parallel development of a large number of ancillary industries such as moulds, enamels, transport services or materials for product packaging. Moreover, the high level of competition and rivalry in the sector, being geographically limited, meant that companies had to invest a lot of capital and time in innovation, so that the Italian sector was able to stand out from the rest of the international producers.

By 1970, the domestic demand for tiles had dried up, so companies began to focus all their efforts on exporting their products, advertising in international decoration magazines and taking advantage of the prestige of Italian products in the sector.

Today, the Italian sector is still one of the world leaders in the tile industry. The latest figures for 2021 forecast a sales volume of around 458 million square meters.

After searching for data to compare the two clusters, I have not found sufficiently up-to-date data to be able to compare them in a specific year.

To conclude this point, it should be noted that the history of the Italian cluster is very similar to that of the Spanish cluster, in terms of history, production, turnover and problems to be solved in the medium and long term.

CHAPTER III: MAJOR CHALLENGES FACING THE CERAMICS INDUSTRY

The environmental problem and the need to act on pollution problems continues to grow as both people's concern about climate change and climate change itself continues to grow, making it vitally important to try to reduce pollution emissions.

The large amount of emissions into the atmosphere that is causing a climate change with no return, which affects us directly, is causing technologies to shift towards the search for cleaner and renewable energies, such as wind, solar or green hydrogen.

All these problems can be extrapolated to the ceramics industry, a highly energy-intensive industrial sector that needs innovations to reduce its emissions, as most of the energy used comes from highly polluting sources such as coal or gas.

It is therefore of vital importance that new energy sources are developed in the coming years and that they can be used industrially, so it is also of vital importance to design the appropriate storage and transport for these energy sources.

3.1. Change in internal structure

The current economic situation caused by various macroeconomic factors, such as the coronavirus pandemic that started in March 2020, has had consequences that are having an impact on industries in both countries today.

The high production costs, mainly due to the rising cost of raw materials, electricity and gas, have increased the price of raw materials, which has made them less competitive at international level.

Fernando Roig, president of Pamesa, one of the most important groups in the sector, said the following. "From paying eight million euros a month for gas, we have gone to 32" (NIUS DIARIO, 2021).

We have already notified that from 1 November we will raise our prices by 25%, because we can no longer maintain them. We will lose competitiveness, but to maintain jobs and supply to our customers we have no choice but to pass on this barbarity, the gas price increase, to the end consumer (NIUS DIARIO, 2011).

Vicente Nomdedeu, president of ASCER (Asociación Española de Fabricantes de Azulejos y Pavimentos Cerámicos), made the following statement. "We have good

demand and prospects, but we cannot produce tiles because of cost overruns" (Economía 3, 2021).

He also highlights the importance for industry of the increase in the price of gas "Gas was around 24 euros and now it is 140 euros. This means a 600% increase in the price of energy that makes our companies move and create wealth for the Valencia region".

The president of ASCER also made reference to the fact that sales figures are good, with a turnover of around 4.6 billion euros, a growth of 20%, with export figures rising by 19% and in the domestic market by 22%. (Economy 3, 2021).

Despite these figures, the final profit that remains for the companies is very poor and therefore quite a few jobs are at risk. "Although the sales figures are good, some companies have hardly any growth or no growth at all. Moreover, in recent months growth has started to slow down. From 30% in the first quarter of the year, it has dropped to 20% at the end of the year" (Economy 3, 2021).

It also highlights that the data does not work with the new structure of production costs, not only for gas, but also for other raw materials such as wood, cardboard, earth or enamels, all of which are growing more than sales, leaving an increasingly narrow profit margin, with some even producing more than the selling price, which means they are selling at a loss, a situation that is completely unaffordable in the long term, causing redundancies and even leading to the closure of factories.

Finally, he stresses that if the situation continues like this, unpopular measures will have to be taken "This could have repercussions on the cost of human resources, if we stop production, sooner or later, the ERTEs will increase" (Economy 3, 2021).

The situation in the Italian sector is very similar, being geographically close countries, the aspects causing the crisis situation tend to converge.

Giovanni Savorani, president of Confinsdutria ceramics (put at the bottom of the page that it is confindustria), highlights that the sector had positive forecasts for the end of 2021, with a sales volume of 458 million square metres, increasing by 13% the metres destined for export and 9% the metres invoiced within the national territory. In addition, there is a considerable increase in the main international markets such as the United States and Germany.

The positive tone of the market and demand will allow us to close this year's balance sheets well, but we can by no means rejoice. The strong growth in the costs of all factors of production is putting the present and future competitiveness of our companies to the

test. Perhaps for the first time in our history we are experiencing a paradox: we are full of orders from all over the world, but they are clashing with extremely high marginality tensions.

In turn, Giovanni Savorini stressed: "The adoption of measures to safeguard the planet, such as the energy transition, is correct. However, it will only be possible to switch to other energy sources when they are available and at competitive prices compared to natural gas". (LEVANTE 2021)

In both cases, demand for products has risen sharply after a very slow year caused by the pandemic and where economies have been at a standstill.

In addition, the turnover of both countries has increased considerably, due in part to the increase in production prices and their subsequent impact on the final sale price to the customer, so although the data have improved nominally, the profit margin has narrowed, so we can extrapolate that the data are good, they are improving compared to 2020, but they are not to shoot rockets, since the increases in production costs must stop their rise and start to fall to regain competitiveness.

To conclude, ASCER and CONFINDUSTRIA issued a joint communiqué in which they set out the problems they were experiencing, with the aim of guaranteeing the sustainability of the industries and jobs. In it they seek to make the European Union understand the unrealistic objectives of decarbonisation of European industries in the short term.

Another topic discussed at the meeting was the request from both sides to increase the state's ability to provide financial support to companies in the sector and to subsidise aid for the development of a greener economy.

"The exclusion of the ceramics sector from the eligible sectors is a wrong and unacceptable decision that prevents the ceramics sector from having adequate protection against indirect carbon leakage and thus endangers European ceramics companies".

Finally, both associations have stressed the importance of this industry being able to enter into a framework of support to ensure change and protect the jobs currently employed in both countries, as both clusters employ more than 35,000 people directly.

Another important point to highlight within this change of structure is that the number of brands and tile companies within the Castellón cluster is very significant, but many companies do not always mean many owners, which can lead to a situation of oligopoly.

Within the same sector, we can find various lines of business, from companies that seek organic and sustained growth of their organization, focusing on providing their product with added value and brand prestige, such as Porcelanosa, to industrial groups such as Pamesa, acquiring other tile manufacturers such as Navarti, Azuliber Group or TAU and incorporating them into their production, which has led to the group presided over by Fernando Roig controlling around 34% of Spanish ceramic production.

In addition, large groups and investment funds that do not come from similar businesses but have the capital and business experience to take the firms they have acquired to the next level. The acquired companies are of medium size and it was very difficult for them to reinvest money to improve their conditions, which is why they have sold part or 100% of their shares. Among them we find the American fund Avenue Capital or the British Victoria PLC, which have taken control of several ceramic groups around the world. Also noteworthy is the purchase of Altadia, one of the world's largest enamel producers, by the American investment fund Carlyle from Lone Star, which was its current owner.

This leads to the following reflection, What is better, a structure of SMEs with more fragile economic structures in a completely globalized world, valuing the essence and history that has brought us to this situation, or an oligopoly of large companies capable of competing at the highest international level?

Well, this gives rise to a debate where both can be winners and losers, among the advantages that we find in this conversion from a structure of small companies to these being acquired by large groups and structures that are economically very powerful and with a greater capacity to counteract movements at an international level more quickly and effectively, being able to continue scaling up the business.

On the other hand, one of the disadvantages of this situation is the real possibility of the structure becoming an oligopoly, with the possibility of price collusion and a lack of reinvestment in companies due to the lack of motivation to innovate, due to the lack of competition that we would see in this situation, and the possibility of the sector not prospering, which would mean that so many years of development would be thrown away and we would be forced to be overtaken by industries from other country.

As a final reflection on this point, the best option that could be integrated is to have powerful structures to be able to compete internationally, without losing the essence of what has brought us this far and to try to ensure that the sector becomes an oligopoly and that the companies within it continue to compete normally. All this is vital for survival in times of economic recession and especially for a territory that focuses a large part of its economy on the ceramics industry or related industries.

The future of the sector depends enormously on the correct development of this process, it is vital that there continues to be constant innovation in production processes because we are going to find ourselves with the search by governments to reduce polluting emissions, so finding ways to produce more environmentally friendly will be fundamental.

[7]

[7] The data provided here may have been aggravated by the recent outbreak of war between Ukraine and Russia, both of which are suppliers of raw materials for production, but real data on how this is being passed on to the industry is not yet clear.

3.2. The change of energy model

The change in the energy model, the ecological transition, has been underway for several decades, with the abandonment of highly polluting energies such as gas, coal and oil in favour of renewable energies that are cleaner for the environment. This change is of vital importance in the short, medium and long term. In 2015, 190 countries signed the "Paris Agreement", which replaced the Kyoto Protocol and became a universal protocol.

The main objectives are to decarbonize industry and reduce emissions of carbon dioxide and other greenhouse gases, with a 40% reduction in emissions by 2030 and a carbon neutral footprint by 2050.

For all these reasons, the governments of the countries are developing different measures to carry out this transition towards a more ecological society. In Spain, the Ministry of Ecological Transition has been created, which focuses all its work on carrying out measures to carry out projects that help the change.

3.2.1 Energy-intensive industry

The tile sector is an energy-intensive, large-scale industry, which, together with other industries such as metallurgy and iron and steel, must change its energy model in order to be sustainable in the medium and long term.

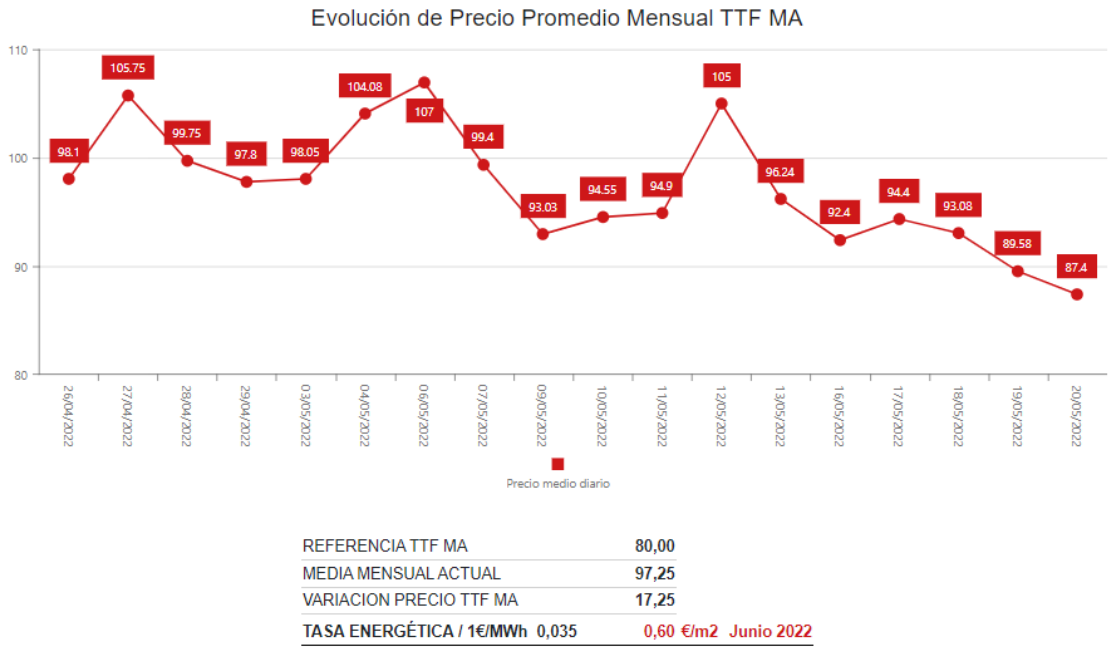
The ceramic industry is very heavy, so it needs large and powerful machines to be able to develop its activity, among others we find heavy machinery for the transport of raw materials, vacuum structure to obtain the paste, pressing to give the selected shape to the piece, dryers to remove excess water and thus not cause problems inside the kiln, large kilns for firing the piece, machinery to paint the pieces with the chosen design or machines that are responsible for glazing or vitrification.

According to data collected in 2017, the ceramics industry consumes around 14,000 gigawatts, which makes it one of the most polluting sectors in the country. Furthermore, the constant rise in energy prices means that Spanish companies are less competitive than their counterparts in other countries and, as they are part of a globalized sector, this has a very negative impact.

This problem is currently reflected in the example of Pamesa, where all the brands that make up the company have implemented a rate that will increase the price by 0.035 euro cents per m2. To do this, the average price of energy acquisition during the month will be calculated for each 1MWh that exceeds 80MWh, as these are the ones that the company assumes in its initial price.

This is best illustrated by the following example: If the average monthly energy purchase has been 110 euros per MWh, this exceeds 30 MWh of what the company itself assumes, so 0.035 x 30 = 1.05 euros/m2 that consumers will have to pay

Illustration 7: Evolution of the TTG MA Monthly Average Price on 20 May 2022

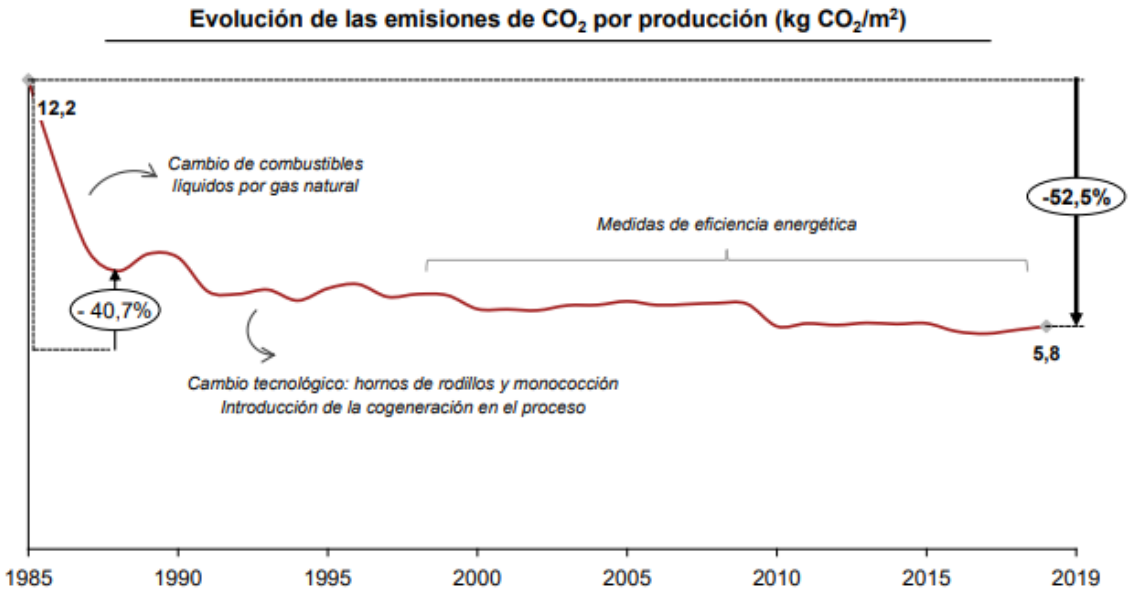


REFERENCIA TTF MA	80,00
MEDIA MENSUAL ACTUAL	97,25
VARIACION PRECIO TTF MA	17,25
TASA ENERGÉTICA / 1€/MWh 0,035	0,60 €/m2 Junio 2022

Source: PAMESA GROUP (2019) INTERNAL REPORT

It is worth noting that in the last 30 years, due to technological progress and invocations aimed at reducing emissions, from 12.5kg CO2/M2 in 1985 to 5.8kg CO2/M2 in 2019, which is a reduction of 52.5%. This can be seen in more detail in the following illustration.

Illustration 8: Evolution of CO2 emissions by production (kg CO2/M2)



Source: ASCER (2019)

3.2.2 Emission Reductions

The reduction of emissions by all actors in society is another point of vital importance to achieve short, medium and long term environmental goals, so contributing to this and having a certain corporate social responsibility is fundamental for industrial companies.

In order to maintain some control over the emissions that certain companies that are determined to be high polluters are allowed to make, we have emission allowances, which we have to define.

"It is the right to emit, from an installation affected by this scheme, a certain quantity of gases into the atmosphere. The emission allowance is transferable: it can be bought or sold" (Ministry for Ecological Transition and Demographic Challenge website. Retrieved 11 May 2022)

The last sentence of the definition is fundamental to our analysis, because if the companies that pollute the most have the power to acquire the rights of other companies to pollute, they can acquire it and save themselves from paying the fines that would result from emitting more than their fair share of emissions.

This brings us to a new debate, Should allowances be transferable or should each company adapt to what each company is entitled to?

The debate is wide-ranging and has many nuances, but in my opinion, it is good that emission allowances can be traded, as you ensure that a specific number of emissions is allocated between all companies and if it is exceeded, the company that emits outside of the allowances acquired must be fined.

To conclude on this point, I would like to add that currently, with the technology that industrial companies have, limiting these emissions helps to pollute less, but it can end up destroying an industry, with all the losses that this means, so, until the technology they have is more advanced, putting sticks in the wheels does not seem to be the best option.

3.2.3 Importance of making change

Making this change is of great importance not only in environmental terms, but also because the economic and social opportunities that will be presented to us are vast.

Environmental opportunities are the main ones, as they are key to curbing climate change and meeting the targets set by states.

On the other hand, the economic objectives are also very important, since this type of technology requires a large investment, which will create new jobs and help to obtain a new form of energy to produce, thus entering into competition with the current ones, which will have to reduce their prices to be more competitive, which is very positive for the final price received by the consumer.

Finally, there are social opportunities such as the reduction of local pollution by activating a sustainable ecosystem and where human development is promoted, living in cleaner and less polluted environments is very beneficial for people's health.

In conclusion, the development of these technologies has a positive impact on society from different perspectives and helps society to develop properly.

3.3. Projects

There are a large number of projects that seek to mitigate the importance of polluting energies for industrial use and that focus on cleaner and renewable energies, among these projects are the following.

3.3.1 Iberdrola's green hydrogen Project

Green hydrogen is a new way of obtaining energy from water and renewable energies by breaking down water molecules (H2O) into oxygen (O2) and hydrogen (H2) through a process called electrolysis. This process has very high costs, and reducing these costs is one of the most important challenges to be able to apply this energy in an efficient and scalable way.

Until now, hydrogen has been obtained only from fossil fuels, which is a very polluting and environmentally damaging technique. Another way of separating hydrogen is by means of electrical energy or natural gas, which are also very harmful to the environment.

Work is currently underway to develop new applications for green hydrogen, where electricity is generated through devices called fuel cells, combining hydrogen and oxygen from the air. Other improvements being developed include the transport of this energy, where there are vehicles with fuel cells and tanks and places to store the energy.

Among the green hydrogen projects being developed around the world, we find the production plant for industrial use that Iberdrola has contracted in Puertollano (Ciudad Real).

The plant, which will start operating in 2022, has required an investment of 150 million euros to carry out this project, creating around 700 direct jobs and will avoid emissions of around 48,000 TCO2/year, making it one of the most efficient plants in the European Union.

The plant consists of a 100 MW solar photovoltaic plant, a lithium-ion battery system with a storage capacity of 20 MWh and one of the largest hydrogen production systems by electrolysis in the world (20 MW). All from 100% renewable sources.

This project will make a very positive contribution to the maturation of this technology in our country, as it has become a real alternative to decarbonization in the medium term.[8]

Illustration 9: Green Hydrogen production plant

Source: Iberdrola website (2022). Retrieved 18 June 2022.

3.3.2 Iris cerámica group

Iris Ceramica is one of the largest companies in the Italian ceramic cluster. Founded in 1961, it has a high brand prestige, spreading the feeling of belonging through *Made in Italy,* for its high technical and aesthetic value, for which it has been awarded with a great number of prizes and recognitions at international level.

For Iris Cerámica, the quality of its products and innovation with cutting-edge technologies is non-negotiable, always respecting the environmental sustainability of its products and processes, which is why it is a pioneer in developing the first company in the sector powered by green hydrogen.

For this project, it has partnered with Snam (an Italian company specialising in natural gas transport and dispatch in Italy), which has a large number of resources to bring the project to fruition.

[8] Para realizar esta sección, la información acerca del proyecto sobre hidrógeno verde ha sido obtenida de forma íntegra de la web de Iberdrola

To realise this project, a 2.5 MW photovoltaic system will be installed on the roof of the factory, located in the region of Modena and Emilia-Romagna, the epicentre of the Italian ceramics cluster. This will be combined with an electrolyser and a renewable green hydrogen storage system. This will use a mixture of green hydrogen and natural gas, which will immediately reduce polluting CO2 emissions. This is the first step in a long-term goal, as the plant will be designed to run 100% on hydrogen.

"Through our infrastructures and technologies, we want to contribute to the creation of a national hydrogen supply chain that helps to achieve national and European climate targets, while ensuring the competitiveness of our industry". (Focus stone, 2021, p.1)

This may be the first step for other companies in energy-intensive and currently environmentally damaging sectors to take a step forward and innovate through projects that are capable of being sustainable and less damaging to the environment.

3.4. How it will affect the Catellón cluster

The Castellón ceramics cluster, being an energy-intensive industry, will not be able to escape the change it will have to undergo in the coming years in order to become more sustainable.

To make this transition as efficient as possible, the Spanish government will have to be more permissive with the sector in terms of pollution, and until there are viable energy alternatives to replace the most polluting energies partially or completely, it should not force them to comply with any emission reduction requirements, in other words, until companies are able to obtain a profitability equal to the current one with the new energies, they should not be forced to meet emission reduction targets.

In addition, state subsidies could be used to encourage research into these technologies and how to store and transport them on a large scale.

The companies with the greatest economic capacity in the cluster will be both those that will have the easiest time adapting to change and those that will have to promote it within the cluster, since in the long run, having economies of scale as their main advantage over companies outside the cluster will enable them to reduce production costs significantly, and if the adaptation to these technologies is carried out by most of the

companies that make up the cluster, they will have brand prestige and consumers will see them in a different light, making the cluster's brand more attractive.

Finally, developing domestic energy and its commercialization is of great macroeconomic importance, as this would help us to become less dependent on other countries such as Algeria or the United States and we would become the ones to start selling energy.

As a final conclusion to this point, I will make a personal assessment of the situation and the change that the cluster will have to make in order to survive. If we manage to develop in our territory new energies capable of replacing the current ones with determination, it will be very positive for the industries in our territory and for the companies that manage to develop them, as they will be marketed worldwide and will leave part of the profits in Spain. If, on the other hand, we do not manage to develop these technologies ourselves, we will continue to be dependent on other countries and will be at the mercy of their decisions.

CHAPTER IV: CONCLUSIONS

The case we have just dealt with in this research work on the Castellón cluster can be defined as a successful case of how the business concentration delimited in a specific area can make companies interact both to compete and to support each other, and this makes the performance of the companies that form part of it greater than those that are not integrated in it, because it is a competitive advantage over the competition

The example that concerns us is the best example of this, as the ceramic cluster in the province of Castellón is the most important in the world together with the Italian cluster, both in terms of production and turnover, and one of the most prestigious at an international level due to its aesthetic and technical quality.

To begin with the final reflection, I will explain whether we have correctly developed the objectives that I established at the beginning of the work.

In the main objectives of the first chapter we can see that I have correctly developed the definition of cluster, its history, the advantages for a company to establish itself in it, and the differences and similarities with the concept of industrial district.

I have also managed to resolve the objectives in Chapter II, explaining in simple terms the tile production process, developing the similarities between the Italian and Spanish clusters and the problems they are currently experiencing with the growth of fixed production costs. Finally, I have shown the advantages and disadvantages and given my opinion on the process of acquisition of companies in the cluster by both large corporations and venture capital funds and shown that it is tending towards oligopoly, with all that this entails.

The objectives of chapter III of the paper have also been successfully developed, as I have developed what I believe the cluster needs to do to achieve the ecological transition, and what projects currently exist that could be integrated into the sector in the medium term. In addition, I give my opinion on the position that the states should take in this debate.

Among the things that have surprised me the most after carrying out this research work is that we have a sector in this area such as the tile industry, which really has great relevance worldwide and is an industry with high added value, both in terms of product, quality and prestige in its brands, and which is super relevant at the provincial level due to the large number of direct and indirect jobs it produces.

The development of ancillary industries and sectors that support the proper functioning of the main industry and that are born out of the need of the main industry to be supplied with services and products and that indirectly also create a large number of jobs.

Another of the things that surprised me the most is the large amount of emissions caused by industry and that, although there is an action plan to reduce them, if there are countries that do not take a stand and also seek to reduce emissions in their territories, it is worth nothing that there are others that do make an effort to reduce them. It should also be noted that I do not believe that emissions limitations and fines are appropriate until there is a real alternative so that industries that have to change their production methods do not suffer major variations in profitability or delays in production.

Finally, among the things that have surprised me the most is the importance of innovation in developing new forms of technology capable of replacing the current ones and among which we find the projects related to green hydrogen that are currently being developed and that in the coming years may be more than a dream and become a reality.

Among the possible works that we could study after this one, I think it could be very interesting to carry out an investigation of how digital printing changed the industry, the repercussions it had and its current importance. We could also focus it from a research point of view on how the most important innovations have had an impact on the sector and how it promotes the development of these innovations.

It would also be interesting to carry out this same index, but in 5 years' time, to see what the situation is like with the changes that have arisen, such as the current war between Russia and Ukraine or how the sector has fared after a few years of the coronavirus pandemic.

As a final reflection on this work, I would like to highlight several aspects that I found very interesting after carrying out the work.

The first is the value of doing this kind of work as a student, as it introduces you to research, a field in which you can dedicate yourself professionally, and I think it is very important to learn to think, to know where to choose the sources of information and to translate it into your own synthesis.

It might be a good option to start doing this type of work from the first years of the degree, as it helps to learn more about a subject than the exam itself with which we are assessed.

As for the chosen topic, the work on the ceramics sector, the concept of cluster focusing on the case of the province of Castellón and the challenges it has to face in the medium

and long term, I found it very interesting, because when you do research on a topic close to you, I think that the work is done with more enthusiasm and it costs less to do it.

On a personal note, I would like to highlight my father's interest in the work, as he has worked all his life in the sector and in companies that make up the cluster, so he found research into it very interesting and tried to learn and contribute to the work.

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