

EVOLUTION OF FRIT, GLAZE AND CERAMIC COLOUR FACTORIES AND THEIR CONTRIBUTION TO THE CERAMIC SECTOR



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ABSTRACT

The Spanish National Association of Frit, Glaze and Ceramic Colour Producers (ANFFECC) was established in November 1977 as a non-profit business association of national scope, with a view to providing member companies with a supporting instrument to defend their common interests and collaborate at the same time in the improvement of the sector, both with regard to their relationships with the Administration and to other organisations, associations, etc.

After a brief introductory description of the world and Spanish ceramic sector in general terms, focusing particularly on the situation of the frit, glaze and ceramic colour factories in this context, the milestones are reviewed that have led to significant changes in the development and evolution of these companies. Other aspects are also dealt with, such as the contributions to the ceramic sector by the frit, glaze and ceramic colour producers, the manner in which these contributions have modified the way of working and the relationship among the different companies that make up the sector, as well as the way in which ANFFECC companies have understood and applied basic action criteria (Quality, Service and Innovation).

Finally, approaching challenges (technological, financial, social, etc.) are analysed, indicating possible courses of action to address these, both at the general level of the ceramic sector and specifically by the glaze companies.

1. INTRODUCTION

The Spanish National Association of Frit, Glaze and Ceramic Colour Producers (ANFFECC) was established in November 1977 as a non-profit business association of national scope.

At the end of 2000, it comprised 26 companies, of which 16 produced frits, glazes and ceramic colours, 6 produced frits and glazes, 3 produced colours and one produced glazes and colours.

The Association's main mission is to act as a supporting instrument for the affiliated companies, with a view to defend their common interests, concurrently collaborating in the improvement of the sector (both with regard to their relationships with the Administration and to other organisations, associations, etc.) and in their promotion on a national and international level.

Figure 1 presents the sales evolution of the group of companies belonging to ANFFECC from 1982 to 2000 ^[1]. Average annual growth of 17% can be observed during this period, in the last few years with identical percentages for domestic and export sales.

This evolution has not been an isolated fact inside the Spanish ceramic sector, since while average annual growth of world floor and wall tile production in the period from 1990 to 1999 (a period for which reliable figures are available) was 8.7%, the corresponding figure for Spanish tile production was 11.8% ^[2].

These figures highlight the current strength of the Spanish ceramic sector as a whole, which at the moment together with Italy occupies top position in the world.

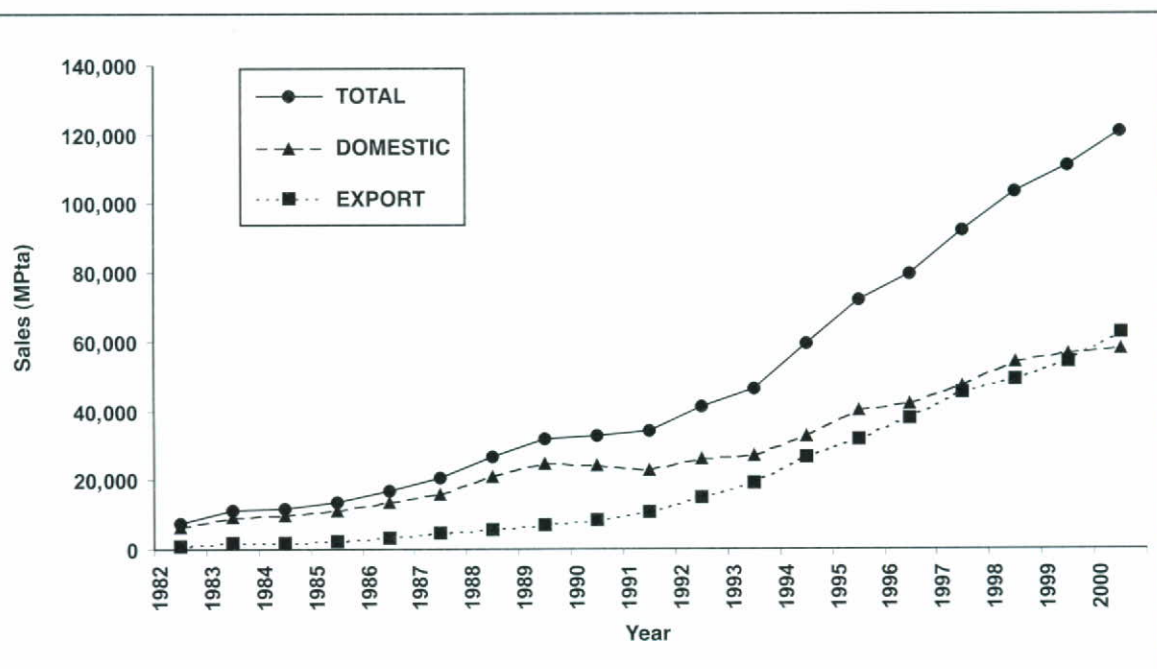


Figure 1. Evolution of sales of ANFFECC member companies.

Many factors have led to this situation, although the key to success has principally been based on innovation and quality, two aspects which characterise the work of the Spanish companies. In particular, the frit, glaze and ceramic colour producing companies

have been engaged for years in a continuous striving to improve products and processes, upgrading their facilities, and supplying integral quality service, etc., without forgetting the outstanding role played in all this activity by human resources.

For all this important work of many years to be consolidated in a definitive way, it is necessary to lay a solid groundwork for the future development of the ceramic sector, a groundwork which in turn must enable continually raising the sector's already high present level of competitiveness.

It is the joint responsibility of all those involved to carry out this task, for which it is indispensable to break through existing barriers and foster collaboration and communication among the different parties.

Therefore, in this lecture I should like to set out a series of reflections, with a view to contributing as far as possible to reaching the objective indicated. It is hence of interest to review the evolution of the frit and glaze factories, and their contribution to the ceramic sector to date.

2. EVOLUTION OF THE FRIT, GLAZE AND CERAMIC COLOUR COMPANIES

In the beginning, the frit or "glaze" was melted by tile manufacturers themselves at the rear of the hearth in the Arab kilns, so that the first really important fact in the history of the frit companies was their own appearance as factories specifically for this type of product. This occurred in the 30s, coinciding with the appearance of "bassin" or tank furnaces. Later on, the use of zirconium silicate as an opacifier, replacing arsenic and tin, led to an important change in melting technology. The new formulations presented a higher viscosity, which prevented the frits from being melted in the so-called "lengua" or pot furnaces used until then, making it necessary to switch over to rotary kilns. This change in technology also affected other types of compositions and opened up new possibilities as regards formulations and hence end effects. However, for several decades, frit or glaze continued being just another raw material for the tile manufacturer. It was a time when glaze technology was in the hands of American, German and Italian companies, with the presence of only one or two Spanish companies.

Not until the beginning of the 80s did another truly significant fact occur in the brief but intense history of the frit and glaze companies. This was when the great expansion of the Spanish ceramic industry began, driven by the improvement in energy infrastructures (natural gas), which facilitated the changeover from "slow twice fire" to "fast twice fire", and later on to "single fire". In fact, it was the technology known as "porous single firing", which marked a watershed in the evolution of the ceramic sector in general, and of the frit and glaze companies in particular, affecting not only aspects of the production process, but also the way in which the different companies making up the ceramic sector interrelated. From that moment on, the Spanish companies, which pioneered this process, became the leaders in technology as well as in quality and service, and set the benchmark.

Since then, the frit, glaze and colour producing companies have unceasingly contributed to the development of the ceramic sector with numerous innovations. By way

of example and without being an exhaustive list, Table I details some of the most significant technological advances.

Industrial implementation of "Porous Single-Firing" manufacturing technology
Glazes for fast firing cycles with different ceramic bodies: porosa, red and white stoneware and porcelain tile
Glazes for dry application (granulars, granulated glazes, etc.)
Definition and optimisation of working conditions in terms of type of glaze and ceramic body
Improvement of ceramic design by photomechanics and computer tools
Development of profiles by using milling machines
Glazes and granulars with high wear resistance
Glossy glazes for fast single firing (stoneware)
Metallic, iridescent, fluorescent, pearly effects, etc.
Development of inks for decoration by rotogravure and flexography
Ceramic colours for porcelain tile bodies
Soluble colours for porcelain tile bodies
Glazes that provide tiles with a specular image without requiring polishing

Table I. Some of the technological advances contributed by frit, glaze and ceramic colour companies.

Equally to be highlighted is the active participation of glaze companies in the World Congress on Ceramic Tile Quality (QUALICER), in which they present on average about one third of all the technical papers.

This whole work has fully deserved the recognition it has received from society in general, through the different awards granted by national as well as autonomous organisations, or by those of the ceramic sector itself. Particularly noteworthy have been the Prince Felipe Awards to Business Excellence granted by the Ministry of Economy and Treasury, and the Ministry of Science and Technology, the Golden Alpha Awards of the Spanish Society for Ceramics and Glass and the Valencia Innovation and Nova Awards given by the Autonomous Government of Valencia.

Among the different technological advances set out in Table I, to be noted as particularly important milestones in the evolution of the ceramic sector are **"Porous Single-Firing" tile manufacturing technology**, the **Development of glazes that provide tiles with a specular image without requiring polishing** and the **Development of colourants and glazes for porcelain tile**, this last advance having increased decorating opportunities, and hence of the use of this type of product.

“POROUS SINGLE-FIRING” TILE MANUFACTURING TECHNOLOGY

It is well known that “Porous Single-Firing” technology is based fundamentally on the use of a single firing in which the clayey body and various vitrifiable coatings are fired together, unlike the so-called “Twice-Fire” technique, which requires two firings, a first firing for the clay body and then a second glaze firing for the glaze. This fact, which today needs no explanation, was at that time a true revolution in the sector, and despite affecting all the parts of the production process (body forming, glazing, firing, etc.), it was incorporated in a fast, decisive fashion by the tile manufacturing companies. This can be seen in the evolution of tile production in terms of the technology used ^[3], as Figure 2 shows.

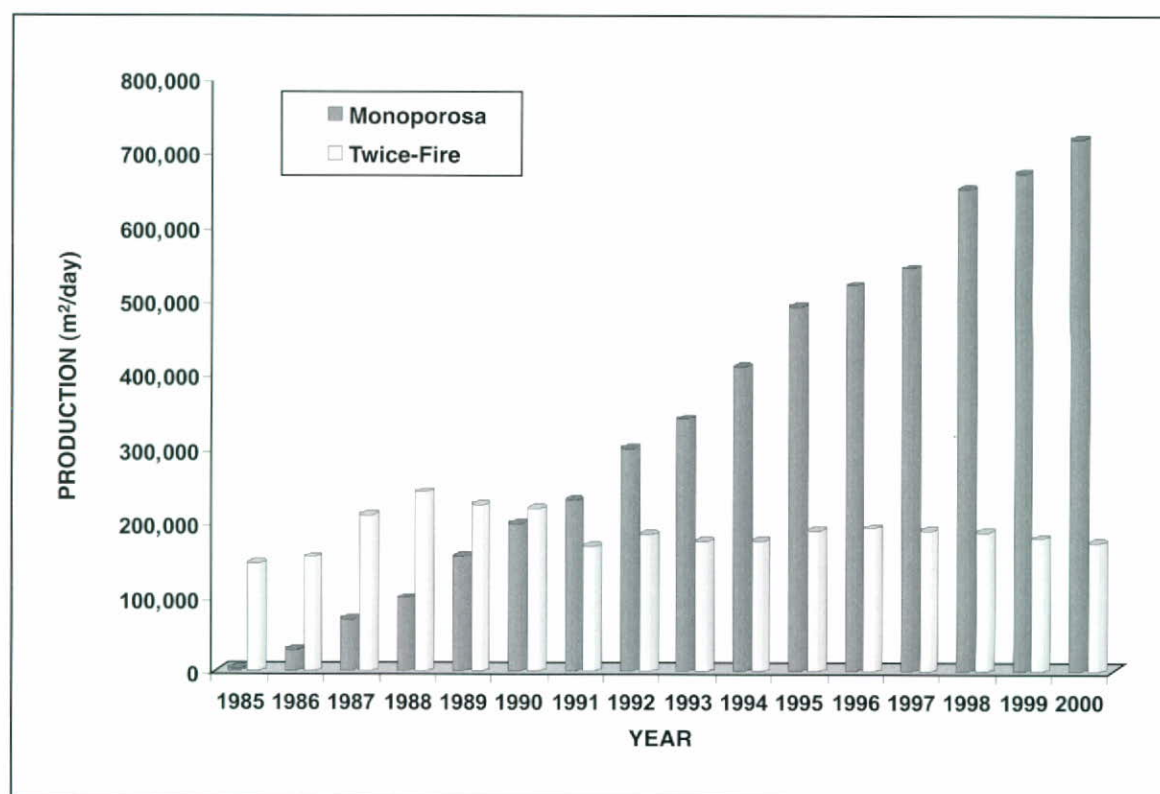


Figure 2. Evolution of ceramic tile production in Spain in terms of Monoporosa and Twice-Fire tile manufacture.

From a technical point of view, it was necessary to change the frit formulation used till then. New chemical elements were incorporated, altering the quantities of those being used, mainly of the network modifiers, to achieve a viscosity curve fitting the firing requirements of the green clay body with regard to softening temperature and coefficient of expansion. These changes in turn affected glaze rheology, making it necessary to use new additives and glazing conditions. Changes were also implemented in the pressing process, modifying, for example, clay body compaction or the presentation and composition of the ceramic body. It was also necessary to alter the firing cycle by incorporating an outgassing stage, raising firing temperatures, etc. This all required heightened raw materials control, and therefore the purchase of appropriate equipment, more technologised production, incorporation of qualified workers, new in-plant layouts,

etc. In a word, this whole series of changes led to a production process with numerous advantages, which impacted very significantly on production costs (energy, manpower, etc.) and on the necessary investment for new facilities.

All the issues mentioned above were important, but no less so were the profound changes that "Porous Single-Firing" technology gave rise to in the structure of the ceramic sector itself. Indeed, for the manufacturing improvements to become a reality, information exchange was required, establishing a climate of communication and collaboration among the different parties involved: frit and glaze company technicians needed to achieve in-depth knowledge of tile manufacturing to be able to analyse and define the requirements that the new materials to be engineered had to meet; it was necessary to carry out numerous tests in co-operation with tile manufacturers in their production plants, etc. This all became possible on breaking through barriers that had existed till then, and tile manufacturers, machinery builders and frit and glaze producers worked as a team, with appropriate information flows, enabling the right decisions to be taken fast. From that moment on, frit and glaze producing companies began providing technical assistance, they created design departments to be able to offer their clients new developments, they began to invest systematically in innovation, in human as well as in technical resources, etc., with a view to providing their clients with an integral service, with greater added value, supplying them with the greatest possible competitive edge.

In short, an important Structural Change occurred, which transformed the relationship between tile manufacturing companies and frit and glaze producing companies from a mere customer-supplier relationship, to a relationship based on collaboration and mutual understanding. This Structural Change occurred to a greater or lesser extent, depending on the country involved. It has been precisely those countries that have understood and applied this most widely, which have experienced the greatest growth in the last few years.

Finally it should be pointed out that the Changes produced by this "Porous Single-Firing" technology, have been lasting and continue in force today, forming one of the cornerstones of the ongoing development of the ceramic sector.

DEVELOPMENT OF GLAZES THAT PROVIDE TILES WITH A SPECULAR IMAGE WITHOUT REQUIRING POLISHING

While "Porous Single-Firing" technology, as set out above, is a technology basically centred on tile manufacturing, the innovation involving "Development of glazes that provide tiles with a specular image without requiring polishing", focuses on the product. It introduces highly significant improvements in tile final characteristics, fundamentally of an aesthetic nature, making it possible to speak of a new type of tile.

For this technological advance to take place, it was necessary to research and develop new frits, which, while holding coefficient of expansion and softening temperature requirements, had a maximum flow temperature at peak tile firing temperature. Of equally great importance was the work done in the field of Design, incorporating cutting edge computer technology, which enabled achieving high resolution and presenting the decorative pattern in all its detail, providing high aesthetic value. A last feature which contributed to providing tiles with a better finish was the machining of tile sides, eliminating the characteristic rounded edge of traditional products.

In short, this whole work enabled producing a new tile with a very similar appearance to polished natural stone (marble, granite, etc., depending on the selected design), thus fully addressing one of the issues that the ceramic sector had always wished to tackle.

From a marketing point of view regarding the new material, this technological advance had important repercussions. On one hand the market of tile uses broadened. Till then tile applications had been practically restricted to bathroom and kitchen walls, now this advance allowed direct competition with marble and granite in internal tilings for hotels, shopping centres, etc. On the other hand, this type of tile had a greater added value, so that although it was sold in the usual markets, the earnings it generated were higher.

One cannot help emphasising once again, the importance of the close collaboration between the tile manufacturing companies, machinery builders and frit and glaze producing companies, without which the industrial implementation of the present technological advances would have been unthinkable.

DEVELOPMENT OF COLOURANTS AND GLAZES FOR PORCELAIN TILE

In the last few years, porcelain tile production has experienced very significant growth, not just in Italy, where it already represents over 40% of total ceramic tile production, but generally in all the world, and notably also in Spain.

Although porcelain tile was first born as a material with very limited aesthetic possibilities, even requiring a polishing process to provide the material with a more commercial appearance, at the moment a wide range of product types are marketed with regard to design and finish. This evolution has largely been possible thanks to the work done by machinery builders and frit, glaze and ceramic colour producers. The former have developed sliding press fillers that allow double charging, pre-press equipment specifically engineered to produce certain effects, machines for mixing and application in the press of materials of different colours, shapes and sizes, etc. The frit, glaze and colour companies have in turn provided their clients with soluble colourants or stains for tile decoration after pressing, high-temperature ceramic colours, glazes of all types for wet applications by traditional methods, spray-dried glaze materials for press applications, flakes, granules of different shapes and sizes, micronised materials, etc. Ceramic colours deserve special attention, since they have become a basic, indispensable component of porcelain tile bodies. In this sense, it is necessary to highlight the work done in developing new pigments, based on stable crystalline structures at the high temperatures used in processing porcelain tile, which provide high colour development in spite of the minor quantity of residual glassy phase. These studies have also allowed very significant broadening of the range of available colours and even of the colouring methods used, so that for example, the spray-dried ceramic body can be coloured by a dry method, or the pigment can be added directly to the slip that will subsequently be spray dried. Complementing the laboratory work, frit, glaze and ceramic colour companies have pilot plants for developing new effects in ceramic products with the engineered materials, as well as for exploring the possibilities of new application equipment as it appears.

In this whole process, continuous collaboration has taken place between the different companies for the initial development and subsequent industrial start-up of new models and products. This has all led to a great number of possibilities, which have materialised in products with high aesthetic and technical value.

Just as in the foregoing technological advance indicated, the innovations achieved in the field of porcelain tile have always been focused on the product, the main objective being the improvement of its aesthetic and technical properties. Further to be noted is that this type of material is being successfully introduced in markets for external floorings and facade claddings, kitchen worktops, steps, etc., which considerably widen the possible range of ceramic floor and wall tile uses.

3. CURRENT SITUATION: ACTION CRITERIA

The previous section has presented a brief review of the most significant events that have taken place since the frit, glaze and ceramic colour companies first appeared. Now we shall analyse the current situation and define the basic action criteria, and how this type of company understands and applies them.

To do so, we shall review the problems or challenges that companies, independently of the branch to which they belong, have had to face over the years ^[4].

Figure 3 shows how at the beginning of the 60s, the predominant factor was Production Capacity. Demand exceeded supply, the product dominated the market, so that the biggest concern for companies was to have the necessary means of production and to get the manufactured products out onto the market, all with a certain organisation. At the end of the 60s, manufacturing alone was no longer enough, but rather it was necessary to manufacture without defects. The market demanded products free of faults, leading to the introduction of the concept of Quality. This situation was maintained until the mid 70s, when supply already began to exceed demand, owing among other reasons to the dollar (1971) and oil crisis (1973). Besides having the necessary Production Capacity and supplying the market with Quality products, it became necessary to manufacture in a competitive way, by increasing process efficiency and providing companies with the required Productivity. Once again the market continued to evolve and in the 80s it no longer sufficed to have a wide range of fault-free products for the market to choose from, but the market started thinking about the product and called for a series of characteristics. It became indispensable to hear the voice of the market. It was necessary to incorporate the customer in the product to satisfy his Needs. Client Service became the buzzword to govern the situation for more than a decade until the beginning of the XXI century, when the approach "doing things in a different way, looking for New Business Opportunities started to prevail. It became the time of Innovation in all contexts (products, processes, services, organisation, etc.), in order to be able to provide the market not only with what it asked us for, but also with new ideas and new solutions to make the offer more attractive and allow further advances in product performance and reliability.

Of these aspects, Quality, Service and Innovation continue to be fundamental for corporate development, for companies seeking a leading position in the market. Production Capacity and Productivity have in time become something taken for granted in any company. Production Capacity, because nowadays production means are easy to define and find, and the price of money is affordable, so that it is a matter of deciding what investments to make and then to do so. Productivity, because if a company is not competitive it cannot survive in such a voracious market as the one surrounding us at present. However, Quality, Service and Innovation are factors on which a company can set its stakes to a greater or lesser extent, depending on company strategy. In general, the Spanish frit, glaze and ceramic colour sector has adopted these three factors, making them

their basic action criteria.

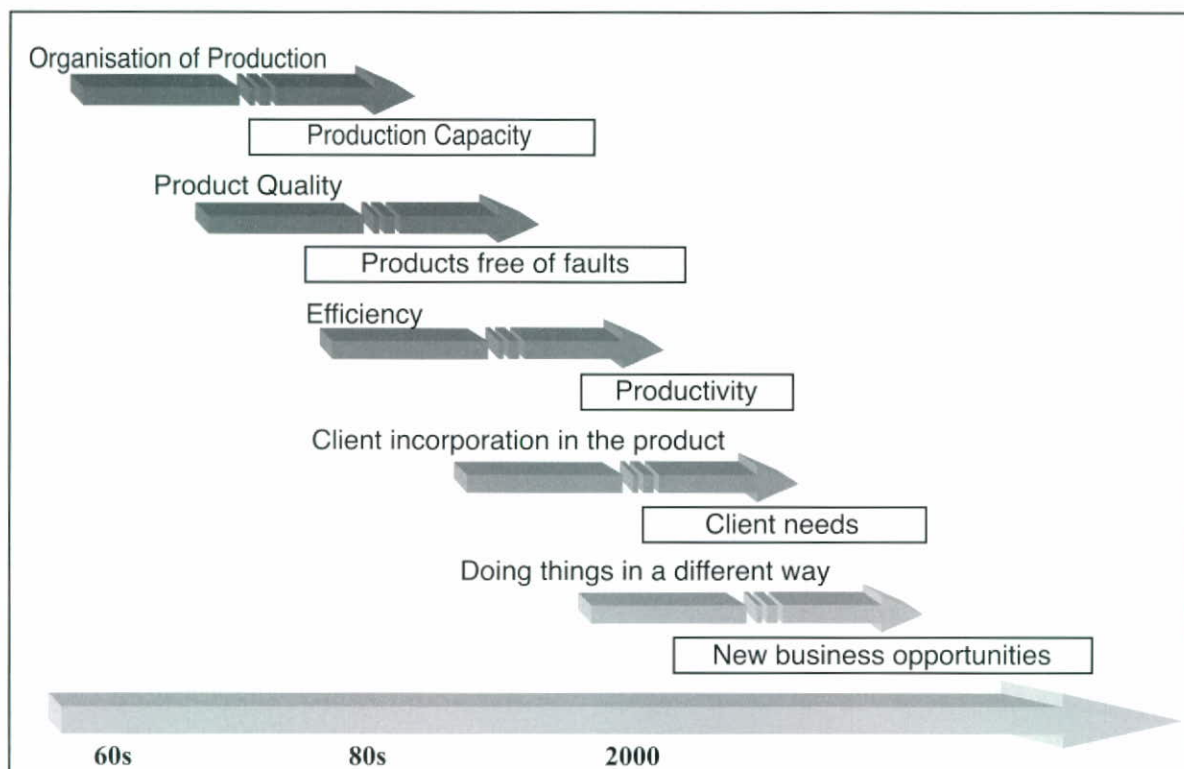


Figure 3. Problems the Company address.

QUALITY

As stated previously, it was at the end of the 60s when the business world began to become aware of the concept of quality, then understood as “products free of faults”. Nowadays this understanding has changed completely in the frit and glaze sector, and the last decade has witnessed the greatest advances with regard to quality, as a result of a series of factors:

- The awareness of business leaders that quality is decisive to the success of their companies, to which the institutional campaigns conducted by different organisations have also been of great importance.
- Intense competition fostered by the sector’s concentration in a small area has forced manufacturers to continuously improve products and services so as not to lose market share.
- Progressive upgrading of production technologies, together with important investments in control equipment, has led to general improvement of all the processes, from raw materials control to the development of new products, including the production process itself.

Change and continuous improvement have therefore become a reality in the frit, glaze and colour companies, which understand that the term quality should be applied to all company activities, not just to those directly concerning production processes or

the marketed products, but also to other types of issues such as relationships with clients, organisation and planning, human resources, technological innovation, eco-management, safety and health in the workplace, and the company's commitment to Society. In fact, products need to be continually sought that more closely meet market needs, attempting to make the proposed innovations more fruitful. The supply of products and services has broadened to offer the client all that he may need to run his business perfectly. The very relationship with the client has gone from a cold business relationship to a warm human relationship which seeks mutual benefit. In the field of organisation, the necessary means are provided to respond swiftly to new needs and the continuous changes that take place in the ceramic sector, in which the fact of being able to have ever better qualified and satisfied people plays a fundamental role in enabling the future to be faced successfully. Day by day, the necessary means are progressively incorporated to contribute to improving the environment and enabling sustainable advance, making economic growth compatible with appropriate preservation of natural resources and the Environment as a whole. Finally, the commitment that companies have to Society also needs to be mentioned, as a result of which enterprise continually participates actively and directly in activities that can benefit the community, such as promotions, sponsorships, scholarships, etc.

SERVICE

Glaze companies rely on Service as one of the fundamental drivers of their own development and of that of their Clients. Close communication is maintained with the client, with a view to gathering the necessary data that will allow understanding every kind of need, and enable attempting to anticipate these, putting forward new ideas and alternatives.

It should not be forgotten that the ceramic sector is the "raison d'être" of the frit and glaze producing companies, so that all their activity is directed toward strengthening the good relationships with the client, in order to know how best to collaborate with him, to provide him a wide variety of products and services, which cover the whole range of branch needs (glazes, raw materials, balls and alumina linings, etc.), carrying out collaborative projects of mutual interest and benefit, making communication among the different parties easier, more agile and swifter, etc. This close relationship has been one of the key enabling factors in achieving the advances made to date.

It is common practice in the sector to define together with the clients the products to be developed and the requirements to be met. The support and technical assistance required is then provided in fine-tuning the new developments, while assistance can be extended to the daily work in the ceramic companies, thus contributing to the ongoing improvement of products and processes.

Design deserves a special mention, since a fundamental requirement of the current market is the need for the products developed to present a high aesthetic value. In this sense, the glaze companies have equipped themselves with the necessary human and technical resources to be able to address this challenge. Specific Design departments have thus been created, in which the arising new technologies have been progressively incorporated, such as photomechanics in the beginning, or more recently computer-aided design and the elaboration of profiles with milling machines.

As support in carrying out all these tasks, full, sophisticated instrumental equipment for analysis and tests is available at the companies, as well as pilot plants equipped with the latest technologies used in the ceramic industry.

In short, the frit and glaze producing companies have evolved to become companies that supply a complete service for all their clients' needs, always based on a policy of collaboration and communication.

INNOVATION

As Figure 3 shows, Innovation has been the last company approach to be incorporated to address the arising challenges. The first question that could be posed is: why is it necessary to Innovate? To answer this question the following argument might suffice ^[5]:

"In the medium and long term, the most favourable financial results are always accompanied by staking heavily on Innovation"

Indeed, in accordance with a recent study based on company rankings in terms of Innovation criteria, "the return on investment of companies in the top 20% of the innovation ranking, is twice that that of the rest of the companies in the same sector."

However, it is convenient to seek other types of arguments that really reach into the company consciousness, and make the innovation felt as an essential, fundamental part of the company, since there is no innovation without a will to change. Arguments are not difficult to find:

- Clients require more innovation every day.

Clients' expectations and needs evolve. Clients become steadily more demanding and sophisticated. Products and services of the whole market are renewed by adding new performance features, whether they be basic technical qualities, ease of use or lower costs.

- New technologies facilitate innovation.

Many of the social advances in which we are immersed are intimately bound to technological innovations. Business leaders have the capacity to identify "problems" for which a solution does not yet exist, and to transform these into business opportunities, either by combining available knowledge or developing new knowledge.

- What used to work no longer does.

The growing sophistication of the market, and the super-segmentation that it brings with it, produces growing business complexity. Successful products and general services of the past are today no longer valid. The ensuing frustration grows owing to the fact that the solution to the company's problems lies outside the range of experiences of past successes.

- The competition copies better all the time.

There are companies that focus on pursuing a follower's strategy. They let others innovate and try to quickly reproduce the innovator's contribution. Independently

of the effectiveness of this approach, the presence of copiers fosters the need to innovate unceasingly in a company that aspires to achieve superior results and hold these over time.

All these reasons are good arguments for any company to decide to incorporate innovation into its strategy and the frit and glaze sector has understood this and adopted this approach.

From a business point of view, the innovation process, and more specifically that of technological innovation, goes from the time one has an idea to the moment the product or process developed from that idea is marketed. Along that whole road, it is necessary to carry out research (fundamentally in the first stages), development and trial runs, first on a semi-industrial and later on an industrial scale. If the marketing stage is not reached, i.e., if the new process or product is not introduced in the market with sales that allow recovering investments, real Innovation cannot be considered to have occurred. In any case, all innovation should contribute a value; it should contribute value to the company and therefore to society.

As may be observed in Figure 4, numerous agents can play a certain role in the Innovation process, but only companies can tackle this process in its entirety, from beginning to end. The remaining agents can only facilitate or act as catalysts in this process, with a supporting function.

In fact, if mature innovation systems are taken as a reference, such as the American or German systems, it can be observed that in these countries almost 3% of GDP is devoted to innovation, with companies contributing around 70% of the total cost ^[6]. However in Spain, the percentage of GDP that goes to innovation is just slightly over 1%, with companies contributing a little over 50%. To try and reach the levels of these other countries it is necessary for the Spanish companies to adopt a leader role.

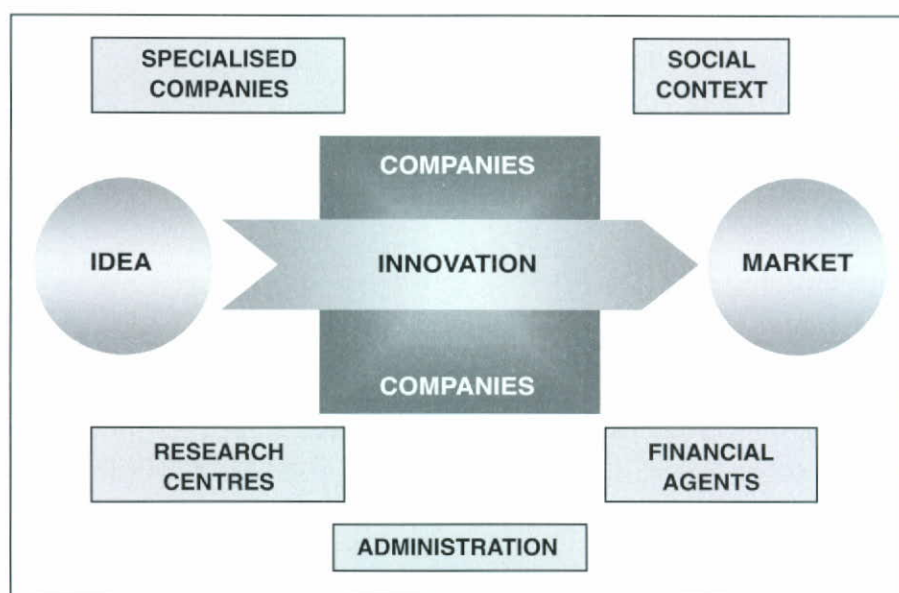


Figure 4. Main players in the innovation process.

The ceramic sector in general, and the frit, glaze and ceramic colour producing companies in particular, have been playing this leader role for years. This is demonstrated by the continuous incorporation of new technologies, launching of new products, improvement in product finishes, etc., which have yielded important, steady growth of domestic floor and wall tile production in the last decade. Specifically, the frit, glaze and ceramic colour producing companies have equipped themselves quite independently with the necessary technical and human resources to enable conducting the Research, Development and Innovation (R+D+I) work that the market demands. This is why it is usual in these companies to find teams solely devoted to R+D+I, consisting of a considerable number of highly qualified staff. The most advanced, modern technical equipment is to be found, not just with regard to laboratory instrumental techniques (electron microscopy, X-ray fluorescence, X-ray diffraction, etc.), but companies are also equipped with the necessary machinery to be able to carry out trials and tests simulating industrial working conditions, while at the same time incorporating the latest technology to explore the possibilities of new techniques, etc. It is also common practice, amongst other activities, to do Technological Prospecting, attending Trade Fairs and Congresses of all types, and systematically conducting literature surveys; research work is conducted in collaboration with specialised Centres and companies, where basic aspects of the ceramic process are studied in depth, with the acquisition of important, interesting knowledge; there is furthermore participation in European projects enabling contacts to be laid with companies and technologies from other sectors. All these activities are always focused in terms of the other two basic action approaches, Quality and Service, in order to provide clients with tools that allow them to maintain and even heighten their competitiveness.

4. FUTURE PROSPECTS

Figure 3 presented the different solutions that the industrial sectors have successively adopted in responding to the arising challenges: Production Capacity, Quality, Productivity, Service and Innovation. This brings us to the current situation, which requires reflecting on what the next challenge will be and how to address it. It is difficult to answer this question, but he who finds the answer will have travelled a long way toward success.

One can have a more graphic vision of the situation, if one considers the exercise known as the "time sequence trap" ^[7]. As Figure 5 shows, the exercise starts with a geometric figure and it is always attempted to make a parallelogram with the new figure or item that is added. In our case, each piece represents a new challenge needing to be addressed. Thus, item number 1 represents the situation in the 60s when Production Capacity was the predominant factor, while item number 2 represents the approaching challenge. The solution at that time was Quality. Later came a new challenge, which was solved with greater Productivity, followed by Service and Innovation, as already indicated previously. They have all been fitted perfectly, as the successive graphic items in Figure 5 show, yielding the corresponding parallelograms.

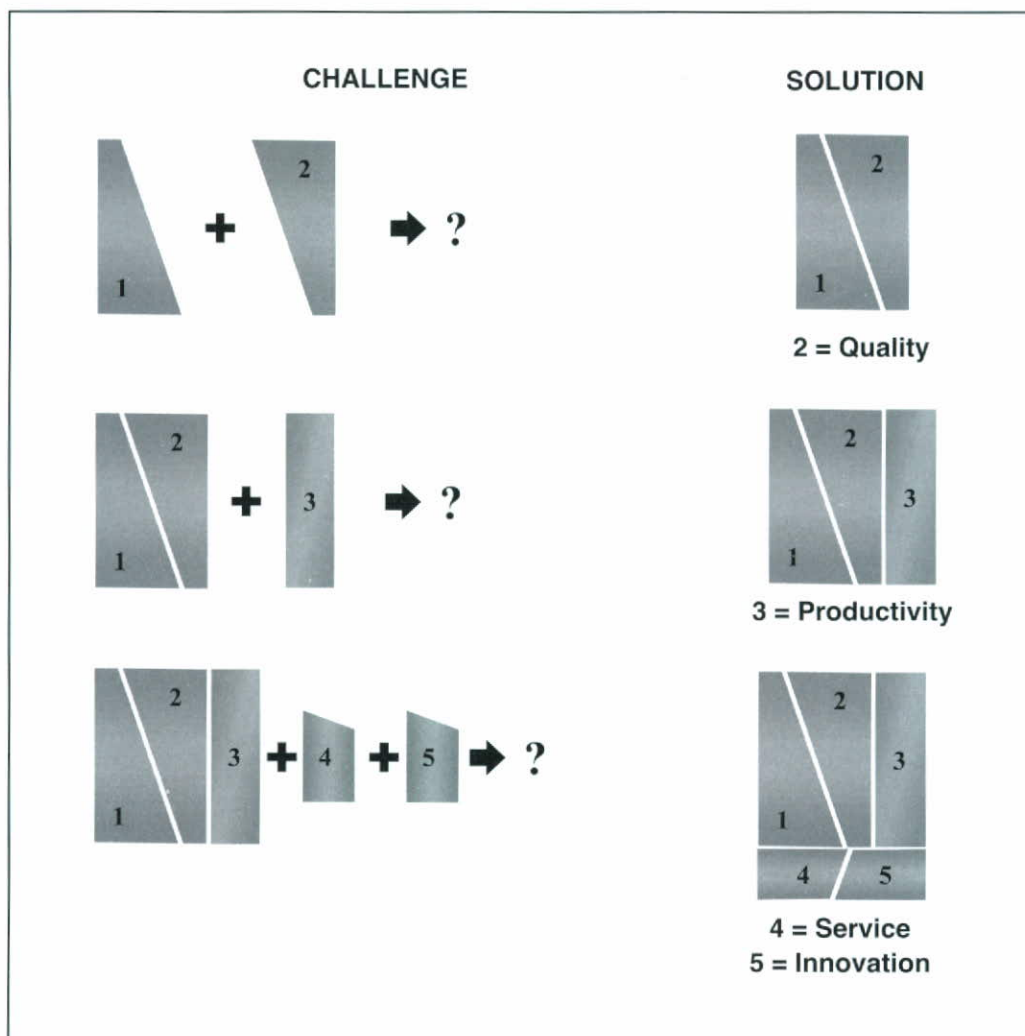


Figure 5. Time Sequence Trap. Challenges and adopted solutions.

Figure 6 represents the current situation, with all the fitted pieces and the approaching new challenge (item number 6). As can be observed, it may not be possible to fit in the "future."

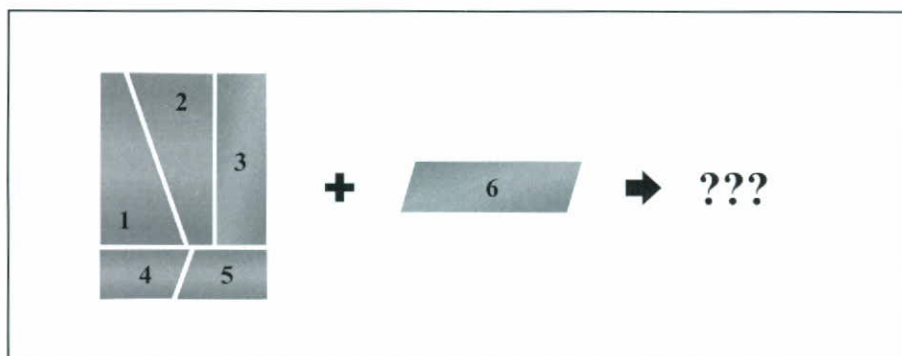


Figure 6. Time Sequence Trap. New future challenge.

In the face of this situation, organisations can respond in different ways. The easiest and most immediate way is to underrate the new challenge, to consider it to be something absurd that does not fit in with what is known in the company or with the company's plans for development and to reject the challenge without addressing it. The future of companies that adopt this solution cannot be very promising. "If the rhythm of change inside an organisation lies below that of its environment, I am sure that the company's end is in sight. The question then remaining to be solved is when that moment will be" (Jack Welch, General Electric).

However, companies wishing to survive and be market leaders need to face new challenges in a very different way. They must have the capacity to react, break with the current situation, generate new ideas and restructure their resources to thus, by producing movement, i.e. change, transform challenge into opportunity (Figure 7).

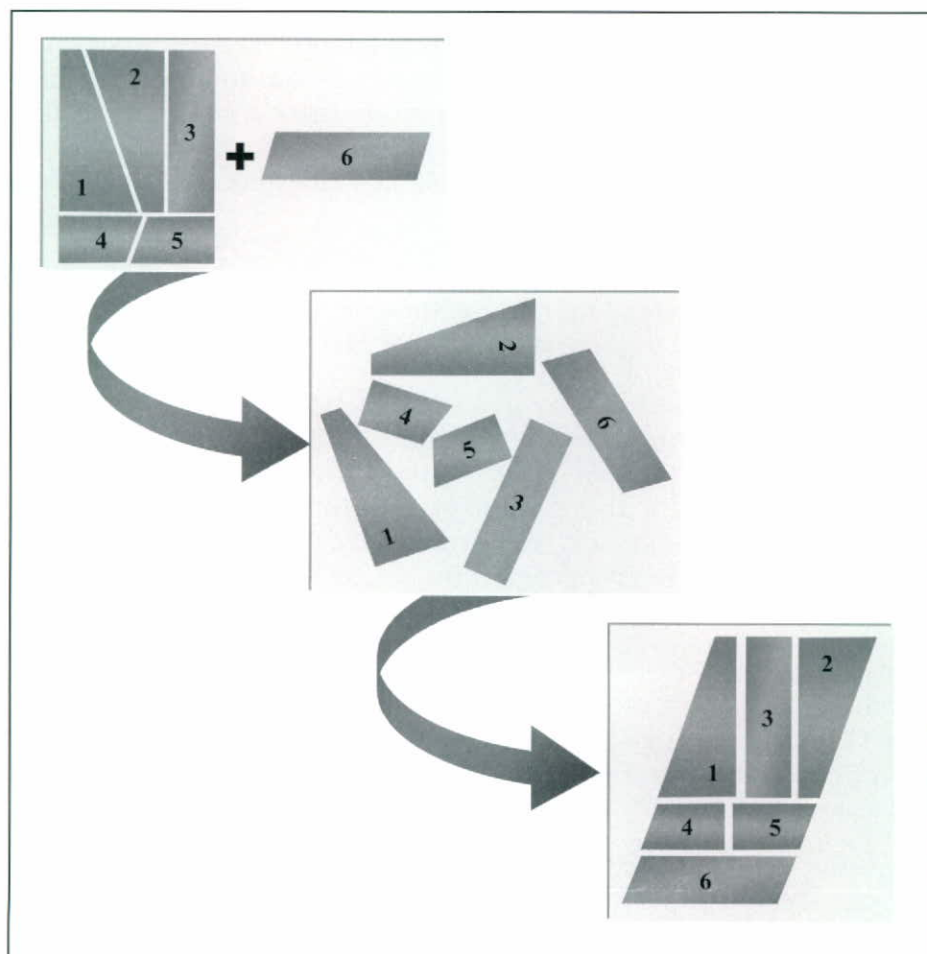


Figure 7. Time Sequence Trap. Reorganisation and change.

The origin of these challenges can be very different and unforeseeable: they may range from merely social issues (fashions, new requirements of use, cultural changes or changes of habit or manners, etc.) to financial and economic issues (unification of European currency, swings in the economies of different geographical areas, dependence on US economic world leadership, etc.), including of course the continuous advances taking place in the field of technology.

Given the manufacturing nature of the ceramic sector, the last issue mentioned deserves closer, more systematic monitoring. Today the concept of globalisation can be applied to very diverse contexts, not just to the economy or telecommunications, as has usually been the case till now, but also to technology, and within this context, to the field of Materials, which is where the products manufactured in the ceramic sector belong. It is becoming increasingly difficult to establish boundaries between organic and inorganic materials or products, between metal and ceramic, etc. It is commonplace to hear of "ceramic matrix composites", of fibre-reinforced plastic materials or concrete with metallic embeddings. Technologies that just a few years ago seemed far away, such as Chemical and Physical Vapour Deposition, Sol-Gel, Target Sputtering, are currently being applied in a regular fashion in branches not very far removed from the ceramic sector, such as the Glass branch.

The field of Materials evolves unceasingly. New materials will therefore appear, changing the way things are made. Some decades ago great efforts were made in the world of Biomaterials, which though not leading to great advances at the time did serve to lay the groundwork for a future revolution in this field. We are still living through the last stages of the revolution in Telecommunications, a revolution made possible thanks to the development of materials that have enabled miniaturising components to increase the speed of data transmission, etc. Aeronautics is another inexhaustible source of new materials. The field continually seeks to fly faster, which requires flying higher so that lighter, stronger materials are needed.

All these developments from sectors which could be termed of "high technological intensity", are gradually moving toward sectors of "low and medium technological intensity", until they eventual become part of daily life.

Thus at present new additives are available, polymers, chemical compounds, etc., which will enable introducing changes that affect features such as glaze rheology, characteristics of spray-dried glaze materials for presses, granules, flakes, etc. New technologies can be envisaged with regard to body forming, glaze application, new glaze compositions, surface treatments, etc., tending to lead toward lighter, stronger ceramic materials, with new technical properties. Further to be noted is the critical need to continue incorporating new advances in the field of design and decoration, a crucial aspect in the ceramic sector.

On the other hand, it should also be remembered that floor and wall tiles need to perform in the Global Coverings Market, and compete with a great variety of materials (carpeting, vinyl, parquet, natural stone, etc.). Any advance in these other materials, or the appearance of a new material, means setbacks for floor and wall tiles.

In short, this whole process of evolution and socioeconomic, financial, and technological change, etc., in which are immersed presents numerous challenges. Identifying them in advance and solving them quickly and effectively is a difficult but inevitable task.

The question to be solved is to define an action strategy for the future. Although it is difficult to give a clear and precise answer, certain tendencies or indications can be perceived, which allow hazarding a few guesses:

- **Company mergers:** "The high competition in the automotive sector will produce a tendency toward mergers in the great world of suppliers. It is expected that by 2010, only between 25 and 30 top-level suppliers will survive the globalisation, compared to the 600 top-level suppliers existing at present. The more than 10,000 second-level suppliers will similarly drop to 600 in that same period of time ^[8]". Analogous processes have taken

place and are occurring in other branches such as the pharmaceutical, energy, banking or telecommunications sectors. Numerous arguments justify this evolution: company mergers facilitate expansion outside the companies' countries of origin and enable financial, business and operational advantages to be created that reduce their vulnerability to economic conflicts in a region or country; in a global economy company size is a crucial parameter in the competition to achieve a larger market share, have greater negotiating power, generate the necessary resources to tackle new investments, etc.; in some cases company mergers are designed to produce synergies in order to grow in activity and capitalisation as a first step toward getting listed on the Stock Exchange. If the ceramic sector wants to keep the competitiveness that now characterises it, it can hardly avoid this process. It will therefore not be unusual to find company mergers in the same branch, which will require closer relations between competitors and the discarding of individualistic tendencies.

- **International company establishment:** the internationalisation of the economy is an irrefutable fact. Taking Spain as an example, of the 50 biggest companies, foreign capital has a majority holding in 22, while Spain ranks fourth in the list of countries targeted by foreign investment according to the OECD^[6]. However as the Spanish ceramic sector is world leader, the situation should be the other way round, i.e., Spanish companies should be the ones establishing themselves in countries where floor and wall tiles are manufactured, putting in place "multi-local" strategies in terms of the peculiar characteristics of each region. This internationalising process will be inevitable to enable holding the high levels of competitiveness, increasing turnover and addressing the possible slowdown in the growth of primary markets such as the Spanish market. By doing so, resources will be generated, which invested appropriately in Innovation, Service, etc., will translate into competitive advantages for companies in the leading countries, such as Spain and Italy. In the regions where companies set up new establishments, this will furthermore enable benefiting from synergies generated in the country of origin.

- **Globalisation:** the step beyond Internationalisation leads to Globalisation. Although the former involves opening up the geographic borders of a society to incorporate symbolic and material goods from other societies, the Globalisation entails functional interaction of economic and cultural activities, goods and services generated by a system with many nodes. It is a process which, though in gradual progress since 1950, acquired its greatest forward thrust in the 90s. On a world scale, globalisation refers to the growing interdependence among countries, as reflected in international exchanges of goods, services, capital and knowledge. It is a process of international or world growth of finance, industry, commercial capital, human resources and of any type of interchangeable activity among countries. Once again, the ceramic sector cannot remain alien to this evolution. Each company will need to define a global strategy for all the geographic areas in which that company is present, a strategy necessarily encompassing company activities in their entirety (production, commercial, financial activities, etc.), to take advantage of the benefits that globalisation affords: lower costs, enhanced product quality, greater competitive effectiveness, flexible production, lower tariff barriers, etc.

- **Horizontal collaborations ("Co-opetition"):** it can be observed ever more often, that innovation and value are generated in networks. In fact, for business development "social" resources (networks, shared principles, trust, etc.) can be as important as physical and human resources. Even as competition increases, so does collaboration between competitors: while in 1985 the number of technological alliances in the USA and Europe were similar, in the 90s they shot up in the U.S. (driver of the world economy) and diminished in Europe. Today advanced countries compete in markets, co-operate in science

and “co-opete” in technology ^{[6][9]}. . Examples abound of “co-opetition” in the field of aeronautics, the automobile industry, Telecommunications or computer science. American Airlines and Delta Airlines compete for the number of landings and gates at airports and they complement each other by funding Boeing’s research and development costs. In short, it will be necessary to build more or less stable alliances, even with one’s most direct competitors, to achieve certain objectives that would be impossible to attain alone.

All these “macro-tendencies” will play a crucial part when it comes to establishing business strategy. However other aspects also exist, belonging to the peculiar idiosyncrasy of the ceramic sector, which are no less important and require special attention. Such are for instance the price war intended to control growth, ethics as a competitive factor, the image of a company mark as an element helping to identify the sector or the management of knowledge as a basis for inter-company collaboration. They all need to be the subject of profound and serious reflection by the various players involved.

5. FINAL REFLECTION

The present paper has attempted to reflect the current situation in the ceramic sector and the threats that lie in wait, using the evolution of the frit, glaze and ceramic colour companies and their contribution over the years as a thread. Numerous reflections can be drawn from this evolution, susceptible of more detailed, profound analysis. However amongst all of these, the following deserve to be highlighted because of their special importance:

1.- Change is the opportunity to beat our competitors, but changing is not enough. It is necessary to do it at least one second before the competition.

2.- The ceramic sector consists mainly of three key business groups, Ceramics, Glazes and Machinery, and the interests of the three, although sometimes questioned, head in the same direction. The real competitors are the alternative products to tile, whose number and quality increase day by day. The only way of facing these is for the three sectors to work shoulder to shoulder, because whether we like it or not, we are all in the same boat together and only the winds of joint Innovation will lead us to the harbour of Survival and to business and personal Success.

[1] Figures supplied by ANFFECC

[2] Report of 1999. ASCER.

[3] Andar per Ceramiche

[4] Puesta al día de la empresa: de la Calidad a la Innovación. IESE. University of Navarra

[5] Dirección Integral de la Innovación. IESE. University of Navarra.

[6] National Plan for Scientific Research, Development and Technological Innovation 2000-2003. Fernando Aldana, Director of the Office for Science and Technology.

[7] Creatividad Industrial e Innovación Tecnológica Asistida por ordenador. José Miguel Vicente Gomila. TRIZ XXI

[8] Boletín de Vigilancia Tecnológica. Sectores Básicos y Transformadores. January – March 2001. OPTI.

[9] Co-opetition. Adam Brandenburger and Barry Nalebuff