ARTIFICIAL INTELLIGENCE AND SOCIAL MEDIA IN THE CERAMIC INDUSTRY. ANALYSIS OF THEIR APPLICATION AND EVOLUTION IN THE NEAR FUTURE

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ABSTRACT

In the last few years, artificial intelligence (AI) has become an unstoppable force that is changing the way we do business, sell, manage and interact with our customers and suppliers. As part of the new wave of automation in Industry 5.0, AI is attracting great attention in the media and is causing significant interest and concern in business, both the actual technology and its applications, but can AI be used in the ceramic industry? Given its capabilities, AI could be used to analyse and predict sales, draw up, classify and forecast budgets and new marketing opportunities, identify improvements in the sales funnel and in customers' purchasing decisions, or to detect potential customers, etc. In this context, one of the challenges is whether its use could be extended beyond business management and, for example, whether AI could become a gamechanger in terms of designing new products and predicting new uses or the inclusion of new components or raw materials.

Simultaneously, the use of social media has evolved and grown in the last few years, with varying results. The aim of this study is to undertake fieldwork that investigates how AI is implemented in companies and what concerns and prospects those companies hold regarding its future use. At the same time, based on the observatory of social media usage that we initiated in 2017, it analyses how their usage has evolved over the last 6 years.

INTRODUCTION

The Castellon ceramic cluster, which is home to 80% of Spanish firms and 94% of the country's ceramic production, is a key sector in the Valencian economy and the leading manufacturing stakeholder of Spanish ceramics, as well as one of the most important ceramics producers worldwide. As performance in recent years has shown, the Spanish ceramic tile-manufacturing industry is one of the most dynamic and innovative of its type, both nationally and worldwide, and is a leader in terms of technological development, design and service quality. It is important to underline the fact that the tile sector is the sixth largest amongst Spanish industry in terms of trade surplus, a fact that illustrates the highly international character of its companies. It is also worth mentioning that, in recent years, the industry has undergone a process of business concentration through various acquisitions, mergers and takeovers that are changing its traditional family-owned structure.

That said, the economic and social panorama in Spain over the last few years has had serious consequences for the Spanish ceramic industry. The health and social crisis of 2020 and 2021 was followed by the still unresolved conflict between Russia and Ukraine (the latter being the sector's main supplier of white clay), which led to a rise in energy prices, high inflation and lower demand. The more recent outbreak of hostilities in the Middle East has added further uncertainty to the global economy, with further upward pressure on prices (inflation), a loss of purchasing power for citizens and greater uncertainty at employment level, all of which contributes more directly to higher costs in the construction and renovation sector and reduces people's ability to afford the purchase of a new home or higher renovation budgets. This loss of global competitiveness obliges us to come up with new business strategies to improve results.

Thus, we confront an unquestionably pessimistic outlook, in which, according to data from the Spanish ceramic tile manufacturers' association (ASCER), exports during the first half of 2023 dropped to €1938.2 million, a slump of 15.1% over the same period in 2022.

In contrast, on a global level, Ceramic World Review shows in its report of October 2023, drafted in collaboration with MECS using data as of 31/12/2022 (Table 1), how almost all the world's top 25 ceramic tile manufacturing corporations, including Spain's Pamesa Group (placed number 5 with an increase of 35%) and STN Group (number 7 with an increase of 29%), have significantly improved their revenues, some by double-digit increases and even, in a number of cases, by over 20%. These data contrast with the figures for the Spanish ceramic tile industry as a whole, as mentioned above.

Rank	Group	Output in million m^2 tile (Dec. 2022)	Financial status
1.	Mohawk (Marazzi) (USA).	300	Revenue up by +10% ($4,300 million in 2022, managing to remain stable in the first half of 2023 ($2,200 million) compared to the same period in 2022.
2.	Lamosa (Baldocer, Roca). (Mexico)	215	+22% just in the ceramic tile division (€1,270 million).
3.	SCG Ceramics. (Thailand)	152	+24% (€667 million)
4.	RAK. Ceramics (UAE)	130	+18% (€550 million)
5.	PAMESA (Spain)	101	+35% (€1186 million)
6.	Ceramica Carmelo Fior (Brazil)	-	
7.	STN (Spain)	100	+29% (€585.3 million)
8.	Kajaria (India)	84.2	

Table 1 *Main ceramic tile producing corporations in the world. Source: Ceramic World Review & MEC, October 2023.*

In general, all firms related to these large production holdings were able to offset their increases in production costs by pushing up their prices and selling products with higher added value, which enabled them to improve their financial results.

In order to reverse the downturn, it is important that smaller companies in the Spanish ceramic sector commit to innovation in order to differentiate their products from other world manufacturers, and that they find new ways to maintain and improve their business figures and, thus, define a roadmap for the future.

In short, uncertain and turbulent times lie ahead that will certainly bring changes to the Spanish ceramic industry over the coming years. It is expected that in the immediate future, the threats of rising costs in Europe, the uncertainty permeating the world economy and the process of corporate mergers will all continue, although they will be accompanied by significant investments in R&D&I that will enable firms to continue growing worldwide, to better differentiate their products from third countries that are more committed to lowering costs, such as China, India or Türkiye, to reduce the price gap with Italy, and to improve recognition of the "Made in Spain" brand at global level.

SOCIAL MEDIA IN THE CERAMIC INDUSTRY

Societies in most developed countries have been undergoing a constant process of digitalisation that has changed the way people live and behave, including the use of social media among the general public and also among businesses (Salo, 2017). On average, the amount of time spent on the Internet in the first half of 2023 was 6 hours and 41 minutes per day (4 minutes more than in the same period in 2022), and of that, one third is spent on social media, totalling 2 hours 24 minutes per day (4 minutes less than in the first half of 2022). An analysis of social media by monthly usage time shows TikTok in first place, followed by YouTube and Facebook (*We Are Social* - Meltwater Elogia, 2023).

Studies carried out since 2017 by Jaume I University (UJI)as part of its observatory of social media usage in the ceramic sector show that it has increased moderately (Callarisa et al., 2022), with log-ons occurring daily, although in a rational manner, in what is more selective behaviour in the use of social media, in line with data from the IAB Spain study (2023). The time spent browsing social media ranges from 1 to 5 hours a week in 2021, with the length of time spent at each log-on being less than one hour, which nevertheless is a slight increase in usage intensity compared to 2019. Instagram is the most widely used social medium by Spanish ceramic companies, to the detriment of Facebook, which has moved into second place. LinkedIn follows in third place, followed by YouTube, Pinterest and Twitter, in that order. These media tend to be used in relations with wholesale customers, suppliers and private customers.

It should be remembered that we are talking about a ceramic sector that has traditionally maintained B2B relations with its suppliers and, above all, distributors (López-López and Giusti, 2020; Callarisa et al., 2022), which means that B2C is developing slowly, striving to avoid making mistakes and attempting to adapt to the pace of communications demanded by the sector. One must bear in mind that B2B companies traditionally take longer to generate and implement a digital strategy compared to B2C companies (Martini et al, 2023). Moreover, B2B companies that adopt a digital strategy generally initiate it using vertical social media such as LinkedIn, whereas B2C strategies usually rely on the use of social media such as Instagram or Facebook, or more recently TikTok, as well as YouTube. In that type of relationship, social content takes precedence over the more specialist and professional content used in B2B (Su et al., 2023). The leap from B2B to B2C implies a certain risk of ignorance by the end consumer that may affect the company's image should errors or negative experiences occur in the end consumer/company interaction, which is why many B2B companies delay their use of social media until they have clarified their digital strategy (López-López and Giusti, 2020; Su et al., 2023).

As an industry traditionally highly focused on sales and products, the use of social media in the ceramic sector is primarily based on promoting and publicising its brands and products, in an attempt to improve its image and positioning.

The need to provide more innovative content beyond an extension of their general product catalogues is a palpable fact in the results of the study and in companies' present behaviour. One can see how the ongoing concentration process in which the ceramic sector is immersed, together with the increase in costs and slump in sales, enhances the process of digital innovation applied to content on social media but does not eliminate the need for it.

The changes taking place in society as a result of such progressive digitalisation in all fields has inevitably led to significant changes in corporate behaviour, where consumer empowerment has forced companies to design and implement communication channels that allow consumers to resolve the various queries and contacts they may wish to make (Guenzi & Nijssen, 2020; Martini et al, 2023; Su et al., 2023).

Such increased consumer interaction with firms through different channels has forced companies to reconfigure their internal functioning, and the new roles of interaction with external audiences are either assumed in their entirety by the company, undertaken in collaboration with a specialist external firm, or delegated wholly to an outside company. In cases where social media management has been assumed in-house, it has, to a greater or lesser extent, required companies to significantly modify the way in which employees interact and collaborate within the organisation (Martini, 2023) and the way they do so externally. Marketing and PR have been the most affected departments, leading to significant changes when they have had to recruit new people with digital skills, able to carry out the tasks efficiently and control and manage everything related to those tasks (Agnihotri, 2020, López-López and Giusti, 2020).

On the other hand, hybrid management (that is, collaboration with an outside firm specialising in the digital world with in-house participation regarding content), whether on an occasional or regular basis, can bring certain freshness, although budget constraints as a consequence of such outsourcing do not help. Presumably, the trend will be upwards in the coming years.

On another note, companies' own evolution and improved interrelationships enable them to start using social media as a source of data capture, creating valuable information and, therefore, generating competitive intelligence. With that, companies can plan and implement corporate strategies, make better decisions and improve sales and reputation (Chae, McHaney, & Sheu, 2020; Guenzi and Nijssen, 2020, Martini, 2023). For example, it is feasible to use social media as a way of communicating achievements and highlighting the importance of sustainability in the ceramic sector, demonstrating companies' sensitivity to the social impact of such initiatives, particularly in terms of employability. That way, a community is built in which companies and their brands connect with their audience and society in general.

In short, social media are becoming essential to the marketing strategies of any company, given that, when properly and professionally used, they can have positive effects on sales (social sales) and customer service provision and improve company recognition and overall image (reputation) and communication with its environment and society in general.

ARTIFICIAL INTELLIGENCE IN THE CERAMIC INDUSTRY

The use of artificial intelligence in both society and business has been growing steadily over the last two years. According to the Spanish Statistical Office (INE (2023), in the "Survey on the use of ICTs and e-commerce in companies, full year 2022 - first quarter 2023", 9.6% of companies with 10 or more employees used Artificial Intelligence in the first quarter of 2023. 18.6% used some Business Intelligence software and 31.7% purchase Cloud Computing services. Looking at online trading, the report states that 31.7% of companies made sales via e-commerce in 2022, which represented an increase in turnover of 20.3% compared to 2021.

These data reveal the unstoppable growth of digital activity in companies, in both sales and the management of business and social relations. However, the figure clashes with the results of a report entitled "***Digitalisation in the construction and real estate sector***" produced by the project management software Plan Radar, which indicates that the Spanish construction industry (of great importance to the Spanish ceramic sector) will not invest as much in digitalisation in the coming years as its European counterparts. This low rate of digitalisation is a very important challenge, since despite the fact that Spain is second only to China in the world as the country that is awarded the most tenders, only 7% of companies that innovate are construction firms and, as is the case in other sectors, only the largest and best-known companies do so, which reduces overall competitiveness. In particular, the report points out that 70% of companies do not invest in innovations in virtual reality, 3D printing, robotics or artificial intelligence.

For consultants Price Waterhouse Coopers, one of the great challenges facing companies in the use of AI is to be able to generate digital trust throughout the entire AI lifecycle in accordance with applicable guidelines, issues that are not resolved as yet (PwC, 2021). On the contrary, trusted AI offers Spanish companies, and ceramic companies in particular, a unique opportunity to differentiate themselves from their national and international competitors and to drive projects with greater added value and agility, which would allow them to improve their overall results.

On the other hand, another recent study carried out by Hubspot (2023) shows that 36% of companies in general consider technological tools, such as artificial intelligence, to be a key advantage for improving the results of their sales departments. In recent years, as a result of various technological advances and improvements in global infrastructures for transport and telecommunications, companies have been facing a growing need to differentiate their products and improve their connection and interaction with customers, which in turn has resulted in difficulty to attract new customers, according to 39.2% of the companies that took part in the study. Another important fact the study points out is that 70% of Spanish companies are already using different artificial intelligence tools or applications, which implies a steady improvement in their digitalisation processes, with ChatGPT being the most widely used, according to 85.1% of these companies.

The application of artificial intelligence has not only led to operational benefits for the companies that have adopted it, but 87.43% report that they have also gained a competitive edge. Improved efficiency and productivity driven by automation have been crucial for 89.7% of the companies surveyed. Therefore, in view of such a situation, 84% of companies consider that they will continue or start using artificial intelligence applications or tools in 2024.

Consequently, 2024 is shaping up to be a year in which companies will increase their budgets to invest in technology, at least that is what more than 60% of companies stated in the HubSpot survey. Investment in technological tools (57.2%) and the adoption of artificial intelligence (48.8%) are presented as two key strategies to be addressed, not just in 2024 but in the coming years, as a key factor for continuous improvement, progression and adaptation to change, and ultimately as a way of improving companies' overall results (sustainability).

Turning specifically to the ceramic industry, as happened in other sectors, consumers of ceramic products have changed their purchasing behaviour as a result of society's constant digitalisation. Industry 4.0 and 5.0 reflect such change of behaviour in the transformation companies have been undertaking in recent years (ElFar et al., 2021). These technological innovations applied throughout the entire ceramics value chain are a key factor to continuing to improve competitiveness vis-à-vis other major producing countries and should serve to continue advancing towards the new paradigm of Industry 5.0, in which the human factor will be incorporated into the technification, robotisation and automation of production plants and stock management as the industry's differentiating element and value (Berretta et al., 2023). The new Industry 5.0 applied to all stages of the value chain (research, design, development, production – distribution - after-sales services) makes it possible to improve process management and overall control, from the moment the initial idea for a new product arises (inspiration through research) to its delivery or sale, and it can continue to improve the level of satisfaction from its use (Carayannis et al., 2020; Maddikunta et al., 2021). This new industrial paradigm introduces and gives greater relevance to the interaction of human beings with technology, where the former becomes a relevant figure based on their capacity to think and interpret, which contributes value to the system and influences organisational performance (Mirbabaie et al., 2022). Thus, in processes where artificial intelligence is used, the human factor is key to supervising and enhancing the results achieved throughout the process and therefore to improving the company's overall results (Dubey et al., 2020; Berretta et al., 2023).

In this way, its proper application in the ceramic sector enables a series of advantages to be gained that go beyond predicting demand and innovating traditionally valued materials. For example, the application of AI to immersive Augmented Reality and Virtual Reality experiences, together with IoT, can bring the product closer to consumers, improve their general purchasing experience, enhance distributors' retail reputation, and improve the results of the entire value chain (Kotler et al., 2020).

In short, the challenge facing companies in the Spanish ceramic sector is to know how to take advantage of the opportunities offered by the continuous advances in technology and to adapt them appropriately to their value chain, while considering the customer and the human factor within the company as a factor that enhances technology, in order to ensure that it is intelligent, flexible and functional, and responds to customers' actual needs in terms of the durability, design and functionality of ceramic products.

METHODOLOGY

For the purposes of the study, a structured questionnaire was drafted and sent to 107 companies in the Spanish ceramic industry based on data extracted from the ASCER website. In order to collect the data, the questionnaire was designed to include 3 sections, one of a general nature, another on the use of social media, and finally, a third one aimed at finding out respondents' opinion on the use of Artificial Intelligence. The questionnaire was sent by e-mail to the addresses listed in ASCER directories - 3 mails were sent, followed by a telephone call to each of the companies that appeared on the list.

The mails were sent in Google forms format to facilitate users' response. A total of 68 valid responses were collected from 54 companies. This is due to the fact that, in a number of companies, more than one person responded, in some cases because they showed interest in doing so and in other cases, because when the mail was received, they did not know who should respond and sent it internally to more than one person. The sample is therefore representative of the sector and enables us to build on the exploratory studies carried out in 2017 (12 valid responses), 2019 (45 responses), and 2021 (27). The fieldwork was performed between July and November 2023. Table 2 shows the study's technical data sheet. The programme used for data analysis was SPSS V28.

Prior to launching the survey, all these companies were assessed online to see which of them were active on social media. The result was that only 82 of the 107 initial companies were active on social media (76.6%).

Technical data sheet	
Start date	24 July 2023
End date	24 November 2023
Target population	107
Size of sample group	54 (52.94%)
Sampling procedure	Survey sent to the entire survey population by mail with follow-up phone call
Target sector	Spanish ceramic floor and wall tile manufacturers, clay and machine suppliers

Table 2. *Technical data sheet for the survey*

For the Artificial Intelligence section, after reviewing the literature, the questionnaire used by Berreta et al. (2023) was adapted to meet the actual circumstances of the ceramic industry.

The most prominent findings from this research after analysing companies in the Spanish ceramic sector's digital presence were the same as had already been seen in the previous study, namely:

SOCIAL PHENOMENOLOGY OF COMPANIES ON SOCIAL MEDIA

- 29.9% of the companies do not have a presence on social media or do not indicate it on their website, i.e., neither the symbol of the social medium nor its link appears on the website.
- Not all social media are indicated on the website.
- The company has a presence on social media but the links are not easy to find on the company website and, moreover, the links are not equally available in the different sections (website, contacts, ...).
- Some companies have videos posted on YouTube, but they do not specify it as a social media or their logo does not even appear on the website, they just appear in the videos or multimedia section.
- There are some that have interesting contents (ceramic dictionary, answers to technical questions, etc.) but they do not disseminate it in a clear way.

DATA ANALYSIS

As far as respondents' characteristics go, 13.2% had secondary school education, 57.4% were university or higher educated, and 29.4% had a master's degree or Ph.D. 54.4% were men and 45.6% were women. Average age was in the 41-50 age bracket at 42.5 years.

In regard to their jobs in the company (Table 3), 25% held a position of marketing director, graphic designer (14.8%), and the rest in very similar percentages, export director (7.4%) and country manager (7.4%), senior manager (7.4%), showroom manager (7.4%), director of communications (7.4%), commercial director/head of sales (7.3%), and the rest from the communications department (7.4%), sales department (4.4%) and administration (4.4%).

	2019	2021	2023
Male	44.4 %	48.1 %	54.4%
Female	55.6 %	51.9 %	45.6%
Age bracket	31-40	41-50 (44.4%)	41*50 (45.7%)
Education level completed:			
University	41.9%	51.9%	57.4%
Master or higher	44.2%	33.3%	29.4%
Secondary school	11.6%	14.8%	13.2%
Job position held			
Head of Marketing	62.1%	63%	25%
Sales Management	10.3%	18.5%	7.3%
Head of Communication	17.2%	11.1%	14.8%
Senior Management	3.4%	3.7%	7.4%

Table 3 *Socio-demographic and employment details*

Table 4 shows the social media used by respondent companies in their relationships with wholesale customers, suppliers and private customers. As in 2021, Instagram is the most widely used social medium (76.7%, 41.3%, 54.5%, respectively), followed by Facebook (28.1%, 25%, 25%, respectively) and LinkedIn (22.2%, 22.2%), while in 2017 and 2019 Facebook was the predominant medium in relations with all three audiences - distributors, suppliers and end customers or consumers, both when asked about the total number of media used and when reference is made to only the most widely used medium. The fourth most popular social medium is YouTube.

In all cases, the type of information most generally posted on social media by ceramic companies in their relations with their distributors, suppliers and private customers, is photographs and images, the same as in the previous three editions in 2017, 2019 and 2021 (Table 5), followed by videos and comments or discussion forums.

	Wholesalers								Suppliers								Private customers							
					Most used								Most used								Most used			
	2017	2019	2021	2023	2017	2019	2021	2023	2017	2019	2021	2023	2017	2019	2021	2023	2017	2019	2021	2023	2017	2019	2021	2023
Facebook	66.7	88.9	77.8	88.2	40	51.3	32.0	28.1	58.3	57.8	50.1	70.6	62.5	45.5	9.6	25.0	66.7	82.2	80.8	67.6	50.0	48.6	25.0	25.0
Twitter	50.0	48.9	38.9		20				16.7	17.8	17.7		12.5				25.0	28.9	13.3	14.7	12.5			
Instagram	58.3	84.4	84.6	95.6	20	38.5	52.0	76.7	16.7	53.3	52.2	72.1	12.5	30.3	57.1	41.3	41.7	75.6	84.4	85.3	25.0	43.2	62.5	54.5
YouTube	58.3	55.6	59.1	41.3	10				25.0	20.0	22.2	4.4	12.5				50.0	37.8	31.6	30.9	12.5			
Pinterest	41.7	66.7	47.6	51.6	0				8.3	17.8	5.6		0				33.3	46.7	22.7	17.7	0	2.7		
LinkedIn	41.7	71.1	75.0	79.6	10	7.7	1.6	22.2	8.3	46.7	54.5	38.3	0	24.2	33.3	22.2	33.3	37.8	22.3	22.2	0	5.4	12.5	
Vimeo		4.4				2.6				2.2							2.2							
Flickr		2.2																						
Block		4.4								2.2							4.4							
Houzz	8.3	4.4								2.2							4.4							
Vk																								
Tumblr																								
Wechat		2.2															2.2							
None/No reply										11.1														

***Table 4**. Social media used (%)*

With regard to whom and how often information is consulted on social media, there are significant differences with respect to 2017 and 2019. As in 2021, in this edition, following well-known people or professionals was the most relevant behaviour pattern, but following companies from other sectors has increased, as well as following competitors, companies in the same sector, and suppliers, in that order (Table 6). This question may be relevant, given that, together with following key people and professionals, finding out about others' projects and opinions, as well as trying to find out what is being done in other sectors, may be a source of inspiration for new products and projects in the companies where surfers work.

	Distributors				Suppliers				Private customers			
	2017	2019	2021	2023	2017	2019	2021	2023	2017	2019	2021	2023
Photos & images	75.0	88.9	100	85.3	50	62.2	73.1	85.3	75	88.9	96.3	79.4
Videos	58.3	53.3	72	54.5	16.7	26.7	64	20.6	33.3	51.1	80.8	36.7
Comments or debate forums	16.7	24.4	33.3	2.9	25	17.8	38.1	-	25	31.1	38.1	22.1
Sales statistics and web visits	-	2.2	3.7	-	-	8.9	16.7	*-		2.2	28.6	-

***Table 5.** Type of information most often posted on social media (%)*

	Average*			
	2017	**2019**	**2021**	**2023**
Competitor firms	3.80	3.38	3.63	3.70
Reputed people or professionals	3.50	2.24	3.78	4.15
Social media belonging to organisations or firms in my sector	3.40	3.79	3.48	3.68
Supplier companies	2.67	3.47	2.92	3.81
Social media belonging to organisations or firms in other sectors	2.40	2.76	2.85	3.91

*Scale from 1 to 5 (1=never, 5=always)

Table 6. *Whom and how often do you consult for information on social media?*

With regard to the number of followers or likes they have on social media, the companies in the survey have an average of 16,821, which represents a slight increase compared to previous editions, 14,425 in 2021, 12,748 followers in 2019 and 8,547 in 2017, with a maximum of 338,000 and a minimum of 121. In 2023, the 2021 trend of companies connecting to social media every day (41.2%) continues, followed by log-ons several times a day (29.4%) and several times a week (25%). This restrained behaviour may be a sign of a certain level of maturity in the use of social media, as companies are more familiar with them due to accumulated experience and, as a result, more efficient use (Table 7).

	%			
	2017	**2019**	**2021**	**2023**
Hardly ever	0	2.4	0	0
Once a month	0	2.4	0	0
Several times a month	11.1	9.8	7.7	4.4
Several times a week	22.2	24.4	30.8	25.0
Every day	33.3	24.4	38.5	41.2
Several times a day	33.3	36.6	23.1	29.4

Table 7. *How often do you log onto social media?*

When the length of time spent browsing social media is analysed, the most common amount of time spent is still 1-5 hours a week (52.9%), which was also the case in the two previous editions, followed by 6-10 hours (22.1%) (Table 8). As for the amount of time spent at each log-on (Table 9), the most common is between 10 and 30 minutes (69.1%) or less than 10 minutes (18.1%), which indicates a slight drop compared to 2021.

%				
	2017	2019	2021	2023
Less than 1 hour	27.3	15.0	3.7	1.8
1-5 hours	36.4	42.5	48.1	69.2
6-10 hours	27.3	27.5	33.3	18.1
Over 10 hours	9.1	15.0	14.8	10.9

Table 8. *Time per week dedicated to social media*

%				
	2017	2019	2021	2023
Less than 10 minutes	18.2	17.5	11.1	18.1
10–30 minutes	54.5	40.0	40.7	69.1
31–60 minutes	18.2	25.0	29.6	12.8
1–2 hours	9.1	12.5	7.4	-
2-3 hours	-	5.0	-	-
Over 3 hours	-	-	11.1	-

Table 9. *Length of time spent at each log-on to social media*

With regard to the use given to social media, the same trends as in the previous edition continue, i.e., in order of importance, they highlight: promoting and publicising their brands and products; improving the company's information and communications, and improving its positioning; being in closer contact with suppliers, customers, distributors and end customers or consumers (Table 10).

	Average *			
	2017	2019	2021	2023
… to **promote** and publicise our brands and products	4.00	4.57	4.52	4.62
… to improve the company's **information and communication** and to have a greater online presence and **positioning**	3.91	4.46	4.15	4.21
… **learn about new products**	3.55	3.87	3.63	3.75
… to **monitor** and get to know the **competition** better	3.45	3.56	3.48	3.36
… to do **research**	3.09	3.67	3.33	
… to keep **abreast** of news and to search for information	3.00	3.59	3.56	3.83
… to **keep in touch**, interact and get to know our suppliers, distributors and private customers better (customer loyalty)	2.91	3.82	3.70	3.91
… to maintain **communication** with the **rest of companies in the sector**.	2.09	3.05	2.81	2.11

**Scale from 1 to 5 (1=very low, 5=very high)*

Table 10. *Use given to social media.*

With regard to social media management and creation of content (Table 11), the results show that the need to rely on a professional external company to improve the outcome has grown (50%) compared to self-management (42.6%). This datum is relevant as it indicates a greater need for professionalisation and a greater understanding of the importance of using social media in both B2B and B2C, i.e., in relations with both distributor and supply companies and with customers or end users. In turn, proper management of this type of relationship can enable companies to generate greater brand awareness, which could be a driving factor in differentiating themselves from their competitors and a lever for growth. In addition, it is important to generate content that is relevant to the target audience, especially to the end customer, and for that purpose, it is imperative to count on the assistance of professionals who have in-depth knowledge of the digital market. It must be remembered that changes in search and positioning algorithms are constantly taking place in both social media and the Google search engine itself, which in turn implies constant adjustments in operating them, changes that may be difficult for professionals from companies in the ceramic sector to understand.

	%			
	2017	2019	2021	2023
Wholly in-house by the company	66.7	46.7	50	42.6
Outside specialists	8.3	13.3	3.8	7.4
In-house with help from outside specialists.	25	26.7	46.2	50.0

Table 11. *Social media management (creation and content)*

Finally, focusing on the last section of the questionnaire, which is new to this edition and deals with their opinion and use of Artificial Intelligence (Table 12), 55.9% of respondents acknowledged that their company did not use AI, in contrast to 29.4% who did use it, or 14.7% who did not use it personally but knew someone in the company who did.

%	
	2023
Yes, I use it	29.4
I don't use it but colleagues do	14.7
No, my company does not use it	55.9
	100.0

Tabla 12. *Use of AI in companies*

%	
	2023
Sales	40
Human Resources	20
Marketing	80
Design	20
R&D&I	20
Production	40
Don't know	20

**Multiple answer*

Tabla 13 *Which department uses AI in the company?*

With regard to the question of which department used AI in their work (Table 13), among the companies that do use it, the department that was most frequently named was Marketing (80%), followed by Sales (40%) and Production (40%), as well as R&D&I (20%) and Human Resources (20%). There may possibly be a response bias due to the profile of the respondent, although the responses follow a fairly logical operating pattern in view of the tasks carried out by each of the departments mentioned. However, this is something that should be further analysed in the future and requires reflection by company senior management.

Finally, with regard to personal opinions on the use of AI in companies, the general response shows a high level of scepticism, given the incipient nature of its use. Among the 21 questions asked, 76.2% expressed in some cases unfavourable or at least sceptical opinions about its current use in companies. Among the favourable responses to its use, the most noteworthy were that "working with an AI system will be fun for me in the long run" (66.6%), that it can help in the long run (50%), that they consider it a tool that may help them in their inspiration process (33.6%), that they consider AI useful when they integrate it in their work, that it can improve results (33.6%), and that they feel comfortable working with AI (33*.6%).

CONCLUSIONS

The Spanish ceramic industry, despite its proven dynamism, has faced various challenges in recent years (increase in raw material and energy costs, global uncertainty), and is also immersed in a continuous process of acquisitions, mergers and business concentration of companies in the sector, aimed at increasing global competitiveness. Two Spanish companies are included among the world's major producers: the Pamesa Group in 5th place, and STN Group in 7th place, both with significant increases in revenue.

This concentration process should continue to encourage investment in new R&D&I technologies, which will enhance the degree of automation and digitalisation of production processes, improvement in energy efficiency and reduction of CO_2 emissions (which have fallen by more than 24% compared to 1990), as well as improving management of companies' relations with their environment, which has made them a world reference. These technology and production, but also environmental, innovations must drive continuous improvement processes by incorporating aspects such as artificial intelligence applied to business management, design of new products, planning of sales and marketing actions, or improvements in production processes, as reflected in the results of this study, but always under human supervision, with its ability to interpret facts based on accumulated knowledge and expertise. It is very important that human thinking remains widely instilled in Industry 5.0, but for that to happen, new, more technological professional profiles need to be trained in both intermediate and higher education. Public aid or changes in legislation are of little use if the best human resources are not available.

The results obtained in this study confirm once again that new information technologies have a growing presence in companies in the sector, where the use of social media and the introduction of Artificial Intelligence has increased in recent years. The number of followers of both of them and in general has gone up in this survey compared to previous editions. All the same, orientation towards production and the product remains clearly dominant, which generates strong pressure on the sales departments in the sector to maintain and improve their business results, but there is still no clear orientation towards the end customer. Despite being a long-lasting product, ceramic tiles are present in the lives of many people, and it is necessary to continually demonstrate in a friendly and attractive way the virtues and benefits of our product and to stimulate its positive image as a preferential purchase option.

As this study points out, the use of social media has increased in the ceramic sector since 2017, as it has in the rest of society. However, a review of the contents that appear and are shared on social media shows they are mainly used to present and display the product, both individually and in environments or usage scenarios, relying on images, photos and videos, and to improve the company's information, communications and Internet visibility. With such a content profile, Instagram has established itself as the most popular social media platform in the ceramic industry for relationships between manufacturing companies and their various audiences (suppliers, distributors, retailers and end consumers), followed by Facebook and then LinkedIn (especially in supplier-manufacturer or manufacturer-distributor relations). YouTube and Pinterest come further back while X (formerly Twitter) has practically disappeared from the ranking.

The use of social media shows greater concern by companies to attempt to contribute new ideas or initiate potential projects based both on the opinions and actions of professionally renowned people and by other companies that have nothing to do with the ceramic sector, with the aim, perhaps, of breaking with existing mimicry. A more responsible and efficient behaviour is also seen in terms of log-on times (once a day and at intervals of 10 to 30 minutes), in line with data from the IAB Spain and Elogia study (2023).

This greater need for professional use of social media is evidenced by the growth in hybrid management of social media seen in the observatory's data (50%) and in external management (7.4%) compared to those who opt for in-house SM management (42.6%). As mentioned above, the complexity of how the digital market works, the continuous changes taking place in search engine algorithms, in interactions with digital channels and their rules of use, make it increasingly necessary - to the extent that budgets allow - to hire firms specialising in the field. The aim is to improve creativity and content strategies, which will improve the effectiveness of campaigns, achieve better results with the target audience they are aimed at and, therefore, improve overall results.

Finally, in regard to the new block concerning the use of AI in the ceramic sector, it is clear that such use is still incipient and that there are still many more shadows than lights on its real usefulness and results, both in the workplace and in the achievement of objectives and improvement of end results. It is evident that its application and use generates a certain amount of resentment among employees, as in some cases it is thought AI may replace people in the workplace. Controversies also exist in regard to regulation, what it can do, what it should not do, and who should regulate its functioning.

This, together with the fact that there exists a lack of real knowledge about its proper use, may justify the responses received. Focusing on the positive side, respondents rate the possibility of it improving the quality of work performed, improving their level of inspiration, and of it bringing long-term benefits if it is used, applied and integrated properly with the company's various information and management systems.

It is therefore clear that further research will be needed. It is imperative to establish a regulatory framework to help break down some of the psychological barriers that hinder proper use of these tools and their consequences. It is also necessary to regulate malpractice involving undesirable and opportunistic behaviour that leads to harmful results for third parties and society in general. Its existence and potential have put governments and competent authorities on alert, and assessment is ongoing to decide how to ensure "safe and responsible development" of artificial intelligence. In short, we are still at the introductory phase of AI in corporate management and operation, which will require constant monitoring and research in the coming years.

The fact should not be overlooked that, in the globalised environment in which we find ourselves, companies in the ceramic sector need all the available tools and interaction of human knowledge to be able to offer better responses to the demands of the different markets in which they operate. Improving business knowledge should not be undertaken at any price. Both social media and AI have the potential to offer us a great deal if we are able to use them in an integrated and proper manner. The current situation, both at sector level and in society as a whole, requires a better understanding of what is happening inside and outside corporations and an ability to offer more creative solutions that improve end results.

As far as the limitations of this study are concerned, the fact that it was only carried out in one country (Spain) restricts the scope of the results. Although the size of the sample is significant, the tone of the responses denotes a certain pessimism as a result of the current delicate situation in the Spanish ceramic sector, which may have affected the responses received, as several companies, in view of the degree of uncertainty in which they find themselves, preferred not to answer the questionnaire.

As regards new lines of research or future studies, it would be advisable to replicate this study in other producer countries such as Italy, Mexico, the United States or Brazil, which would provide richer and more varied data with more useful results for the ceramic industry worldwide. It would be interesting to analyse how the different business groups mentioned above behave to see if there are significant differences between them with respect to the rest of individually owned companies. Another line of research to be addressed would be to analyse the role of social media in generating a positive image of the company with its different audiences, including in-house audiences, and their contribution to end sales, and also, to analyse what factors are decisive in improving interaction with distributor customers and end customers. Or how to build upon digital natives and the new Internet generations to improve everyday performance. We also consider it appropriate to be open to collaboration with other research groups that may offer a more innovative vision to strengthen this study and provide more valuable results for the ceramic sector and its companies.

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