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Castellón Ceramic Industrial District: Characterization and its impact on employment

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Abstract

In this paper we try to quantify the impact of the Castellón Ceramic Industrial District (CID) in its area of influence. To do so, we have reviewed the theory of industrial districts, from which we have been able to infer a series of characteristics that define them, such as the presence of a district effect, the existence of a developed social and a strong orientation towards innovation. Later, we have applied these characteristics to the CID. After that, we have presented the main economic figures of the CID and its evolution from 2007 to the present in order to quantify its impact on the economy and employment, focusing on the Comunidad Valenciana. The work concludes with a section that addresses one of the most important problems in the sector: the mismatch between the knowledge and abilities of workers and the needs of the sector's companies.

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INTRODUCTION

The Spanish ceramic sector is one of the most dynamic and innovative sectors of Spanish industry. This continuous focus on innovation has allowed it to adopt new technologies applied to its process of production, storage and distribution processes, which has led it to maintain constant growth since its beginnings.

The Ceramic Industrial District in the province of Castellón is the driving force of the sector in Spain. The industrial districts have been fundamental for the growth of many regions, such as Castellón in the case of the ceramics sector. Therefore, in the first part of this work we will review the literature on industrial districts with the objective of inferring their main characteristics, focusing on the existence of a district effect, the question of homogeneity/heterogeneity and the importance of social capital and innovation. Based on these results, we will apply these characteristics to the CID and we will address the most important questions about, human capital, division of labour, support institutions and inter-firm relations in the sector.

This is followed by a second part, which is in turn divided into two parts. On the one hand, we analyse the position of the Spanish ceramics sector in the world and its main magnitudes at a national level. On the other hand, we study the impact of the CID on Comunidad Valenciana economy and employment through the study of the evolution of production, employment and productivity during the period 2007-2021.

Finally, we have a section about one of the main problems of the sector: the lack of knowledge and abilities in an important part of the employees. There is a gap between the training of workers and the need of the enterprises, which undermines the sector productivity and competitiveness. In particular, the problem is relevant for ceramic tile installers. This problem has to be addressed to ensure that it can continue to grow.

PART I

1. THEORETICAL FRAMEWORK

1.1 INDUSTRIAL DISTRICT

The concept of industrial district (ID) was born in Italy in 1979 from the article of the Florentine economist Giacomo Becattini entitled *Dal settore industriale al distretto industriale*, published in the *Rivista di Economia e Politica Industriale*. In this article the author recovered and initiated the analysis of external economies and Marshall's notion of industrial district.

Alfred Marshall was the precursor of what would later be called industrial districts. This author, at the end of the 19th century, observed that the joint presence of companies from the same sector in the same geographical area formed an "industrial atmosphere" of "mutual trust and knowledge" capable of sustaining and boosting local industry. Thus, in *Principles of Economics* (1890) he made an important statement: "The advantages of large-scale production can, in general, be obtained either by grouping (a large number of small producers in the same area or by building a few large factories". Further, he argued that economies of scale in production depended on a combination of coordination, specialisation, motivation and cognitive support. According to him, the regrouping of operators in the same locality normally implies that they belong to the same cultural environment, which is characterised by a series of values, languages and, above all, implicit rules of common behaviour.

From this Marshall's contribution it is important to highlight the idea of "industrial atmosphere", which is ultimately "a social and dynamic conception of the process of individual intellectual growth" (Becatinni, 2002). Thus, local societies play an active role in promoting human knowledge as a factor of production.

In the case of industrial districts, this "industrial atmosphere" is the most distinctive feature of Marshallian external economies, as it refers to the fact that communities and their non-market relationships and interdependencies a learning and organisational system that ultimately brings positive consequences to the production process. In short, this industrial atmosphere can be translated as the existence of intangible resources based on experience, knowledge and information, which are common to companies in the district.

From a Marshallian point of view can be identified the main characteristics of industrial districts, which go beyond the industrial district mode of production:

- The central role of labour and people as central subjects.
- The conception of external economies as a key to understanding the relevance of the organisation as an economic factor.
- The role of the "economic nation" concept to interpret the economic change.

Years after Marshall's death, from his *Principles of Economics*, the Italian school of ID headed by Becattini, together with Sebastian Brusco and Arnaldo Bagnasco among many others, focused on Marshall's theoretical perception as an explanatory hypothesis for the Third Italy. Specifically, Becattini proposed a definition of industrial district with a socio-economic approach: "a socio-territorial identity characterised by the active presence of both a community of people and a set of enterprises in a natural and historically determined area". (Becattini, 1991).

From this definition we can infer that a ID is an economic and social system in the sense that it's not compound only by the simple concentration of enterprises in a concrete area, but rather it is the result of the transformation of a local community, being it a group of people living in that area, which specialise in a particular type of production. This local community shares a system of common values and practices, which are disseminated throughout the district by means of social norms and institutional structures (markets, businesses, formative institutions, unions, and employers' associations (Sforzi, 2015).

Another relevant contribution to this concept was made by Porter (1990), who introduced the concept of industrial cluster to agglomeration theory. Porter defines clusters as a "geographic concentration of interconnected firms and institutions in a particular sector". Although the concepts of district and cluster are not synonymous (Sforzi, 2015), they share similar theoretical roots (Porter and Ketels, 2009). Therefore, according to Sforzi, there is a certain substitutability between the two notions, since both are essentially referring to the same phenomenon: that economic activities tend to be concentrated in the territory and that the advantages for grouped companies are significant compared to isolated companies. Therefore, in this work we will not distinguish between the two concepts, always using them as synonyms, as do López-Estornell, Tomás-Miquel and Expósito-Langa (2014) and García-Villaverde, Parra-Requena and Molina-Morales (2018) in their respective papers.

1.1.1 CHARACTERISTICS

From the characterisation of the industrial district provided by Becattini (1990) and Marshall (1890), together with the contributions of other authors, we can derive a list of common characteristics for all industrial districts, which are addressed below.

Firstly, as we have stated above, IDs are delimited territorial systems, which means that they are formed and develop their activity in certain delimited geographical area (Marshall, 1890; Becattini, 1990). However, this does not mean that the IDs activity takes place in a closed area, as it interacts with and receives information from outside. An example of this would be knowledge, which can be originated from internal or external sources to the organisation. In addition to this, the most recent literature on strategy and innovation has highlighted the relevance of external factors from the firm, referring to the positive externalities that they receive in terms of knowledge from the environment (Molina-Morales, Ares-Vázquez and Molina-Puertas, 2010).

The second characteristic of IDs is the community of people who form them. They share a set of values and ways of behaving, forming a common socio-cultural environment with which all members are identified and existing a reciprocal cooperation among them. This local culture, which drives the processes of work and change in the district, must be understood as a set of social norms, which, from a productive point of view, allow the acquisition and development of specific know-how, a specific tacit knowledge, making possible to reach a specialisation (Soler, 2000). This, together with the culture of the territory itself and the activity of the companies operating in the ID and that of the institutional interlocutors, make up the industrial atmosphere, a concept that we have discussed above.

This brings us to the next feature: the role of institutional actors. Institutional interventions are a key element in IDs, as they are the basis for the transformation of their companies, so it is essential to have a good capacity to combine the strategies of the enterprises with the initiative of these social, public and private institutions.

Examples of these institutions can be business and professional associations, industrial policy agencies, universities and research centres, and regional or local authorities. Furthermore, Dei Ottati (2006) argues that the existence of common values and institutions condition some aspects of the accumulation process, which act as a mechanism to reduce the risk and improve the economic governance of ID firms.

Following, the industrial district is characterised by the presence, within the territory, of a large number of companies specialised in a specific stage of the same production process. Within these companies, in addition to the organisation of production, there is a certain degree of cooperation, both between companies operating in the same stage phase and between companies belonging to a different one. In short, the IDs function of production is divided in stages and the firms in the id present both a horizontal cooperation and different ways of forms of vertical productive development.

This specialisation in production is the source of many of the competitive advantages obtained by ID firms, and Fuensanta (2008) identifies three of them as the most important: proximity to specialised suppliers, the possibility of benefiting from knowledge spillovers and access to an extensive and qualified local labour market.

The latter competitive advantage leads us to the next characteristic of IDs. The specialisation achieved through the division of labour, from a strictly technical point of view, allows the existence of a high level of professional competences of people in the cluster's labour market (Fuensanta, 2008). Concretely, this division of tasks makes workers specialise in specific areas of the production process, which allows a higher quality of human resources compared to companies outside the district.

As a result, companies located in the ID enjoy a labour market characterised by a highly qualified workforce with a wealth of specific skills, which they have built up as a result of tradition. As Ybarra (2003) explains, this characteristic is essential to cover the specific needs that the ID have, giving the territory an enormous advantage, since this specific and high level of qualification allows it to achieve a competitiveness that other areas do not have.

IDs are composed of a large group of specialised and territorially concentrated companies, which means that between them we can find the coexistence of cooperative and competitive relationships; these relationships make up the next characteristic of IDs. On the one hand, the fact that many companies are territorially very close creates a higher competition at each stage of production than in the rest of the economic system. On the other hand, the development of international trade and the globalisation of the economy, united to the intensification of competition which this entails, has forced these companies to increase the cooperation among themselves in order to adapt to the challenges appeared as consequence of this new context. This combination of

relationships promotes the development of ID, as well as the diffusion of new knowledge and innovations.

The main factors that have led to this intensification of competition have been the evolution of technology, changes in demand and internationalisation processes, so that companies have developed agreements to deal with the crisis situations that appeared in the economy, thus they have been able to reach the levels of competitiveness necessary to stay in the market (Fuertes et al., 2003).

Another characteristic that we found is the entrepreneurial spirit of ID company leaders, which is due to the innovative nature of these territories. Finally, we can identify significant entry and exit barriers in the IDs. By this, we are referring to the different obstacles, such as technical, legal or intellectual property barriers, which prevent external agents from being part of the cluster. At the same time, it is also necessary to take into account the difficulties that may exist to be able to leave the ID if there is a desire to leave it.

1.1.2 DISTRICT EFFECT

The above characteristics show the existence of a series of competitive advantages for companies belonging to these territorial agglomerations compared to those that aren't part of them. Thus, they show better results in terms of efficiency, level of exports, financial results and innovation. This set of competitive advantages has been referred to in the literature as the district effect.

To explain what the district effect is, it is useful to refer the definition given by Dei Ottati (2006): "set of competitive advantages derived from a strongly interconnected set of economies external to the firms, but internal to the district. These economies not only depend on the territorial concentration of the productive activities, but also (and this is the distinctive feature of the industrial district) on the social environment in which these activities are embedded".

According to Galletto (2014), these advantages can be divided in two parts. On the one hand, efficiency in the use of resources, especially labour and intermediate resources. On the other hand, the innovation as a consequence of an accumulation process of specialised human capital, competition and the speed with which information is shared.

Having explained what, the district effect is, an interesting question to address is how it has been quantified in the literature. The quantification of the district effect has been done comparing two groups of firms belonging to the same industry, so that they only differ in terms of belonging or not to the industrial district under study.

Many researchers have studied this phenomenon, analysing its presence in different contexts and over different periods of time. The studies have confirmed the existence of a better performance in certain economic, financial and labour variables of companies belonging to the ID compared to those who do the same activity in diffuse territorial areas, this is outside the district (López-Estornell, Tomás-Miquel and Expósito-Langa, 2014).

A methodology for identifying districts was first presented by Fabio Sforzi in 1987. This methodology was widely accepted, so much so that the Italian National Institute of Statistics (ISTAT) decided to use it to analyse the division of Italy into local labour systems. Later, the same institution with the collaboration of Sforzi, tried to identify which of the 784 local work systems could be defined as ID, based on the 1991 census of population and productive activities. After work with the data, 199 industrial districts (ISTAT, 1996) dispersed across all regions were identified, making it possible to compare many characteristics of the areas defined as ID with those that were not.

The main results of this analysis, obtained through an exhaustive econometric research carried out by the Research Department of the Bank of Italy and coordinated by Luigi Federico Signorini, were able to confirm many of the contributions of the so-called industrial district theory, as well as the presence of the district effect. Regarding the later, we have to highlight the higher productivity of firms belonging to the ID compared with those outside it.

1.1.3 HOMOGENEITY/HETEROGENEITY

One issue that we consider important to address respect the IDs is the homogeneity/heterogeneity. The first papers that studied this question stated that internal homogeneity is one of the characteristics that distinguish firms belonging to industrial districts, which appears as a consequence of sharing a series of externalities in the form of resources that are located in the internal market (Tomás-Miquel, Expósito-Langa and Molina-Morales 2015).

As Tomás-Miquel, Expósito-Langa and Molina-Morales (2015) point out, although this position has been held by several authors, subsequent posterior studies have pointed to

the emergence of changes in the way districts work as a consequence of globalisation. Thus, in terms of the internal structure of the IDs, internal differences have appeared between the companies, this is heterogeneity. As a result, internal sub-networks have been generated or larger companies have been consolidated and have positioned as leaders.

Despite this evolution in ID structures, this continue generating these externalities shared by all, which add value to the companies, making up what we know as district effect. Therefore, although the degree of dispersion has increased within industrial districts, firms located in them continue showing higher homogeneity values than firms outside them, which shows the influence that the district effect is still able to have influence ion firms (Tomás-Miquel, Exposito-Langa and Molina-Morales 2015).

Therefore, as this previous authors state, from their analysis it is clear that the industrial district model, as traditionally considered, is evolving towards a new type of district in which small and medium-sized companies coexist with larger companies. These changes in the structure of IDs lead to a district concept with more open borders and diverse types of firms with different positions within the district, which is the basis of this increase in internal heterogeneity.

To put an end to this issue, we present the work developed by Coll-Serrano, Martínez-Fernández and Molina-Morales (2008), entitled *La heterogeneidad interna en las redes empresariales: un análisis de la eficiencia y la innovación en el distrito cerámico español*, in which the authors go further and question this assumption of homogeneity often assumed in the literature. In this study, after analysing the ID of the ceramic industry in Castellón, they state that belonging to an ID is not enough to obtain certain benefits and that different levels of results can be found in ID companies, which means the existence of a certain degree of heterogeneity.

1.1.4 SOCIAL CAPITAL AND INNOVATION

As explained above, one of the characteristics of IDs is that they are made up of a dense community of people, who share a set of values and ways of behaving, which leads to the conformation and development of a common local culture. As a consequence, several authors have investigated the structure and strength of interpersonal relationships in this social systems.

Thus, considering the ID as a social network, in this work we will use the concept of social capital to refer to the structure and content of relationships and their possible consequences, analysing these from different levels, such as individual, corporate, regional or even national (Molina-Morales, Ares-Vázquez and Molina-Puertas, 2010). IDs are considered appropriate to be analysed under the network model, as they are made up of companies, institutions, research centres, administrative entities and labour resources that are in constant interaction (Martínez-Cháfer, Molina-Morales and Roig-Tierno, 2021).

IDs are characterised by being a network where social capital increases the capabilities of knowledge exploitation of companies. These social networks allow the circulation of information and the generation of trust, encouraging exchanges between companies, which make possible the continuous improvement of existing technologies through innovation (Molina-Morales, Ares-Vázquez and Molina-Puertas, 2010).

The special conditions under firms operate in the ID make them compete more intensely than those located outside the ID (Becattini, 1990). The high degree of rivalry that exists between many of the ID firms is essential in terms of diffusion the best practices and encourage innovation within IDs (Martínez-Cháfer, Molina-Morales and Roig-Tierno, 2021). In fact, proximity to rival companies makes possible to increase the quality of the information exchanged (Martínez-Cháfer, Molina-Morales and Peiró-Palomino, 2018).

On the other hand, vertical relationships, which involve customers and suppliers, have been identified by the literature as important elements to accelerate the firm's access to knowledge and technology (Martínez-Cháfer, Molina-Morales and Roig-Tierno, 2021). These relationships provide firms with external sources of information and knowledge, which has a significant effect on value creation and have a positive influence in firms' innovation and performance (García-Villaverde, Parra-Requena and Molina-Morales, 2018).

In addition to these vertical relationships between companies, in the ID we can find a series of local companies, institutions and support organisations that canalise the knowledge between the outside and the ID companies. These institutions interact with a large number of companies in the cluster, which gives them close information about the activity difficulties they face and their organisational challenges. From this knowledge and experience generated, they act as intermediaries, encouraging the development of

skills, routines, methods and know-how inside the ID companies (Martínez-Cháfer, Molina-Morales and Roig-Tierno, 2021).

In particular, these local support institutions facilitate innovation to business management by providing access to valuable information and resources that allow firms to acquire new innovative skills and knowledge. In addition, this permits companies to reduce search costs. For this reasons, we can conclude that the support of this type of local organisations can improve the innovation capacity of ID companies (Martínez-Cháfer, Molina-Morales and Roig-Tierno, 2021).

The knowledge that allows this innovation can be originated both internally and externally to the ID. Despite this, recent research has emphasised the importance of factors from outside of the firm, which are the positive externalities in terms of knowledge that firms receive from their environment. In this context, inter-organisational relationships have a great importance, as they allow the appearance of opportunities to acquire and exploit knowledge, as well as access to new opportunities (García-Villaverde, Parra-Requena and Molina-Morales, 2018).

To sum up, companies are not able to generate internally all the knowledge they need to deal with a complex and dynamic environment. Therefore, they need to resort to external sources, which are their relationships with suppliers, customers, competitors, institutions, etc., providing them with this knowledge and allowing them to take advantage of and exploit external knowledge. In addition, strong relationships between geographically proximate organisations are drivers of a wide range of knowledge sources. Physical proximity encourages, or at least increases the possibility of collaboration, as well as make easier for firms to exchange technical and market information. In addition, it produces social and professional interactions between entrepreneurs and employees in the industry, a context that allows for greater knowledge diffusion (García-Villaverde, Parra-Requena and Molina-Morales, 2018).

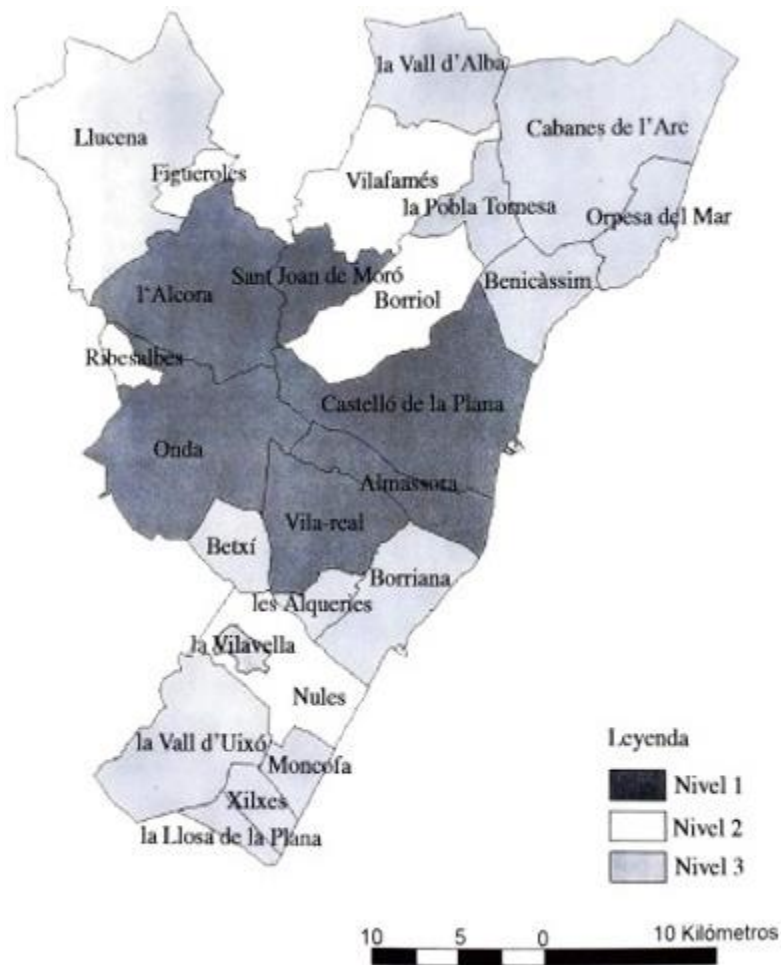
1.2 CERAMIC INDUSTRIAL DISTRICT OF CASTELLÓN

Once the conceptual framework has been explained, we are going to analyse what will be the object of analysis in this paper: The Castellón Ceramics Industrial District (CID). To do so, we will first present the basic information and its main figures of this, and then we will study if it complies with the characteristics of IDs explained above.

In the economic literature about industrial districts there is consensus on the existence of an industrial district model in the ceramic sector in Castellón. The confirmation of the existence of one or more industrial districts in the Castellón area begins with the work of Ybarra (1991), in which a total of eleven IDs were identified in the Valencian Community; among them we can find the ceramic industry. This work was followed by others papers of authors as Soler (2000), who used the mentioned above methodology developed by Signiorini (1994) and applied it to the CID case. They concluded that this sector is consolidated and has a notable territorial implantation, making possible the existence of the Ceramic Industrial District-Cluster (CID).

The CID is located in 25 municipalities around the city of Castellón de la Plana, covering a radius of 30 kilometres and concentrating the majority of Spanish tile production (Budí, 2008). The towns which are part of the CID registered 439.483 habitants in 2020 (INE). Below we can find a map of the province of Castellón, highlighting the main cities where tiles are produced.

Figure 1. Area of the Ceramic Industrial District by levels.



Source: Fuertes et al. (2003)

These 25 municipalities were classified by Ana María Fuertes et al. (2003) by level of intensity, typology of companies and by the historical moment in which they joined became part of the CID. The first level is made up of Alcora, Onda, Sant Joan de Moró, Castellón de la Plana, Almazora and Vila-real. These towns are the first where the sector was installed, being the most important in terms of employment and production levels, as well as the type of companies based in them.

The second level is formed of towns with a later incorporation into the CID, but which have a great importance as a consequence of the expansion of the sector. At this level we can find Nules, Borriol, Ribesalbes, Vilafames and Figueroles. Finally, in the third level we have Les Alqueries, Benicàssim, Betxí, Borriana, Cabanes de l'Arc, la Llosa de la Plana, Llocneta, Moncofa, Oropesa del Mar, la Pobla Tornesa, la Vall d'Alba, la Vall d'Uixó, la Vilavella and Xilxes. These towns have production facilities or provide human resources to the CID.

1.2.1 CID CHARACTERISTICS

Once we have explained which geographical area comprises the CIDS, and taking into account the set of characteristics of the CIDs set out in the previous section according to the literature, we are going to apply them to the ceramic sector in Castellón with the aim of confirming that it is a CID, which is important to the development of this province.

A) HUMAN CAPITAL

The first characteristic, the delimitation of the territory, has been addressed back, so we are going to analyse the importance of the community of people which forms the ID. The human capital within this agglomeration is a very important aspect, as it constitutes a sustainable comparative advantage because it provides companies with an external source of information and knowledge, thus increasing business added value and providing security and continuity in the market. In the Castellón CID this is direct consequence of the intensity of knowledge transmission due to the constant creation of companies and the mobility of human resources between the companies' part of the cluster. These elements result in an informal communication channel between cluster members (Molina-Morales, Martínez-Cháfer and Valiente-Bordanova, 2017).

B) DIVISION OF LABOR

The third characteristic is the division of labour and, as a consequence, the high quality of human resources. The CID is made up of companies specialised in a certain stage of

the tile production process, which is the final product. Thus, the ID is formed by a group of firms working together, where the division of labour happens on an inter-firm rather than intra-firm basis (Tomás-Miquel, Molina-Morales y Expósito-Langa, 2010); Molina et al., 2018). This joint work encourages cooperation between them, which gives the sector distinctive characteristics and allows the CID to evolve.

Therefore, ID companies position and specialise themselves in different phases of the local chain. In the case of the CID, we can observe that complementary companies have been created around the tile companies, which are dedicated to activities related to the manufacture of ceramics.

The tile manufacturers are the core of the industrial district, thus encompassing the major part of the tile production process. In order to be able to carry out the entire production process, these companies rely on specialised companies from the extraction and atomiser industry, which supply the raw materials for the CID. Other important type of complementary firms are frit and glaze manufacturers. These companies are positioned as a key element of the district, as they are responsible for a large part of the continuous innovations and improvements in product quality. They have permitted to CID activity to be highly innovative and also the continuous development of new products (Fuertes et al., 2003). The activity of these companies is essential, as the glazes are applied to the ceramic surface for decorative purposes, as well as to protect and waterproof the product.

Finally, we have the companies dedicated to make the machinery for the production of ceramics. Although production in Spain is currently much lower compared to Italy, which makes it dependent on Italy. Despite this, as ID has been grown, has increased the importance of ceramic producers in the design, development and production of new machinery.

Finally, all types of companies that are part of the CID has an important role, but, in addition, as the work together a high level of cooperation has been reached. This make the sector distinctive, drive innovation and knowledge transfer, and allow the CID to evolve continuously.

C) SUPPORT INSTITUTIONS

The next issue we are going to address is the presence of support institutions in the ID. The local institutional framework that supports the businesses gives the CID a comparative advantage, as these agents act as intermediaries between companies, making easier the transmission of information between them, as well as building skills, routines and procedures. Therefore, they reduce information search costs and help companies to offer faster solutions to business problems and organisational challenges, providing support in the face of any adversity (Martínez-Cháfer, Molina-Morales and Roig-Tierno 2021). These organisations can be public or private, and their main objective is to promote and spread the innovation.

Firstly, we find the Instituto Tecnológico de la Cerámica (ITC), created by the Jaume I University and the Ceramic Industries Research Association (AICE). The function of this organisation is to generate and disseminate knowledge to the whole of the CID, since, given the size of the companies, many of them are not able to have a specialised R+D+I department. So, the ITC acts as a technological partner, providing them with highly technological services and technologies.

Then, the role of the Asociación Española de Fabricantes de Azulejos y Pavimentos Cerámicos is very important. This organisation is responsible for promoting and defending the general and common interests of the ceramic industry. Their function varies according to the needs of each company, focusing on those areas where certain actions cannot be afforded or are too costly for them.

Like ceramic manufacturers, frit and glaze manufacturers and machinery manufacturers have their own support institutions. On the one hand, we find the Asociación Nacional de Fabricantes de Fritas, Esmaltes y Colores Cerámicos (ANFFEC), which have 23 frit and glaze manufacturers as members, mostly located in Onda, Alcora and Vila-real. He has to say that Spain has been the world leader in this sector for more than a decade, surpassing Italy, the country where these products were done by first time. ANFFEC's objective of ANFFEC is to promote the growth of the ceramics industry in Spain, as well as to improve the quality and competitiveness of the final products.

On the other hand, although is less important, we have the Asociación Española de Fabricantes de Maquinaria y Bienes de Equipo para la Industria Cerámica, which is responsible for representing those companies involved in the production of machinery for the production of ceramics. This organisation is made up of 71 companies, which are

machine manufacturers, maintenance and service workshops, technical assistance workshops and representatives of foreign firms. This association helps to maintain the growth of ID by adapting technology to the needs of the industry. Machinery companies have strengthened their global importance through the quality of their products, and through innovation in the enamelling process.

The following type of organisations that we present, in addition to encouraging innovation, are also oriented towards training and guidance, both for companies, employees and the unemployed, with the aim of promoting quality employment within the ID. On the one hand we find the Asociación Española de Técnicos Cerámicos (ATC), which provides information and guidance to its 520 associates, who are companies and people which are part of the CID. This encourages innovation and an improvement in employment and specialisation within the ID.

On the other hand, we have specialised training centres, such as the Universitat Jaume I, the Escuela Superior de Cerámica de l'Alcora, the Centro Labora Formació de Castelló and the formative courses. All of them are dedicated to the complete training of future specialised professionals, so that they are able to adapt to the needs of the industry and provide technical knowledge, which makes possible the encourage of the innovation and serves as a great support for companies.

D) RIVALRY AND COMPETITION

Finally, rivalry between DI firms is fundamental in terms of the diffusion of best practices and the improvement of innovation within them. The main positive effects of the cluster on its member firms comes from the combination of proximity and rivalry. The mechanism through which proximity influences rivalry is based on the ease with which firms are able to obtain new knowledge from their competitors, as well as being able to know the real depth of their knowledge.

Therefore, in this context, closer firms compete intensively as a consequence of this proximity, but this, at the same time, increases the amount of knowledge and information available, generating an incentive to maintain these relationships with competitors. In short, the relationships that a company has with its competitors are an additional mechanism to obtain knowledge and generating innovation.

PART II

2. IMPORTANCE OF THE CERAMIC SECTOR

The Spanish ceramic industry is one of the most dynamic and innovative in the country. It continually positions itself as the leading sector within the international ceramics industry thanks to its quality, its constant support to innovation and the development of new products and applications (ASCER, 2020a). It is worth highlighting its enormous importance for the Valencian Community industry, especially in Castellón, and of Spain, as it generates wealth, creates jobs and contributes to the trade balance, research, innovation and sustainable development.

For all these reasons, after reviewing the theory on industrial districts and having analysed the characteristics of the CID, we will now analyse the recent evolution of the main figures and outcomes of the ceramics sector. First of all, from a global perspective, and then we will look at the national level, with special emphasis on the Valencian Community.

2.1 GLOBAL CERAMICS SECTOR

In 2020, the Spanish ceramic sector was the leading European producer and the fifth in the world, as well as the third country with the highest volume of exports. Below is a table showing the ten countries with the highest share of world production and share of world trade.

Table 1. Share of world production and trade in ceramic products by country in 2020.

SHARE OF GLOBAL PRODUCTION		SHARE OF GLOBAL TRADE	
CHINA	52,7 %	CHINA	22,5 %
INDIA	8,2 %	INDIA	15,8 %
BRAZIL	5,2 %	SPAIN	15,2 %
VIETNAM	3,3 %	ITALY	11,5 %
SPAIN	3,0 %	IRAN	6,5 %
IRAN	2,8 %	TURKEY	4,8 %
TURKEY	2,3 %	BRAZIL	3,5 %
ITALY	2,1 %	POLAND	2,1 %
INDONESIA	1,9 %	EGYPT	1,9 %
EGYPT	1,8 %	UNITED ARAB EMIRATES	1,9 %
REST WORLD	16,7	REST WORLD	14,4 %

Source: ACIMAC (2020).

As we can see, the world's leading producer is China, with more than half of the production, followed by India and Brazil; this means that the ten countries with the highest share account for 83.3% of world's production. Spain is in fifth place with 3% of the world share. Regarding the share of world trade, which refers to the percentage of a country's exports with respect to world exports, the leader continues to be China with a 22,5%, percentage significantly small compared to production's share, followed by India and Spain. Therefore, Spain is in third place with 15.2% of total world exports.

The top ten exporting countries account for 85,7% of the total, which is similar to the production share. However, it is important to note that export shares do not correspond to production shares. For example, China, despite produce more than half of the world's ceramics, its exports represent only the 22.5%. This difference between the two variables indicates that there is a disparity in both domestic market consumption and product characteristics. In the case of Spain, the share in global trade is higher than the production, which demonstrates the strong exporting nature of the sector; in particular, it exports more than 75% of its production.

Comparing these data with historical data, it is worth making some clarifications in relation to the new ceramic producer countries. According to Piqueras (2012), in 2012 half of the world's tile production was concentrated in four countries: Italy, Spain, Brazil and China. Today we can see how this has changed, as only China now produce more than 50% of the world's production.

These changes are due to the fact that in recent years new producing countries have emerged on the world scene, which, in addition to supplying their own national markets, have an important position in world markets. The most important player is China, since the large difference in terms of wage costs between this country and other producers, such as Spain and Italy, allows their products to have much lower prices.

However, in spite of the huge competition from products manufactured in China due to their low prices, Spanish ceramics are perceived worldwide as being of high quality, including China, which gives Spain a position of leadership and prestige in a large number of countries.

2.2 NATIONAL CERAMICS SECTOR

As we have seen above, Italy and Spain are the main producing and exporting countries in Europe. Moreover, as Piqueras (2012) points out, production is highly concentrated in two regions of these countries: in Emilia-Romagna in Italy and in the Valencian Community in Spain.

In this section we present the main figures for the Spanish ceramics sector in 2021. Overall, it was a year of strong growth, largely driven by the recovery from the negative impact of the COVID-19 pandemic on the sector. In 2021, a growth in production of 20.30% (585 million square meter), sales of 26.40% (4855 million euros) and exports of 24.60% (365 million euros) were reached. On the other hand, there was a 6.70% growth in employment and a 7.89% reduction in the number of companies. This shows that the trend towards concentration in the sector, which started some years ago, has returned, but without affecting employment.

Table 2. Main magnitudes of the Spanish ceramic sector in 2021.

	2021	GROWTH RATE
Production (million sq.m.)	587	20,30%
Direct employment	17180	6,70%
Total sales (million sq.m.)	4855	26,40%
Export (million sq.m.)	3665	24,60%
National sales (million euros)	1189,3	32,00%
Import (million euros)	145,2	26,90%
Trade Balance (million euros)	3520	24,50%
Tile manufacturers	114	-7,89

Source: ASCER (2022).

Now, once the main figures for the sector in 2021 have been presented, we provide the most important conclusions obtained by ASCER in the document *Impacto socioeconómico y fiscal del sector de azulejos y pavimentos cerámicos en España* (2020a). Although these are obtained by working with data from 2019, we consider it very interesting to analyse as they reflect the great impact that the ceramic industry has on the Spanish and Valencian economy.

Firstly, the total turnover of the ceramic tile manufacturing sector was 3,824 million euros in 2019, which is equivalent to 2.7% of industrial Spanish GDP and 0.34% of Spanish GDP. This contribution can be broken down into three parts. Firstly, the direct impact, which is that generated directly by the activity of the sector itself, being 1.250 million euros, equivalent to 34% of the total impact.

Next, we have the indirect impact, which is the share of GDP generated by the suppliers of the ceramic companies and their respective supply chains. This was 1.931 million euros, which corresponds to 50.5% of the total and demonstrates the sector's great dragging capacity. Finally, we have the induced impact, which is the part of the GDP generated as a consequence of the consumption of the people directly and indirectly employed by the sector. This was 643 million euros, which is the 16.81% of the total impact.

At this point, we present the main companies in the national ceramics sector. It should be noted that most of them were founded after the reactivation of the construction industry in the 60s and 70s, as this phenomenon allowed a great growth of the sector because of their strong links. During this period, a series of investments and company mergers took place, so companies increased in size in order to be able to get the necessary resources to adopt the new technologies to compete at an international level. Companies such as Pamesa, Porcelanosa and Todogrés were developed during this period (Fuentes et al., 2003).

In 2019, there were 121 companies in the ceramic tile sector in Spain (ASCERa), most of which are located in the province of Castellón. The largest companies in the sector in terms of turnover are shown below.

Table 3. Ranking of companies in the ceramic tile and flooring sector at national level.

RANKING	COMPANY	CERAMIC SEGMENT 2019 (million euros)	GROUP TURNOVER 2019 (million euros)
1	PAMESA	796	987
2	PORCELANOSA	558	772
3	STN CERÀMICA	308	328
4	KERABEN + SALONI	236	702
5	BALDOCER	170	170
6	HALCON CERÀMICAS	149	149
7	AZULIBER	94	110
8	GRESPANIA	87	239
9	MARAZZI	78	9.552
10	ROCERSA + AZULEV	77	77

Source: Vicent (2021).

2.3 COMUNIDAD VALENCIANA

The ceramic industry is a relevant and strategic player in the Valencian Community industry, especially for the region of Castellón. As we have explained above, this high geographical concentration is one of the main characteristics of the CID, so that most of the activity takes place in the regions of Plana Alta, Plana Baixa and l'Alcalatén.

Nowadays approximately the 94% of the total production is manufactured in this and 80% of the companies in the sector are located there (ASCERa). As consequence, the most important companies in the sector at national level are located in the CID. Among them, three stand out for their global importance: Pamesa, Porcelanosa and STN Cerámica.

Regarding the impact of the ceramics sector in the Valencian Community, it generated 2,811 million euros in 2019, which was equivalent to 2.7% of the Valencian GDP. In turn, these outcomes represented the 14.4% of the Industrial GDP of the Valencian Community and 20.7% of the GDP of Castellón, which shows the importance of the CID in its geographical area of influence.

Of this outcomes, the direct contribution to GDP produced by the sector was 43.22% (1,215 million euros), while 41.55% (1,168 million euros) corresponds to the indirect impact and 15.19% (427 million euros) to the induced impact. We can see that, as with the national values, the indirect impact is the most important.

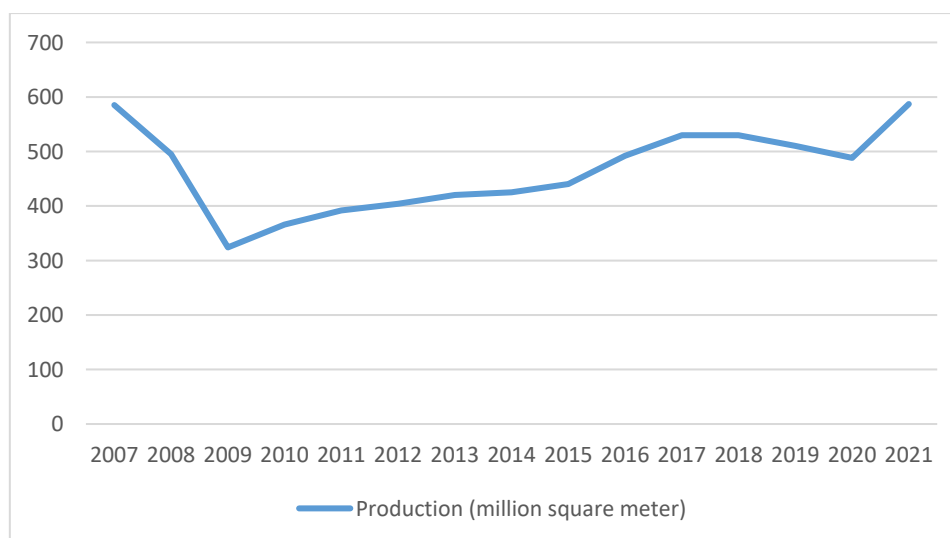
Below, we present an analysis of the main magnitudes of the ceramics sector for the period 2007-2021, so that we can get interesting conclusions about its behaviour. It should be noted that the analysis starts in 2007, as this was the year in which the sector reaches its peak, as a result of the favourable economic conditions. For figures prior to that year, we can see Budí (2008).

Furthermore, it should be noted that the official figures presented by ASCER (2018, 2020a and 2022) are only available for the sector as a whole. However, the high concentration and specialisation of the sector's activity in the CID make us possible to extend the results and conclusions obtained with this data to the CID.

2.3.1 PRODUCTION

The production and turnover of the sector has maintained sustained growth over the last years, making it one of the most robust industries in Spain. The evolution of its production from 2007 to 2021 is present below.

Graph 1. Evolution of production between 2007 and 2021.



Source: ASCER (2018 and 2022).

As can be seen, tile production has followed an upward trend throughout the considered period, with the exception of 2008 and 2009, when it suffered as a result of the unfavourable economic situation caused by the financial crisis of 2008. In 2007, before the crisis, production in 2007 was close to 600 million square metres. In 2009, the year after the outbreak of the crisis, production was 324 million square meters, which was an annual drop of 34.50% and 44.62% in two years.

It would be from 2010 that a period of constant growth began, which would last until 2018, when production did not increase. Between 2010 and 2017, there were years in which growth rates reached double digits, being the average for the period 6.40%. The production only fell in 2019, being this decrease of 3.8%.

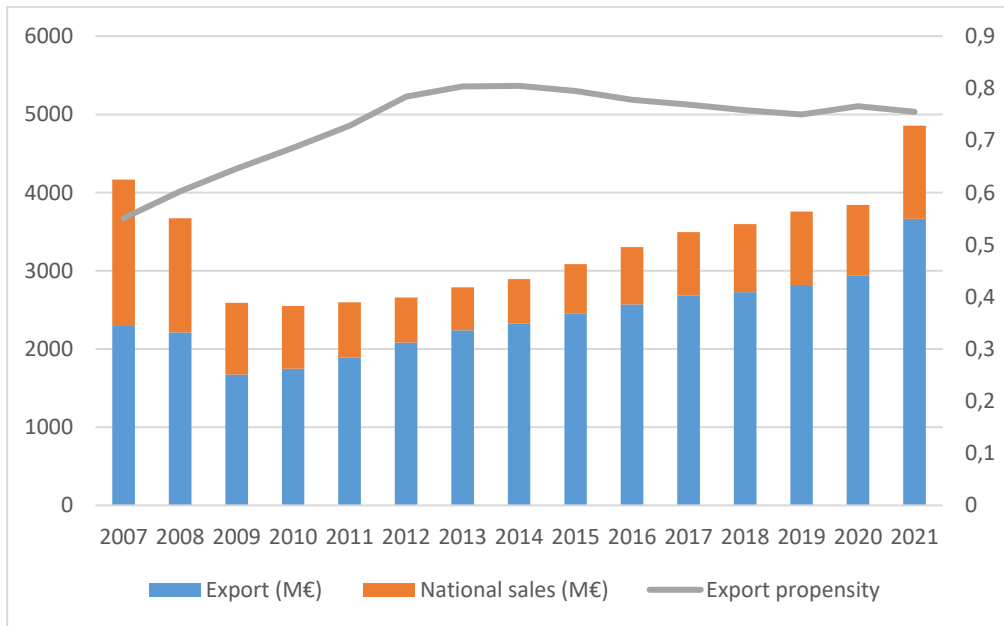
Thus we arrive to 2020, where the sector reduced its production for second consecutive year, but having here a factor responsible for it: the health crisis caused by Covid-19. In this case, production fell by 4.30% compared to 2019. Although this outcome is negative, we can see that it cannot be compared to the drop in production that followed the financial crisis in 2018.

What the sector has shown during the COVID-19 pandemic is an enormous capacity for resilience, since, after some very hard first months, it was able to adapt to the new context and maintain its levels of activity. Moreover, despite the fact that in 2020 production contracted, turnover increased by 2.3%, which shows us an increase in the value of the ceramic product.

Finally, we come to the year 2021. This year, as we have explained above, with the recovery of economic activity after a year 2020 marked by the pandemic the sector was able to growth a 20,30%. This is a very positive outcome and evidences the good recovery of the sector from a bad year.

Before present the employment evolution we have to analyse the destination of this production. To do so, we present a graph with the evolution of national sales, exports and the export propensity, this is the ratio between exports to domestic sales.

Graph 2. Evolution of national sales, exports and the export propensity between 2007 and 2021.



Source: ASCER (2018 and 2022).

First of all, we can see that exports have remained higher than domestic sales throughout this period. Concretely, before the crisis (2007), exports represented the 50,09% of the total sales. In 2008 and 2009, both domestic sales and exports decreased, but the latter less. From 2010 onwards, in contrast to domestic sales, they started a constant grow. As a consequence of this process, the export propensity reach his maximum value in 2014, being this 80,47%. Since this year, this magnitude has been decreasing, being around the 75% form 2018 until nowadays.

This great export performance is mainly due to two reasons. Firstly, the national markets were forced to open their borders after the crisis, as they suffered large losses as a result of the fall on the construction of new buildings in Spain; this constituted more than half of their sales destination before the crisis, and this market practically disappeared during it. Secondly, the growing importance of exports can be understood as the sector have a high competitiveness thanks to its technological innovation (Membrado, 2019).

2.3.2 EMPLOYMENT

The CID, as mentioned above, is made up of various sectors. The ceramic tile producers are its main part, which employs the 75% of the total workers. Fritz and glaze manufacturers account for 18% and machinery manufacturers for 7% (ASCERa). It should be noted that CID jobs are of high quality, as most of them are permanent and

are characterised by their high stability in periods of crisis, as these sectors are highly resilient to crises.

The activity of the ceramic tile and flooring sector generated 42.703 jobs in the Valencian Community in 2019. Of this quantity, 15,319 people were directly employed in the companies of the sector, so 35.87% is considered as direct impact. Of the remaining jobs created, 43.61% are considered indirect employment (18,621 employed) and 20.52% induced (8,763 employees).

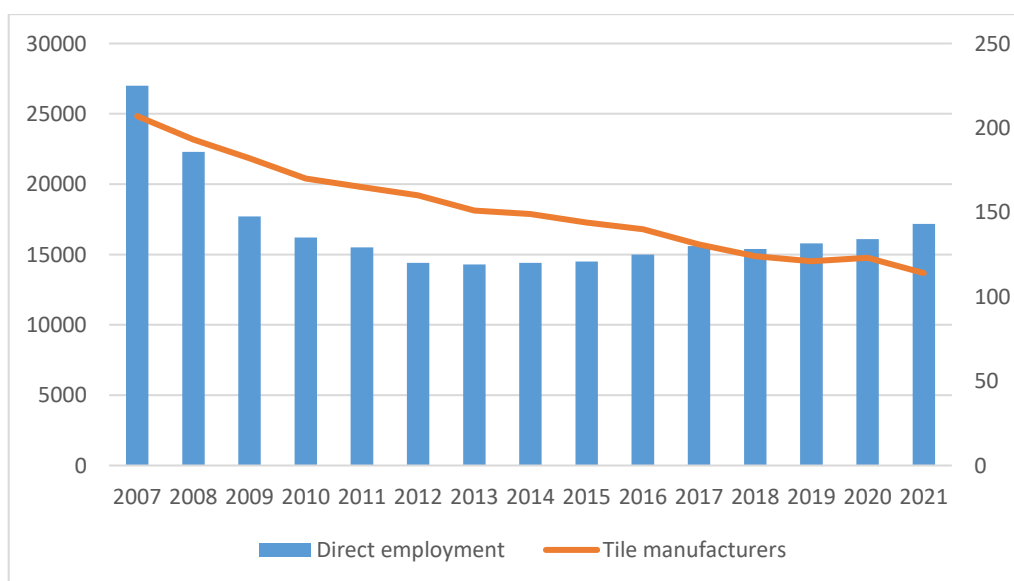
Next, we present a graph showing the evolution of employment and the number of companies over the last two decades. In 2007 we had around 27,000 employees in the sector. However, like production, the financial crisis of 2008 had a very strong, and in this case more lasting, impact. From 2008 to 2013 jobs continuously declined, being the strongest impact in 2008 and 2009, when the 17.4% and 20.6% of all jobs were destroyed respectively, with the number of employers in those years standing at 22,300 and 17,700. During this period, an average of 9.77% of jobs in the sector were yearly destroyed, which shows the strong impact of the crisis, largely due to its relation with the construction sector and the oversizing experienced during the real estate bubble.

It was not until 2010 that this trend was reversed, when the number of employees was 14,300. From then until the present, employment grew at a rate of 2.34% per year, only not growing in 2018, when it fell by 1.3%. In 2021, the ceramics sector employed 17,180 people. It is important to note that this represented an annual growth of 6.70%, which, taking into account that in 2020 was a difficult year for the economy due to COVID-19 pandemic, shows us the good performance of the sector during it. Despite this, the sector has not been able to approach the pre-financial crisis employment figures of 2008, with employment being 36.27% less respect 2007.

Regarding the companies, we can observe that since 2007 the number of companies has decreased every year; on average they have decreased by 4.14% every year. This trend is due to two reasons. On the one hand, during the first years of the period, as a consequence of the effects of 2008 financial crisis. On the other hand, especially during the last few years, due to the rise of a concentration trend in the sector. This has resulted in a reduction of the number of companies of 44,93% since 2007, going from 207 to 114 in 2021.

Finally, it should be noted that despite the fact that if we consider the period 2007-2021 both the number of companies and the number of employees are considerably reduced, the trend for both magnitudes is different since 2013, once the financial crisis of 2008 was totally overcome. Since 2013, the number of companies has decreased by 20.53%, while employment has grown by 20.14%, which indicates that many companies have undergone merger and acquisition processes, as the number of employees has not decreased, but has grown considerably.

Graph 3. Evolution of the number of companies and employees between 2007 and 2021.



Source: ASCER (2018 and 2022).

2.3.3 PRODUCTIVITY

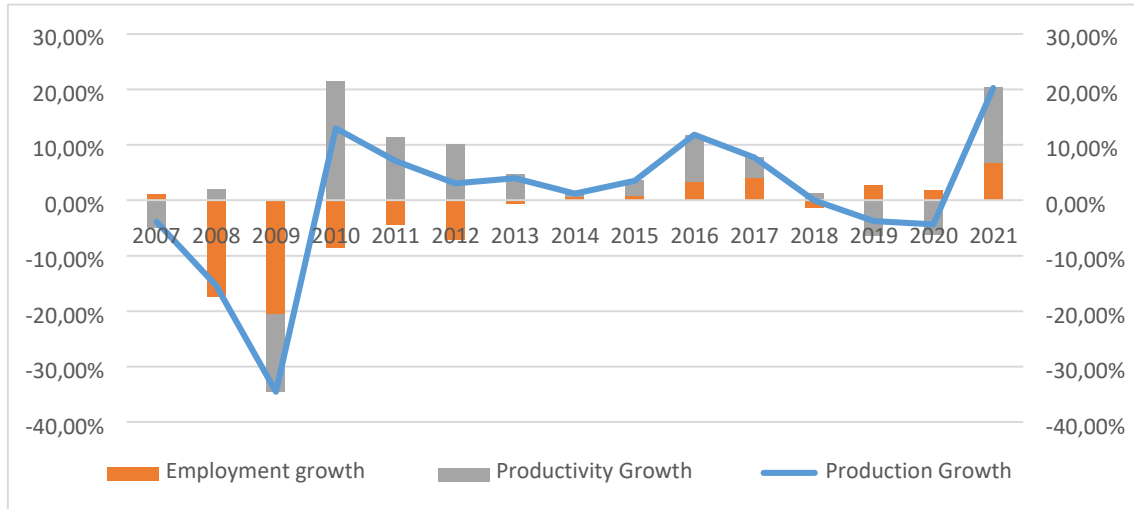
In this sub-section we will analyse a very important aspect for the continued development of the sector: worker productivity. To do so, we will use a graph showing the evolution of production, employment and productivity.

Firstly, we can see that productivity has grown annually during all the period except 2007, 2008, 2019 and 2020; on average this growth has been 3.23%. Moreover, it can also be seen that productivity growth has been higher than employment growth for the majority of years. If we consider the whole period, only in the four years that productivity did not grow and in 2014 did productivity not contribute more to output growth than employment.

Thus, we can affirm that the growth model followed by the ceramics sector is sustainable in the long term. It is worth remembering that this high productivity of the sector is one of

the characteristics of the district effect presented by Signiorini (1994) and, subsequently, Soler (2000) applied the same methodology and developed it for the Valencian case.

Graph 4. Employment, production and productivity growth between 2007 and 2021.



Source: ASCER (2018 and 2022).

3. TRAINING DEFICIENCIES

The population is one of the main economic assets of any territory because it represents an important part of the productive capacity of a country. The ceramic sector is based on a consolidated system of socio-economic relations, in which knowledge transfers take place, have a high labour mobility of ceramics technicians and innovation plays a key role on it. This business innovation is reflected in the continuous improvements in products and production processes in tiles, raw materials and complementary products, as well as in the development of machinery.

In the framework of the Avalem Territori project, Alama and Budí (2020) analyse the innovation processes that allow the development of economic sectors in the Valencian Community; the aim of this project has been to identify the relationships between these innovation processes and the resulting labour market situation.

The Avalem Territori Plan is a strategy promoted by the Servicio Público de Empleo y Formación de la Comunitat Valenciana (LABORA) with the collaboration of the Spanish Ministerio de Trabajo y Economía Social. Through it, LABORA's aim is to improve active policies to make territorial labour policies transversal and adapted to the current needs of the labour market.

One of the strategic objectives is the improvement of the labour skills of the population and the adequacy of the local training system to the territorial needs. In this sense, it is key for the development of the territory and its labour market that the local training offer is adapted to the needs of the territory, both economic and social. In addition, it is important to detect the current and future training needs that may arise in the territory.

The analysis carried out by these authors has made it possible to identify some deficiencies in the training of professionals in the sector, which are as follows:

- Need for technical and continuous training.
- Lack of training in personnel management, which is important as this is a sector with demanding working conditions.
- Need to improve training in commercial strategy, in particular to combine sales and product knowledge in order to be able to adapt to customer needs.
- Lack of innovative human resources in production techniques.
- Training mismatches among the long-term unemployed people.
- Lack of interest among some of the unemployed people in training or working in the sector. In this sense, there is a loss of prestige of the sector, which makes it unattractive for young workers.

On the other hand, taking into account the developed innovation system of the ICD, it should have a strong position in terms of innovation in labour resources. However, the results obtained do not point in this direction. The actors interviewed presented a problem in terms of training of the workforce. Thus, given the highly innovative nature of production techniques, there is currently no proper correlation between labour demand and supply.

This is likely to be partly a result of the long duration of the 2008 financial crisis, as the longer an unemployed person is unemployed it is easier the appearance of an educational mismatch. This phenomenon is a serious problem in some professional sectors such as the installers of the final product or in the information gap between analogue and digital models working with *inkjet* technology.

Despite this, interviewees also indicated a lack of interest of some unemployed people to participate in training courses and to return to work in the sector. Therefore, we have a situation in which there is a double problem in terms of the management of human resources training, but also in terms of the recruitment of professionals.

Regarding to the latter, as we pointed out earlier, the loss of attractiveness of the ceramic industry makes difficult to attract young and qualified personnel. This is partly a consequence of both the effects of the economic crisis on employment and the demanding working conditions. This makes necessary to develop new career models that combine salary with other training incentives and, in general, working conditions.

To be more specific, the training deficiencies of employees in the sector can be grouped in three main general lines:

- Technical aspects: technical courses, robotics, big data analysis, digital printing (inkjet) and 3D design.
- Human resources: industrial process management, logistics, factory professionals, work-related risks and ceramic tile layers.
- Commercial training.

Therefore, we observe a lack of professionals with all the necessary knowledge to work in the industry. To solve this, Dolz and Tárrega (2020) points out that the training of personnel, both current and future, in the new technologies that are developed in the production and marketing processes should be encouraged.

Although in general it is a sector with a highly educated workforce, companies face problems when it comes to recruiting skilled professionals for specific functions, especially those requiring the use of new technologies. Therefore, it is necessary to prepare employees in this area, so that they can deal with the immediate challenges with guarantees, such as the implementation of Industry 4.0 and digitalisation.

According to the contribution of Dolz and Tárrega (2020), marketing is one of the areas with needs of increased training, especially nowadays, as marketing and digital marketing gain importance; this trend was reinforced by COVID-19. In this sense, companies face the challenge of digitalising their points of sale, boosting online displays and being able to obtain information in shop. Therefore, the sector needs sales representatives who are capable of developing other types of sales focused on new technologies such as Artificial Intelligence, which allow them to improve the efficiency of company's operations. This is important as these types of skills will be highly demanded in the future by any company in the sector.

Finally, as pointed out in the *Análisis y retos del sector de azulejos y pavimentos cerámicos en España (2020)*, one of the main weaknesses of the sector is the lack of

personnel in terms of the installation of the final product and the shortcomings in their qualifications, which has led to an increase in the cost of installing this product.

Ceramic is an intermediate product that is not considered final until it has been installed, therefore, tile layers are essential in order to maintain the perception of quality and the properties of the product until it is installed. Currently, the lack of installers has increased the cost of installation, making the final product more expensive, with the resulting loss of competitiveness in comparison respect to other substitutes. To solve this problem, incentives must be provided to train new tile layers in order they can cover a higher demand and reduce the cost to the end customer. In addition, this will make the ceramic to have a better consideration to be selected for new uses.

So, the sector must strengthen the training of current professionals and attract new talent. To this end, it is essential to promote the attractiveness and advantages of working in such a highly developed and technologically advanced sector. Thus, new generation, who are prepared to work with new technologies and are aware of important issues such as environmental care and sustainability, would see the sector as an opportunity for the future (ASCERb).

For all above described, a mature sector such as the ceramic needs to introduce an information and professional guidance system that improves the employability of workers, develop an entrepreneurial spirit and support self-employment business initiatives in order to continue growing in the long term.

4. CONCLUSIONS

The Castellón Ceramics Industrial District accomplish the characteristics of industrial districts that we have inferred from the review of the most important literature in this field. Thus, the companies located in are benefited from the existence of the district effect, both in terms of human resources and innovation.

The distinctive characteristics of the DIC are the presence of strong institutions, the high degree of specialisation of its firms and human resources, and a strong innovative character; all of this in a limited territory compounded by 25 towns, which together produce almost all of Spain's tile production. These characteristics make it easier for companies to incorporate the most modern technologies into production processes and to develop new products, which continually strengthens their competitiveness.

As we have been able to observe in the second part of this paper, the Spanish ceramic tile sector plays a relevant role at world level. In this field, we should highlight the strong development of the Chinese ceramics sector over the last decades, which has allowed this country to accumulate nowadays more than half of the world's production.

Then, we have addressed the impact of the CID in the Valencian Community through production, employment and productivity data between 2007 and 2021. In terms of production, after a fall during the 2008 crisis, an upward trend is observed throughout the period, which is only interrupted in 2019 and 2020. Despite this, it grew strongly in 2021. The employment suffered during the 2008 crisis due to the bad economic condition, so the number of employees declined year by year until 2013. Since then, employment has been increasing, but without reaching pre-crisis levels.

It should be noted that the sector has been affected by two crises: the 2008 financial crisis and the crisis caused by the Covid-19 pandemic. After analysing the impacts of both crises on the sector, we observe that the sector suffered much more during the first one. This can be seen in 2008 data, when were registered a 34.5% drop in production and a decline of 20.6% in the number of workers. On the other hand, during the pandemic, production fell, but turnover and the number of employees grew. This means that the initial drop in activity caused by the sanitary situation was compensated by a strong recovery with the reactivation of the economy.

Finally, we have been able to observe how productivity has been the sector's engine of growth during most years of the period. These continuous productivity growths are evidence of the development of a long-term sustainable growth model by the sector.

Despite these positive figures, the sector is currently facing the challenge of training. It is necessary to update the knowledge of workers to the current and future needs of the companies regarding the technical level and also to the human resources field and the commercial sphere. In addition, we highlight the lack of personnel for the tiles installation, an area that requires a high degree of knowledge and, therefore, training.

In order to achieve the objective of being as competitive as possible on the world market, it is necessary to develop training programmes that continuously update the knowledge of the workers in order to prepare them, and consequently the companies, as possible to the future.

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