

A first approach to the design component in the agri-food industry of southern Spain

Una primera aproximación a la componente "Diseño" en la industria agroalimentaria del sur de España

Óscar González-Yebra, Manuel A. Aguilar, Fernando J. Aguilar

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ABSTRACT

This work raises the need to open new research lines to bring closer "Design" and "Agri-food Industry", understanding design as a structured and multidisciplinary working process headed up to create products, images, spaces, etc. Within this framework, the following objectives have been outlined: i) Identification of the major design areas with regards to the agri-food sector; ii) Estimation of the importance of the "Design" component and iii) Definition of the possible lines of action. After carrying out a previous bibliometric analysis, which highlighted the lack of relevant bibliography regarding the design component in the agri-food sector; the Delphi method was selected as a suitable working methodology to interactively and systematically answer the aforementioned questions by relying on a panel of experts. The obtained results pointed out to the need of providing incentives for design in agri-food industry as a non-technological innovation aimed at increasing the added value and development of the sector. This should also help promote the design culture and push forward the creation of innovative business strategies.

Keywords

agri-food sector development • agricultural and rural change • design • non-technological innovation • Delphi method

Universidad de Almería. Departamento de Ingeniería. Ctra. de Sacramento s/n
04120, La Cañada de San Urbano. Almería, Spain. oglezyebra@ual.es

RESUMEN

Este trabajo plantea la necesidad de abrir nuevas líneas de investigación en las que se relacione "Diseño" e "Industria Agroalimentaria", entendiendo el diseño como un proceso de trabajo estructurado y multidisciplinar orientado a crear productos, imágenes, espacios, etc. En dicho contexto, se han planteado los siguientes objetivos: i) Identificación de las principales áreas de diseño dentro del sector agroalimentario. ii) Estimación de la importancia de la componente "Diseño". iii) Definición de las principales líneas de acción. Tras un análisis bibliométrico previo, que puso de relieve la carencia de bibliografía relevante en cuanto a la componente de diseño en el sector agroalimentario, se decidió establecer como metodología de trabajo el método Delphi para responder de forma interactiva y sistemática a las cuestiones planteadas, mediante la consulta a un panel de personas expertas. Los hallazgos obtenidos apuntan a la necesidad de proporcionar nuevos incentivos para el diseño en la industria agroalimentaria, como innovación no tecnológica dirigida a aumentar el valor añadido y el desarrollo del sector. Lo que ayudaría además a promover la cultura del diseño y avanzar en la creación de estrategias empresariales innovadoras.

Palabras clave

desarrollo sector agroalimentario • cambio agrícola y rural • diseño • innovación no-tecnológica • método Delphi

INTRODUCTION

At the beginning of the 21st century, design has begun to be a determinant differentiating element for stimulating innovation and competitiveness in any sector or area of research and development, and is being added to the term R&D&I&D (Research, Development, Innovation and Design). As Ferruzca Navarro *et al.* (2013) suggested, the most representative example of this situation is the fact that the first speech on the agenda of the World Innovation Forum, in June 2013, was entitled: "Design Thinker: A different breed of innovators". In a very competitive environment characterized by fast changes and technologies in continual evolution, businesses must differentiate themselves and provide value based on strategies and creative thinking. It is here where the "Design" discipline can and must have

an important role. According to Boztepe (2007), it would be needed a special design research effort to develop efficient tools, applicable in the design practice, which allow designers to actively participate in enhancing value creation. This is particularly relevant in the context of this study headed up to strengthen the link between "Design" and "Agri-food Industry".

The added value of design should result in an increased dynamism and development in all areas of agriculture as well as throughout the rural sector.

Furthermore, the agri-food industry has a high specific weight in the European economy, especially in the Spanish economy. In fact, the agri-food industry is the main industrial manufacturing activity in Europe, representing 14.6% of total invoicing and over 1,048,000 million Euros (19).

In Spain, the food and drink industry is the first branch of the industry, representing 20.6% of net product sales, 18.2% of employment, 16.8% of investments in material assets and 15.3% of added value (38).

Important Considerations: Research/Design/Agri-food Industry

This paper is intended to contribute to the beginning of a nexus, today very weak or inexistent, between design practice and the Spanish agri-food industry, in order to improve competitiveness and sustainability in this sector. To contextualize the term "Design" in this study, and underlining that it is extremely difficult to provide a precise definition of this very wide and multidimensional concept (41, 58), it has been approached within the context of this study by taking the definition proposed by

Rose *et al.* (2007), who claimed that design concept includes all activities associated with the creation of a design as a specification for a solution, product, service, system or organization. This point of view conceives design as a structured working process which is additionally understood as creative, technological and multidisciplinary process headed up to create and develop products, images, spaces, etc. This view of design also fits the widely known Herbert Simon's definition and can be easily extended to the design of innovation systems, business processes and technology platforms (55).

However, and focusing on Spain, the entrepreneur has a biased perception of design excessively inclined towards its artistic side. In this sense, only the big companies hire, with some regularity, third-party design services (14).

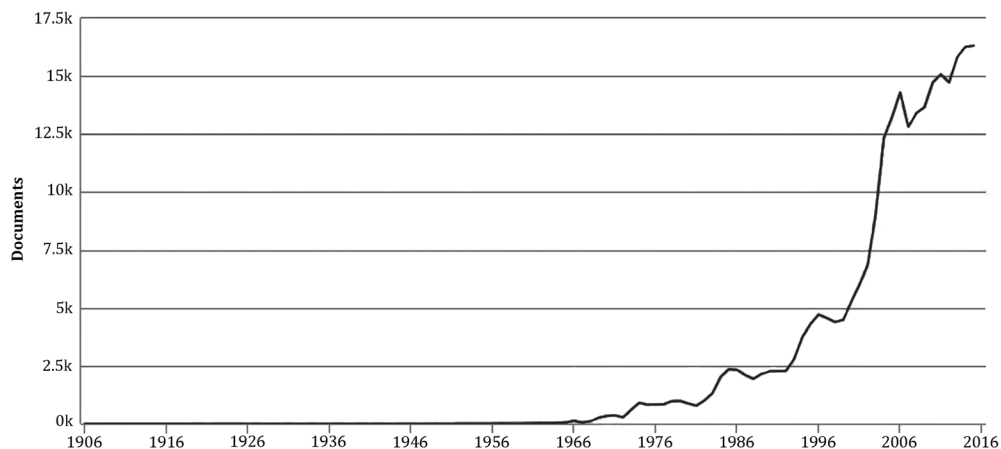
For instance, and in the particular case of industrial design, the term "Design" does not

only concern the purely visual or aesthetic, but also with the study of ergonomics, production, efficiency of the use of materials, and a long list of others (58).

After this brief introduction, two main issues arise in relation to the concept of design held by the experts of the agri-food sector: Firstly, what is the perception that the experts have about the concept of design? Something simply aesthetic or a structured working process? And secondly, what design activities do they consider to be more present in the sector?

As a first step in this direction, a brief review was done of existing publications in this area of knowledge by entering the keywords "Design" and "Agri-food Industry" in the Web of Science (WoS) and Scopus databases. The studies that appeared in these searches were found to really have very little to do with the subject matter posed. To summarize, 95 publications were indexed in the WoS (74 of these were articles) and 58 in Scopus (39 articles) from using the search fields "topic" (first database), "title", "abstract" and "keywords" (second database).

When we entered the keywords "Design" and "Product" (figure 1, page 128), however, the increase in recent years in publications related to product design was clearly seen to be a new and driving discipline of scientific-technical research, although work directly related to the specific field of the agri-food industry was practically nonexistent. Thus, briefly highlighted, design research is a relatively new discipline compared to traditional disciplines (Chemistry, Biology, Geometry and Topology, etc.). This is the reason why Gemser *et al.* (2012) stated that design is still in growth phase to be recognized as a legitimate scientific discipline, being also a drawback which prematurely confined the places and patterns of publication.



Source: Scopus database (search date: until 2015 (included)), keywords "Design" and "Product".
 Fuente: Base de datos Scopus (fecha de búsqueda: hasta 2015 (incluido)), palabras clave "Diseño" y "Producto".

Figure 1. Evolution of the number of documents per year related to product design.
Figura 1. Evolución del número de publicaciones por año en relación al diseño de producto.

This leads implicitly to a very different scenario from the rest of the areas of knowledge, since the conditions for its development (financial aid, research centers, specific postgraduate programs, etc.) are infinitely more limited. Nevertheless, design research is an activity which is going to develop significant momentum in the midterm due to the challenges arising from globalization, multiculturalism and the dizzying advance of technology, becoming an essential component of innovation and sustainable development in many economies and regions (54).

Contextual framework

As a general theoretical framework that justifies the importance of undertaking a first diagnosis about how the agri-food sector perceived design, it is necessary to highlight that there are only a few works

covering this topic, most of them finding a positive correlation between design application and business results (23, 30, 31, 53).

In this way, it is worth noting the work carried out by Hertenstein *et al.* (2005) in EEUU where the authors analyzed up to 93 companies belonging to 9 different industrial sectors to study the relationship between effectiveness in design and business results.

In this paper, it was pointed out that companies promoting "Good design" were more powerful in all the financial parameters, except in the ratios of growth. Focusing on Spain, and according to a study carried out in 2005 by "la Sociedad Estatal para el Desarrollo del Diseño y la Innovación (DDI)" [State Society for the Development of Design and Innovation], the companies that grew the most were those showing a closer relationship between investment in design and increase in turnover (56). This

could be partly explained by the fact that the identification and integration of design in companies allow the development of products and services consistent with emerging cultural and social trends (2).

Moreover, design can be useful to influence on consumer response (11), an aspect that has become a key factor since the technological differences of the companies have become smaller and they are able to produce similar goods (57).

A good example of this could be the horticultural production model in south-eastern Spain. In addition, on an aggregate scale, design has an impact on the quality of life of people through the design of better products, processes and services (56).

Consequently, identifying and disseminating the design component within the agri-food sector is a first important step to introduce design management as a tool to be developed in the field of business management. Notice that this issue turns out to be central to Michael Porter's analysis of the dynamics of industry (1980), in particular to achieve the types of competitiveness included in its classic "Competitive Strategy" (1982). This methodological approach based on improving competitiveness has allowed that several authors relate design, explicitly or implicitly, with the model of Porter (7, 18, 39).

In fact, the three Porter's generic strategies (cost leadership, market niches and differentiation) are associated with three clear design strategies: design-cost strategy, design-image strategy, and brand-design strategy (4). Under this approach, design becomes a fundamental tool in business strategy to cope with the increasing competition and the globalized market. As pointed out by Buil *et al.* (2005), one of the main pillars in this line of work would be to raise awareness of the possible benefits for the

different fields of action (public administrations, businessmen, managers, etc.) provided by including design in their productive chain.

Continuing with the state of the art of the importance of design in the Spanish agri-food industry, a review of about ten years found that: (i) Design as a strategic line of the Spanish agri-food industry is practically nonexistent, (ii) A large part of the publications indexed are about the Spanish wine industry, (iii) The most representative studies have to do with packaging (containers and packing), product trademark and denomination of origin.

Packaging design in the agri-food industry has a primordial presence throughout the life cycle of any agricultural product. Considering the importance of packaging related to product acceptance by the final consumer, bibliographic production about it is currently not very extensive. Some of the more outstanding studies related to product packaging and the consumer were published by Ares and Deliza (2010) on dairy desserts, and the study by Puyares *et al.* (2010) on wine bottles.

Along this same line, Eldesouky and Mesias (2014), who studied the influence of packaging on cheese consumers, concluded that the design and color of the packaging are the most attractive and differentiating factors in the process of purchasing the product.

Therefore, design is an added value which must be understood by all direct and indirect stakeholders in this industry, not just because of its esthetics, but its presence throughout product development, and even more so for perishable products. At this point, the importance of a good packaging design, without doubt determinant for good conservation of the product, its transport, distribution, storage, etc., should be stressed.

Probably the most advanced sectors in Spain in the area of packaging are wine and olive oil, where not only an enormous progress has been made with respect to designing packaging according to market requirements, but they are also working to understand the direct relationship with the so-called "protected designations of origin (PDO)". There are some significant contributions in this field. For example, Errach *et al.* (2014) and Hinojosa-Rodríguez *et al.* (2014), in the cases of Spain and Andalusia respectively, reported interesting research works about the olive-oil market.

In this regard, García-Galán *et al.* (2014) found that winemakers try to promote their brands using the territorial origin of the product itself as a strategy directly related to corporate design of the business. This becomes a possibility for improving market ranking from the point of view of sustainability, quality and territorial differentiation.

Furthermore, Parras-Rosa *et al.* (2013) studied the packaging of olive oil from a marketing perspective, analyzing the ranking of different packaging and exploring the attributes. These topics would have to be very present in packaging for extra virgin olive oil from the consumer point of view.

Although there have occasionally been studies directly related to design as a tool for innovation in the agri-food industry, there is an absence of a body of doctrine which specifically links design and the agri-food industry. Neither has the question of the presence of design in the Andalusian agri-food industry been posed explicitly.

Therefore, this study attempts to cover this important gap with a first approximation contributing to the creation of a line of research that favors inclusion of the design vector as a tool for innovation and

improving added value in both agri-food and rural sectors as a whole, because design, as a differentiating element with high added value, is present directly or indirectly in all of its activities. In reality, as a first approximation, this study includes basic aspects which should be part of a new line of research directed at analysis of the relationship between the design component and the agri-food industry from an exclusively academic/research perspective.

The point of view of the private sector (small and medium enterprises that make up the agri-food sector), which we understand to be crucial, and comparative analysis of the results, will be approached in a following study.

As seen above, hardly any work has previously been done on the design approach to the agri-food industry as a proposal for a new line of research, and therefore, it requires reflection and group analysis. Thus this study poses the following basic goals: (i) Identification of areas of design in the Andalusian agri-food sector, (ii) Estimation of the importance of the "Design" component in different areas of agri-food activity, such as training centers, R&D&I centers, SMEs, large companies and government. (iii) Definition of the main lines of action in design in the agri-food industry.

METHODOLOGY

The Delphi method is especially appropriate for finding information on a specific subject matter with no tabulated data or specific bibliography (28). The number of persons consulted may vary from seven to thirty (34), although it is not the number of experts consulted but the quality of the expert panel which enables reliable results to be obtained.

The validity of the technique was evaluated by Ono and Wedemeyer (1994), who concluded that the results of the forecasts correlated significantly with their evaluation of the trends in the cases studied. It is a method that offers the advantages of group response, efficiency and flexibility, since the new technologies enable individuals who are geographically far away from each other to participate (22, 42). This is indispensable for our study because the experts belonged to nine different institutions.

Sample

To achieve the goals posed in the study, and taking as a reference the theoretical hypotheses of the Delphi method (3, 6, 45), the two working groups necessary to develop the method, *i. e.*, the coordinating group and the expert group were formed.

The coordinating group consisted of members of Andalusian Research, Development and Innovation Plan Research Group RNM-368 and the Agri-food Campus of International Excellence (ceiA3).

Expert panel characterization

The expert panel was made up of 22 participants, 20 members of the Agrifood Campus of International Excellence (ceiA3) from the following institutions: "*Consejo Superior de Investigaciones Científicas*" [Higher Council for Scientific Research] (2), "*Instituto de Investigación Agraria y Pesquera*" [Agrarian and Fishing Research Institute] (7), University of Almeria (3), University of Cadiz (2), University of Cordoba (4), University of Huelva (1) and University of Jaen (1).

Two more experts belonging to organizations outside the ceiA3, the Palmerillas Experimental Station (Cajamar Foundation) (1) and the Andalusian Regional Ministry of Agriculture, Fishing and Rural

Development (1). Of the total number of participants, 23% were women and 77% men.

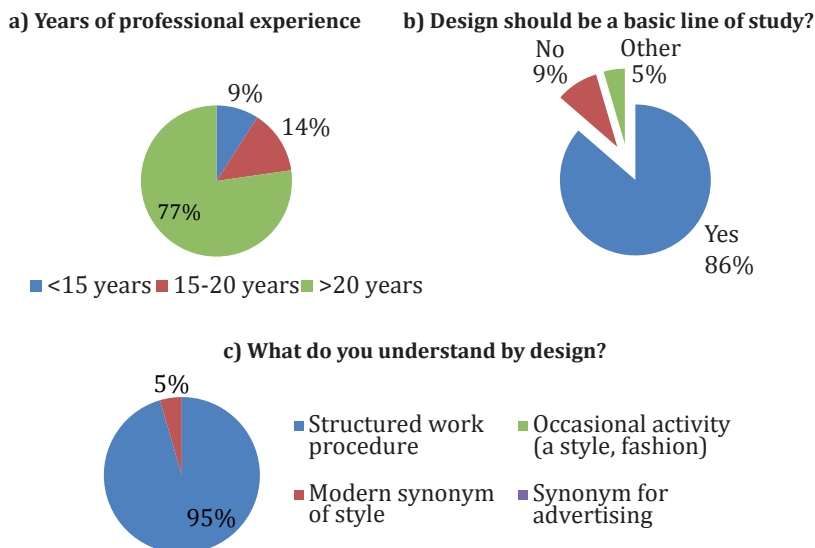
In the preliminary profile selection stage, it was attempted to find an equitable percentage of men and women so in the exploratory stage there would be a significant number of female experts, but in most cases, this was not possible due to lack of availability for participation. Most of them are Ph.Ds. (91%) in very diverse areas of knowledge, given the interdisciplinary nature of this study (*e. g.*, Marketing and Market Research, Graphic Expression of Engineering, Postharvest Technology, Agricultural Economy and Sociology, etc.). They can also be classified by their professional category: senior researchers, senior specialist technicians, technical consultants, university department chairs and full professors, etc. Figure 2a (page 132), shows how 77% of the experts on the panel had had over 20 years' professional experience. 68% of the participants knew of or had worked with the Delphi method.

Figure 2b (page 132), shows that 86% stated that design should be a basic line of study, regardless of the sector (*industrial, social, academic, etc.*) dealt with. And finally, figure 2c (page 132), shows the results of the question "What do you understand by design?" posed in the first part of the questionnaire.

95% answered that design is a structured work procedure and a minority considered it a modern synonym of style. None of the experts considered design an occasional activity (a style or fashion), or a synonym for advertising.

Procedure

As suggested by several authors (3, 6, 45), the Delphi method used here was comprised of the following three basic stages: i) Preliminary stage (preparatory), ii) Exploratory stage (consultation), and iii) final stage (results).



Source: own elaboration. / Fuente: elaboración propia.

Figure 2. Characterization of the experts included in the Delphi panel.
Figura 2. Caracterización de los expertos incluidos en el panel Delphi.

i) Preliminary stage

In this first stage, the coordinating group, which undertook responsibility for selecting the expert panel based on their knowledge and competence, was formed, and made a shortlist for the first contact round. Among its functions was to interpret the partial and final results of the study and supervise how it was running, making any adjustments or corrections necessary. In this preliminary stage, the first version of the questionnaire was drafted. The questionnaire consisted of two parts, one part for characterization of the experts and the other for the main subjects of study (three questions), such as: "Evaluate how much you think design is present in the following fields of action related to design", or "In your opinion, how important do the various stakeholders in the agri-food industry think design is?"

ii) Exploratory stage

This stage consisted of two rounds of consultation. In the 1st round, the question was subjected to validation by the expert panel selected to collect the information posed in the goals of research.

Questions were sent and received by email in attached files.

The questions were raised and answered in based on a Likert scale (36) with a five-point type response: "very important", "quite important", "important", "not very important" and "not important". This stage was designed following the recommendations reported by different studies such as Osborne *et al.* (2003), Rossouw *et al.* (2011) and Kokthi *et al.* (2015). It was also added an open-ended question for feedback and qualitative assessment by each expert.

Later, a qualitative analysis was done of the opinions expressed by the participants in answer to the open question included in the consultation instrument.

The statistically processed results and the questionnaire modified in view of the suggestions made by the experts, were returned to the panel for a second round of consultation to give each panel member the opportunity to reconsider his answers in the light of his original answer and the overall group position, and if necessary, change his answers in the second round.

Table 1 (page 134), shows the final item list. Finally, a space was left for each expert to state his main conclusions and overall observations with regard to the research.

The deadline for answering each of the rounds was 30 days, assigning a number to each expert to ensure anonymity.

It was decided to carry out only two rounds in order to prevent an excessive and forced centralization of opinions that could result from the reiteration of rounds. In other words, more than two rounds could contribute to a loss of information and the artificial construction of a fictitious consensus. In fact, this is a modified version of Delphi method in which are usually performed only two rounds (37, 40).

iii) Final Stage

When the experts had completed the two consultation rounds described above, the research group coordinator analyzed and prepared the final results. The results found by the Delphi procedure were analyzed quantitatively and qualitatively using descriptive statistics and the simple correspondence exploratory method, respectively, using the SPSS statistical package (version 22).

Notice that the definition of the items depicted in table 1 (page 134), are based on an adaptation of the different areas of application of the design included in the Manual on Design Management published by Lecuona (2009): "Industrial or product design", "Graphic design" and "Design of spaces or environments".

Analysis of results

In order to provide an answer to a first approximation for identifying the design vector in the Andalusian agri-food industry, a quantitative descriptive statistical analysis was carried out. First, the relative frequencies of each answer to the items were computed. Second, the median (m) was calculated as the measure of expert panel's central tendency. At the same time, the interquartile range (κ) was entered to measure the dispersion of the sample.

Finally, the arithmetic mean (μ) and the standard deviation (σ) were included as the supporting criterion to put in relative order the different items in the first two questions.

Furthermore, a qualitative study based on the Simple Correspondence Analysis (SCA) exploratory method was carried out. This technique is very useful for exploratory studies such as ours, where there are few or no prior hypotheses, in either correlational or experimental respects (10).

Correspondence analysis (simple or multiple) is done to reduce a large amount of data to a smaller number (principal components) with the least loss of information possible. This graphic representation can show simply qualitative conclusions on relationships existing among the variables studied.

Table 1. Items raised in the Delphi questionnaire.
Tabla 1. Ítems planteados por el cuestionario Delphi.

Fields of action/Areas of design (First question)	Abbrev.
- Development of agro-industrial buildings and secondary industries. Landscape integration. (Industrial and environment design)	DALI
- Facilities and equipment. (Industrial design)	FE
- Development of agricultural machinery. (Industrial design)	DAM
- Agri-food packaging, manufacturing of packaging. (Graphic and product design)	AP
- Trade fair stands and materials. (Graphic and spaces design)	TFSM
- Corporate identity of agri-food companies and sector associations. (Graphic design)	CI
- Product communication. (Graphic design)	PC
* Proposed by the experts: Conception of products and trademarks. (Graphic design)	CPT
Importance by area (Second question)	
- Training centers (Study plans)	TC
- R&D&I centers	RDIC
- Government authorities	GA
- Small and medium enterprise	SME
- Large companies	LC
* Proposed by the experts: Consumers	CO
Lines of design-sector action / Case studies (Third question)	
- Design as an instrument of analysis for integrating agri-food buildings into landscape. (For example type of agri-food model based on greenhouses, "Almeria Model")	IAB
- Design management as part of the strategy of the agri-food sector and agri-food companies. (Determining the level occupied by the design in the most representative organization charts)	DM
- To investigate in new methodological proposals in the area of codesign directly related to the agri-food sector. (Proposal for a particular sector associations)	MPCD
- Eco-design as a differentiating tool in developing new packaging. (Identification of life cycles that are repeated)	EDP
* Proposed by the experts: Graphic design in the agri-food sector: needs and trends, territorial aspects. (Historical development and proposals for improving the labeling in the agri-food industry)	GDNT
* Proposed by the experts: The cross-section design. Market needs. (Ethnographic study for the acceptance of a particular agri-food product)	CSD
* Proposed by the experts: Design related to the area of agricultural machinery and equipment. (To identify and assess whether the processes and design methods used are adapted to the sector)	AME

Source: own elaboration. / Fuente: elaboración propia.

The represented variables come from two categories: i) The different items outlined in the Delphi study (e.g., for first question would be agri-food packaging, corporate identity, facilities and equipment...), ii) the scale of possible categorical answers for each of the previous items (e.g., for first question would be very present, quite present, present...).

RESULTS

First question: Presence of the design component in the agri-food industry

Table 2, shows that 68.2% of the experts considered design quite or very present in the

corporate identity of agri-food companies. On the contrary, 54.6% stated that the design component is very little or not present at all in development of agro-industrial buildings and secondary industries.

Along general lines, the experts found that the items related to graphic design are those which are perceived most clearly in the agri-food industry design component.

With regards to the results depicted in the table 2 and in the tables 3 and 4 (page 137), it is recommended to relativize the values of the mean (μ) and the standard deviation (σ) since, from a purely statistical point of view, the treatment of categorical data from a 5-point Likert scale is a subject that raises some debate.

Table 2. Presence of the design component in the agri-food industry.

Tabla 2. Presencia del vector diseño en la industria agroalimentaria.

Order	Fields of action	VP	QP	P	LP	NP	κ	m	μ	σ
1	Corporate identity	27.3	40.9	22.7	9.1	0	1.8	4	3.9	0.9
2	Agri-food packaging	0	63.6	31.8	4.5	0	1	4	3.6	0.6
3	Stands and materials	13.6	40.9	36.4	9.1	0	1	4	3.6	0.9
4	Conception of products and trademarks	4.5	54.5	27.3	13.6	0	1	4	3.5	0.8
5	Communication	18.2	27.3	36.2	18.2	0	1	3	3.5	1
6	Development of agricultural machinery	9.1	31.8	27.3	31.8	0	2	3	3.2	1
7	Facilities and equipment	4.5	22.7	40.9	27.3	4.5	1.8	3	3	1
8	Development of agro-industrial. Landscape integration	4.5	18.2	22.7	45.5	9.1	1	2	2.6	1

Source: own elaboration. / Fuente: elaboración propia.

VP: Very Present. QP: Quite Present. P: Present. LP: Little Present. NP: Not Present (Values expressed in %). κ : Interquartile Range. m: Median (1=NP 2=LP 3=P 4=QP 5=VP). μ : Arithmetic Mean. σ : Standard Deviation.

VP: Muy Presente. QP: Bastante Presente. P: Presente. LP: Poco Presente. NP: Nada Presente (Valores expresados en %). κ : Rango Inter cuartílico. m: Mediana (1=NP 2=LP 3=P 4=QP 5=VP). μ : Media Aritmética. σ : Desviación Estándar.

In this study they have been used mainly to determine the relative order between items of equal median.

Second question: Importance of design by area

Most of the experts said that neither government nor training centers consider design important. 81.8% revealed that design is quite or very important for large agri-food companies, an aspect which is related directly to the importance given consumers (table 3, page 137).

Third question: What lines of design-sector action do you think are necessary?

Table 4 (page 137), shows that practically the entire panel coincided in the need for eco-design as a differentiating tool in developing new packaging. 63.6% considered research in new methodological proposals in the area of codesign directly related to the agri-food sector to be very necessary, while 77.3% stated that a line of work pushing design as an instrument of analysis for integrating agri-food buildings into landscape is very necessary or quite necessary, and was one of the lines of action with the highest consensus.

Finally, the whole panel considered the least necessary line of action to be related to the area of agricultural machinery and equipment.

DISCUSSION

This type of activity is emerging as a growing economic sector in countries such as Australia, New Zealand or the United States (42). Thus, interest in the product, wine in this case, is transformed into the desire to visit the production area (24). Within the same context (20) analyzed two different wine routes in Italy,

pointing out that the study of the tourists' profile would allow the improvement of marketing strategies, this being an aspect transversally related to the field of design.

Before beginning the discussion, it is important to highlight the current situation in Spain, and particularly in Andalusia, where it is becoming necessary to change the production and economic model to one in which design and innovation play a fundamental role. In fact, many countries (Germany, Great Britain, Norway, Sweden, Australia, Korea and Japan) are turning their attention more and more to both these pillars as drivers of renovation toward sustainable development and progress. In the present economic context, where resources for innovation are scarce, design, as a non-technological instrument of innovation, is particularly relevant and interesting, since it is less capital-intensive and requires shorter investment return periods. Keeping this scenario in mind, this study tries to provide a first approach to demonstrate the importance of design as an indispensable tool for the future of the whole agri-food industry in Andalusia, Spain, although its findings could be extended to other Latin American countries sharing similar realities where the new paradigm based on R&D&I&[d] is beginning to arise.

First Question: Presence of the design component in the agri-food industry

From the results of the exploratory stage of the study, design was found to be present in the agri-food industry in, from most to least: (1) Corporate identity of agri-food companies and sector associations, (2) agro product packaging, (3) trade fair stands and materials, (4) conception of these products and trademarks, (5) their communication (6) development of agricultural machinery, (7) facilities and equipment, and (8) design as an agro-industry spatial and esthetic concept.

Table 3. Importance of design by area.
Tabla 3. Importancia del diseño por ámbitos.

Order	Area	VI	QI	I	LI	NI	κ	m	μ	σ
1	Large companies	31.8	50	18.2	0	0	1	4	4.1	0.7
2	Consumers	36.4	27.3	18.2	13.6	4.5	2	4	3.8	1.2
3	Small and medium enterprise	13.6	18.2	40.9	22.7	4.5	1.8	3	3.1	1.1
4	R&D&I centers	9.1	27.3	22.7	36.4	4.5	2	3	3	1.1
5	Training centers (Study plans)	9.1	4.5	22.7	59.1	4.5	1	2	2.5	1
6	Government authorities	4.5	4.5	13.6	72.7	4.5	0	2	2.3	0.8

Source: own elaboration. / Fuente: elaboración propia.

VI: Very Important. QI: Quite Important. I: Important. LI: Little Important. NI: Not Important (Values expressed in %). κ: Interquartile Range. m: Median (1=NI 2=LI 3=I 4=QI 5=VI). μ: Arithmetic Mean. σ: Standard Deviation.

VI: Muy Importante. QI: Bastante Importante. I: Importante. LI: Poco Importante. NI: Nada Importante (Valores expresados en %). κ: Rango Intercuartílico. m: Mediana (1=NI 2=LI 3=I 4=QI 5=VI). μ: Media Aritmética. σ: Desviación Estándar.

Table 4. Main lines of action involving design and agri-food sector.

Tabla 4. Principales líneas de acción del diseño en el sector agroalimentario.

Lines of action	VN	QN	N	LN	NN	κ	m	μ	σ
Design as an instrument of analysis for integrating agri-food buildings into landscape	27.3	50	18.2	4.5	0	0.8	4	4	0.8
Design management as part of the strategy of the agri-food sector and agri-food companies	4.5	31.8	13.6	9.1	0	1	4	4.1	1
To investigate in new methodological proposals in the area of codesign directly related to the agri-food sector	63.6	22.7	9.1	4.5	0	1	5	4.5	0.9
Eco-design as a differentiating tool in developing new packaging	45.5	54.5	0	0	0	1	4	4.5	0.5
Graphic design in the agri-food sector: needs and trends, territorial aspects	40.9	40.9	9.1	9.1	0	1	4	4.1	0.9
The cross-section design. Market needs	40.9	32.8	27.3	0	0	1.8	4	4.1	0.8
Design related to the area of agricultural machinery and equipment.	13.6	36.4	40.9	9.1	0	1	3.5	3.5	0.9

Source: own elaboration. / Fuente: elaboración propia.

VN: Very Necessary. QN: Quite Necessary. N: Necessary. LN: Little Necessary. NN: Not Necessary (Values expressed in %). κ: Interquartile Range. m: Median (1=NN 2=LN 3=N 4=QN 5=VN). μ: Arithmetic Mean. σ: Standard Deviation.

VN: Muy Necesaria. QN: Bastante Necesaria. N: Necesaria. LN: Poco Necesaria. NN: Nada Necesaria (Valores expresados en %). κ: Rango Intercuartílico. m: Mediana (1=NN 2=LN 3=N 4=QN 5=VN). μ: Media Aritmética. σ: Desviación Estándar.

This order can be related to the aforementioned contextualization framework where it is indicated that the most representative studies found in the literature turn out to be packaging, product brand and denomination of origin.

In the two-dimensional map provided by the SCA (figure 3, page 139), it may be observed that the variables with the content most related to pure "graphic design" [CI, TFMS and PC] appear to be clustered, as they are perceived by the expert panel, in a cluster located in Quadrant IV. On the contrary, landscape and design of agroindustrial buildings [DALI] is clearly isolated in Quadrant I, very near the situation of the evaluation category "not very present", showing low expert panel perception of the presence of design in esthetic and spatial conception (mainly architectural conception) of buildings and agroindustrial equipment. This is obvious, for example, in the lack of planning and territorial zoning related to deployment and integration of greenhouses in the landscape in the province of Almeria and the coast of Granada.

A third group of variables may be seen near the origin of the coordinates, made up of machinery design [DAM] and facilities and equipment [FE]. These variables could be framed within the area of industrial design, and that is how they seem to be perceived by the expert panel.

Finally, stress another group of variables located in Quadrant II which appear to be clearly related to product design and graphic design. This is the case of agri-food packaging, manufacturing of packaging [AP] and conception of products and trademarks [CPT].

The "very present" and "quite present" [VP and QP] answer choices may also be observed in figure 3 (page 139), which shows them located near the variables most related to graphic and product design [CI, PC, AP and CPT], while those most related to industrial design and environments [DAM, FE and DALI]

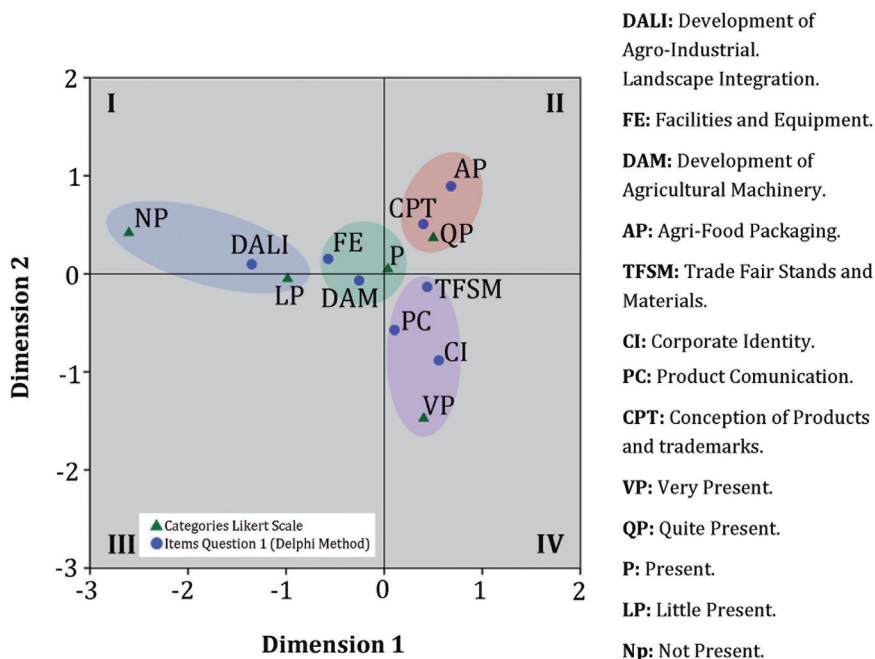
hold positions near the choices "present" and "little present" [P and LP].

Again we find the variable related to planning and integration in the landscape of agroindustrial buildings and secondary industry [DALI] located outside the main cluster, with very low [NP and LP] presence of design in project development. This result can be explained by the following factors: (i) Agri-food industry project engineers lack training in Agrarian Industrial Heritage, a field of research very little explored by engineering. (ii) In general, a striking lack of importance of esthetics in agricultural industries and their insertion in the landscape, since these disciplines are not usually included in undergraduate agricultural engineering courses of study.

However, a positive correlation was detected between the esthetics of the agri-food industries and success in marketing their products, such as design wineries in La Rioja.

As Gómez (2009) suggests, the design of wineries of this denomination of origin attributes high importance to architectural conception and integration in the landscape as part of the region's industrial architectural heritage. Related to the specific type of model, "Almeria Greenhouses" or "plastic sea", and although the experts consulted argued that there is no landscape design, it could be a paradigmatic case that offers huge attractiveness for visitors.

Some of the experts consulted stressed that a secondary industry could be very attractive to the visitor, so a standard of design ordered for visitors could be a good idea to strengthen the image of the business and/or cluster. This is already happening in the wine industry where the concept of wine tourism, defined as the experience of visiting vineyards, wineries, festivals, etc., in which wine is tasted and/or the wine's attributes are experienced, are the main visitor attraction (29).



Source: own elaboration. / Fuente: elaboración propia.

Figure 3. Bidimensional plots provided by the Simple Correspondence Analysis (Question 1: Activity fields).

Figura 3. Mapa bidimensional obtenido mediante el Análisis de Correspondencia Simple (Pregunta 1: Áreas de actividad).

This type of activity is emerging as a growing economic sector in countries such as Australia, New Zealand or the United States (43). Thus, interest in the product, wine in this case, is transformed into the desire to visit the production area (25).

Finally, another point on which most of the experts agree is the need for continual improvement in the design of agri-food labelling and on the lack of industry knowledge of market requirements. Among these requirements is the absence or only slight presence of ecolabelling as a strategy leading to product differentiation and improved competitiveness.

Among the studies done along this line are those by Gunilla *et al.* (2015), on the connection between ecolabels and clothing design from a life-cycle perspective. Chamorro and Bañegil (2003) evaluated the importance of ecolabelling in Spain compared to other countries, while Fernández Sánchez *et al.* (2014) analyzed their specific implementation in fishery and aquatic products. In all cases, the conclusion arrived at was that there is little implantation of ecolabelling in Spanish business.

Second question: Importance of design by area

On the two-dimensional map found with the SCA for the second question (figure 4), it is observed that the closest design-importance relationship in variables [LC and CO] appears, as perceived by the expert panel, clustered in Quadrant IV. The variable "small and medium enterprise" [SME] is located in Quadrant II, very close to the location of the category "important" on the evaluation scale, showing low perception of the expert panel concerning the importance of design for this type of business compared to large companies [LC].

A third group of variables may be seen between Quadrants I and III, made up of government authorities [GA], training centers and R&D&I centers [RDIC]. These variables could be clustered together in a group related to activities directed at administration, training, public information and research.

From the analysis of the importance of design by area, practically the only area where design is perceived as relevant by the expert panel is in large companies. Thus the direct relationship between large agri-food companies [LC] and consumers [CO] may also be seen in figure 4.

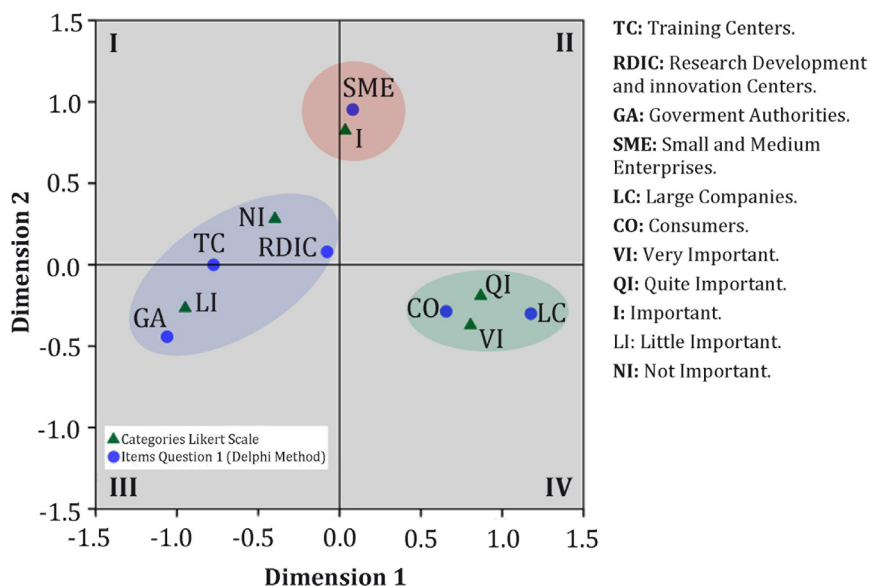


Figure 4. Bidimensional plots provided by the Simple Correspondence Analysis (Question 2: Importance of the different areas).

Figura 4. Mapa bidimensional obtenido mediante el Análisis de Correspondencia Simple (Pregunta 2: Importancia por ámbitos).

The categorical answers "very important" and "quite important" [VI and QI] are observed to be located near the variables which attribute the most importance to design [LC and CO], while those most related to the area of promotion, public information, teaching and design development [GA, TC and RDIC] are near the categorical positions "little important" and "not important" [LI and NI].

At a distance from these two clusters, the variable related to "small and medium enterprise [SME] is clearly associated with the valuation "important" (I), which shows that the Delphi panel understands that the medium and small agri-food businesses do not perceive design as a fundamental tool to their success.

Considering that nearly 96% of the Spanish agri-food sector is made up of small businesses (15), this information is a matter for concern and could be related to the lack of importance given to design by training centers and government.

In the study done by the DDI only 13.7% of Spanish companies say they know of some type of assistance or aid program for incorporating design in their production activity (56). Although the information did not include the agri-food industry, it does give us a vision of the current situation in this respect.

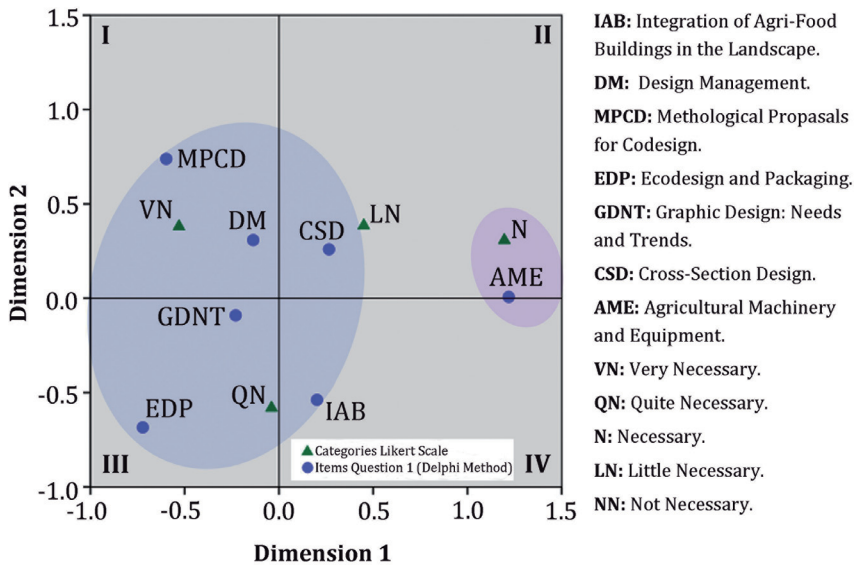
Therefore, among the main evaluations and feedback from the experts, it is essential to underscore that: (i) Most Spanish businesses, although they recognize the importance of design, do not give it the priority it should have because they do not really see the added value it can provide, which fits the postulates introduced in relation to the concept of design where it was explained that many companies have a vision of the design only related to the aesthetic. Add to this the lack of financial resources, and it is easy to explain the

scant presence of the design vector in most companies. (ii) Design is not being taught in public agricultural training courses, which would transfer to agri-food businesses the need to include design as an indispensable tool in the sector.

Third question: What lines of design-sector action do you think are necessary?

This question tried to identify possible lines of work related to incorporating design in the Andalusian agri-food industry. In this case, with regard to the SCA two-dimensional map of the third question (figure 5, page 142), we concentrate on the location of the categorical answers to determine the evaluation offered by the expert panel concerning the need for lines of action proposed. At this point, a correlation is found between the results for the first two questions and this one, since the lines for action are intended to respond to the starting hypothesis.

Therefore, examining the categorical variables "very necessary" and "quite necessary" [VN and QN] it may be observed that they include practically all the lines of action proposed [IAB, DM, MPCD, EDP, GDNT and CSD] in a major cluster. It should be noted that although graphically, the Cross-Section Design variable [CSD] appears near the "not very necessary" category, which may be due to the lack of consensus in the experts' answers on this particular item. It should be emphasized that the experts value so positively practically all the lines of action, especially the one related to the management of the design since it is very relevant for the strategy of the companies, as it is gathered in the general contextual framework.



Source: own elaboration. / Fuente: elaboración propia.

Figure 5. Bidimensional plots provided by the Simple Correspondence Analysis (Question 3: Action lines).

Figura 5. Mapa bidimensional obtenido mediante el Análisis de Correspondencia Simple (Pregunta 3: Líneas de acción).

Aside from this, a second cluster is clearly formed only by the line of action related to design and machinery development [AME]. This is located on the horizontal axis of the coordinates, very near the location of the categorical evaluation scale "necessary", which shows low expert panel perception of the need for design in this line compared to the others. However, it is also true that the attribute "not necessary" [NN] does not appear in the diagram, a point which shows that all the experts believe that all the lines proposed are unavoidable.

Other considerations that form the two-dimensional map (figure 5) are, for example, that the variables related to the training and management areas [MPCD

and DM] appear clustered together, as they are perceived by the expert panel, near Quadrant I.

On the contrary, the Agroindustrial Design [IAB] variable is located in Quadrant IV, far from the variables with a more theoretical-analytical inclination. The same may be said of the AME variable.

Finally, and taking up the two questions initially raised, the experts' perception regarding the concept of design coincides with the one outlined in this line of study, understanding design as a structured working process.

Regarding the second question, the design activities that the experts consider to be more present in the agri-food sector are closely related to graphic design.

CONCLUSIONS

In conclusion, 68.2% of the experts consulted believed that design is quite or very present in the corporate identity of agri-food businesses (component related to graphic design), while 54.6% were of the opinion that design is very little or not present in the conception and development of agroindustrial buildings (space design and production). In view of these results, a proposal for a research line aimed at the development of efficient tools for the analysis and integration of agroindustrial buildings in landscape would be of interest.

The role of graphic design and its specific application to agri-food industry would also be an interesting contribution, keeping in mind trends, needs and territory. 81.8% of the panel members revealed that design is quite or very important for large companies in the sector, and on the contrary, most of them said that both training centers (undergraduate and postgraduate courses of study) and government consider design not to be very important as a fundamental element for innovation and improving competitiveness in the agri-food industry.

The exploratory results gave a first approximation to the need of providing incentives for design and innovation as a compulsory content in new undergraduate and postgraduate courses, as well as the exploration and formulation of new methodological proposals for teaching and disseminating information about the importance of managing design in the context of the agri-food industry.

Summing up, this study has proved the interest and feasibility to advance forward the construction of a promising work line focused on determining the impact

and possibilities of the design application in order to increase added value, sustainability and development of the agri-food and rural sectors, thus helping define guidelines for an action strategy.

Recommendations for further work

Although we have worked on a sample of 22 cases, a sample sufficiently representative as to meet the objectives of characterization proposed in this study, it would be appropriate to extend the obtained results with new consultations including: (i) participation of experts from different fields and sectors, (ii) questions that relates design and economics. Thus, in the short term, it has been planned to carry out another Delphi study similar to this one, but based on an expert panel made up of stakeholders in the private sector in the Andalusian agri-food industry (CEOs and managers of agri-food businesses as well as design professionals). This new study would contribute, on one hand, to a much more complete definition of the design vector in the agri-food industry. On the other, it would enable a comparative analysis of the perception and transcendence of design in the agri-food industry between the private and public sectors.

In the same way, it would be advisable to explore the tangible and intangible benefits that could be obtained from the application of design in the agri-food sector.

Additionally, it would be also beneficial to extend the measurement range from 5 to 9 points to achieve a more accurate identification. In the mid-term, and to keep on going through this research line, it would be very interesting to take a fixed photograph of a specific agro-food cluster headed up to know how the design is

present in the companies of the sector, so being able to relate the experts' opinions and the real decisions taken at the corporate level. This research line could

be extended to Latin America countries bearing in mind that both agri-food model and consumer market actually share many characteristics with the Spanish ones.

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