

Is the design a vector to be considered in the agri-food industry? An interprofessional analysis in Andalusia (Spain)

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Abstract

We currently live in a globalized world where the imperative need to both generate added value and new products and services has been strengthened. Some of the problems pending to solve can be properly faced from the field of "Design". However, and up to now, there is no design science serving as a knowledge pivot for developing and building the solutions required. On the other hand, design is cross-cuttingly present in the different activities of a country like Spain, where one of the most important sectors is agriculture. Starting from this context, a survey about the role of design in the agri-food industry has been developed through the well-known Delphi method, constituting a panel of experts from the private sector of Andalusia. To the best of our knowledge, this is the first study in which a forum of these characteristics has aimed to involve both CEOs and managers of agri-food businesses and design professionals to work together around this topic. The results obtained suggest that design component in the agri-food industry is mainly present in activities related to graphic design, showing less presence in the industrial-product design or, specially, in the environment design. They also point out that design is an important tool to explore in the agri-food sector since it might provide both tangible and intangible benefits. The findings of this work seem to be very valuable as a diagnostic to characterize the design component, also contributing to uncover and develop the design as an important factor of dynamization.

Keywords: Design, Agri-Food Industry, Innovation, Interdisciplinary Research, Delphi Method

1 Introduction

Agriculture is one of the main Spanish strategic sectors for the development of the country [1], being the agri-food industry one of its main business areas according to the high added value it brings to raw agricultural products. In southern Spain, the agri-food industry presents a high-level of innovation focused on food quality and safety, sustainability and, more recently, due to the generation of new products with the implementation of the organic production [2]. Nowadays it is needed to generate added value in agri-food products, considering that most socio-economic activities are evaluated in terms of innovation and the capacity to create (or recreate) new products and services. It is worth noting that most of these aspects are directly related to the field of design. In this sense, it is relevant to define the concept of Design, accepting that there are endless definitions for the word "Design". These definitions vary depending on the focus and final goals, comprising terms such as industrial design, graphic design, package design, production design, service design, etc. Although a common denominator can be identified, the term "Design" can refer to the process of the creating something mostly tangible [3]. Design becomes a key variable in the culture of innovation, being very important that organizations integrate innovation through its different applications [4]. There are many authors ([5], [6] and [7]) that point out that more and more companies in developed countries identify design as not only an activity which refers to the aesthetics of goods or services, but it is a multidisciplinary and holistic process involving economic, sociocultural, technological and environmental factors, constituting an important source for the generation of innovation in any of the activities of companies and organizations.

From the scientific-academic point of view, "Design" could be currently considered as a postmodern discipline that, in practice, is essentially linked to graphic expression/communication, architecture and product engineering, although it is not considered a fully developed scientific discipline, still being in a growth phase [8]. This aspect was evident in a previous stage 0 of this research line consisting of a bibliometric study focused on the main bibliographic data bases for the search of scientific literature. "Scopus" (Elsevier) and "Web of Science" (Thomson Reuters) were the platforms used to search for best references of peer-reviewed publications and conferences. This previous work turned out to be a difficult task, since there was no specific category in "Design" and thus a very extensive search had to be undertaken in a wide range of categories (e.g., Arts, Engineering Multidisciplinary, Architecture, Management and so on). Another fact that denotes the difficulty of gathering information in this field is that there is no "Design" descriptor among the UNESCO codes. All these difficulties were sharpened when relating "Design" with the "Agri-Food Sector".

In this second phase, and after including Google Scholar as an additional search engine delimited to the last 5 years (period 2012-17), some conclusions could be extracted: (i) Most of the reported documents were about design in the sense of agricultural holdings. On the other hand, (ii) those works directly related to design were focused on packaging, product brand and denomination of origin, in line with the conclusions obtained in the first phase of this research line [9]. Note that only two works were found with respect to design in the agri-food sector of Andalusia. One of

them was related to the subject of consumption of agri-food products, making up a classification in different cases and trends, and identifying the most useful tools for improving design (i.e. materials, textures, shapes, styles of illustration, photography or type of messages that allow to connect with the values and taste of consumers) [10]. The other work was focused on the history of the graphic design in the companies of the horticultural sector of Almería, proving that the functional aspect of the communication of design was not developed as it should [11].

During the first phase of this work [9] was constituted a panel of experts from the public arena to explore new research lines in which "Design" is related to "Agri-food Industry". An example of the design component in the agri-food sector can be seen in Figure 1. Since the preliminary bibliometric analysis concluded that the information about the role of design in agri-food sector was scarce, this research line started from scratch by characterizing the design component in the agri-food industry through the application of the Delphi method. This method is based on a systematic and iterative process aimed at obtaining answers to specific objectives from a panel of experts [12].

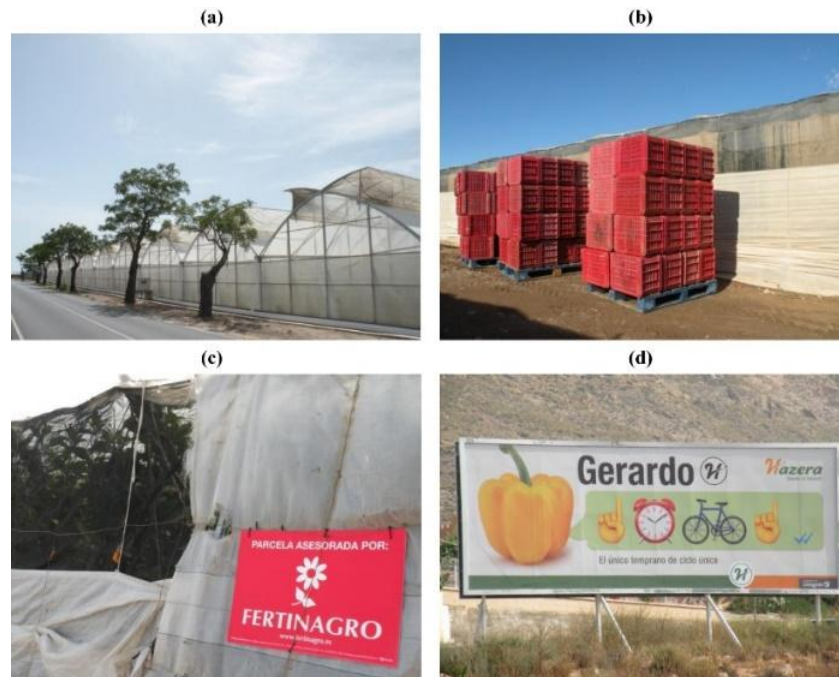


Fig. 1. Examples of the design component in the agri-food sector in the province of Almería (south-east of Spain): environment design (a), industrial/product design (b) and graphic design (c-d).

The research questions were focused on uncovering the perception about the role of design in the agri-food industry. As a basic reference, the experience of a group of experts linked to the agri-food sector is taken to answer to the following questions: *What is the presence of the design component in the Andalusian agri-food cluster? Is design an interesting tool to explore in the agri-food sector?* For the selection of the

main items to be assessed, the previous work carried out in this line of study has been used [9]. The final goals of this work would be the following ones: (i) To identify the main design areas within the agribusiness and agri-food sector. (ii) To know the importance of the design component by areas as well as the tangible and intangible benefits that it can provide to the agri-food industry. (iii) To go further in the search of the main design-sector lines of action.

2 Material and methods

This section will describe the methodological differences with respect to the first phase of this research line divided into three sub-sections: i) panel of experts, ii) instrument of measurement, and iii) analysis of data. An in-depth description of the general methodology applied can be found in Authors [9]. In this preliminary stage, two working groups were constituted, that is, the coordinating group and the group of experts. As in the previous phase, the coordinating group was composed of the members of the research group RNM-368 of the Andalusian Plan for Research, Development and Innovation and the Campus of International Excellence in Agri-Food (ceiA3; further information can be retrieved from <http://www.ceia3.es/en>).

2.1 Characterization of the expert panel

The final panel of experts consisted of 22 participants, although a higher number was contacted, so that the final sample was the same as in the previous phase [9]. The final distribution by professional areas was the following: 68% were professionals of the Andalusian agri-food industry belonging to representative corporations such as, e.g., “*ANECOOP, Empresa Cooperativa Hortofrutícola de Segundo Grado*” [cooperative fruit and vegetable enterprise of the second degree] or “*COEXPHAL-APROA, Asociación de Organizaciones de Productores de Frutas y Hortalizas de Almería y Andalucía*” [association of fruit and vegetable producers' organizations of Almeria and Andalusia]. 32% of panel members corresponded to design professionals in Andalusia associated to most representative corporations such as “*AAD, Asociación Andaluza de Diseñadores*” [Andalusian association of designers] or “*SURGENIA, Centro Tecnológico Andaluz de Diseño*” [Andalusian design technology center].

Regarding genre, 27% were women and 73% were men. Note that in the preliminary phase of the profiles selection, an attempt was made to find an equitable percentage of men and women, so that in the exploratory phase there would be a significant participation of expert women. But in most cases it was not possible, due in part to the low number of women who hold management positions. These participants were mostly presenting (91%) higher education (see Figure 2) in very diverse areas of knowledge. This is required to ensure the interdisciplinarity of the panel (e.g., marketing, social and agrarian economy, agri-food cooperativism, engineering projects, in-

dustrial design, graphic design, etc.). The 50% of panel member counted on a professional experience of more than 20 years, while 23% of them had between 15 and 20 years of experience. Finally, 59% of the participants knew or had worked with the Delphi method. To the question "What do you mean by design?", 95% responded that design is a structured work process. 91% of them claimed that design should be a fundamental line of study regardless of the sector involved (industrial, social, academic...). None of the experts considered that design is a punctual activity (a style or fashion) nor a synonym for advertising. All these answers denote the degree of expertise and knowledge of the panel members with respect to this topic.

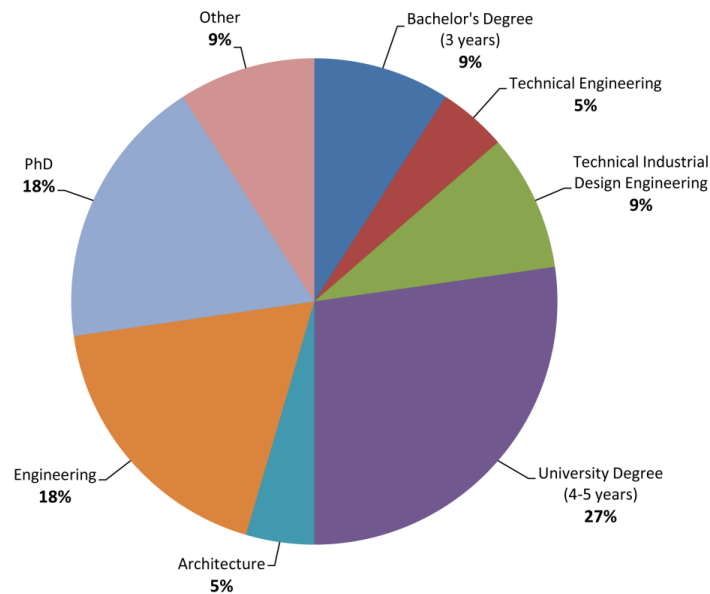


Fig. 2. Professional qualification of the Delphi panel members.

2.2 Measuring instrument

From a methodological point of view, significant modifications have been introduced in the measurement and procedure instrument with respect to the first phase (further information in [9]). Following the recommendations of different authors [13,14] indicating that increasing the number of points on a scale can increase reliability, the Likert scale of response was increased up to 9 points to achieve a more precise assessment (e.g., Nothing Present: 1 / Very Present: 9). In addition, new variables related to tangible and intangible benefits have been added (two subsections to the second question, 2.1 and 2.2) following the recommendations of [15]. Table 1 shows a summary of the items of the first two questions (30 items). The exploratory phase was developed throughout 2016, lasting several months and requiring between 1 to 3 months to complete each of the consultation rounds and incorporate the corresponding feedback.

2.3 Analysis of results

In relation to the quantitative analysis through descriptive statistics, the median (m) has been calculated as a central measure for detecting trends. The arithmetic mean (μ) and the standard deviation (σ) were computed as complementary indicators to establish the relative order between items with the same median.

Table 1. Items raised in the Delphi questionnaire.

| <i>No. Item</i> | <i>Description</i> |
|-----------------|---|
| | Fields of action/Areas of design (First question) |
| 1 | Development of agro-industrial buildings and secondary industries. Landscape integration. (Industrial and environment design) |
| 2 | Facilities and equipment. (Industrial design) |
| 3 | Development of agricultural machinery. (Industrial design) |
| 4 | Agri-food packaging, manufacturing of packaging. (Graphic and product design) |
| 5 | Design of new packaging* (Product design) |
| 6 | Graphic application to existing packaging* (Graphic design) |
| 7 | Trade fair stands and materials. (Graphic and spaces design) |
| 8 | Corporate identity of agri-food companies and sector associations. (Graphic design) |
| 9 | Product System* (Graphic design) |
| 10 | Product communication. (Graphic design) |
| 11 | Conception of products and trademarks. (Graphic design) |
| | Importance by area (Second question) |
| 12 | Training centers (Study plans) |
| 13 | R&D&I centers |
| 14 | Government authorities |
| 15 | Small and medium enterprise |
| 16 | Large companies |
| 17 | Large Distribution Chains* |
| 18 | Consumers |
| | Tangible Benefits* (2.1 question) |
| 19 | Increase in competitiveness |
| 20 | Improvement of the product development process |
| 21 | Increase in exports |
| 22 | Development of industrial and intellectual property |
| 23 | Reduction of environmental impact |
| 24 | Market-Sale Quotas |
| 25 | Profit-Profitability |
| | Intangible Benefits* (2.2 question) |
| 26 | Differentiation and positioning |
| 27 | Quality improvement |
| 28 | Entry into new markets |
| 29 | Customer satisfaction and loyalty |
| 30 | Improvement of the corporate image |

*New items added in this second phase (not present at the first phase of this research line [9]).

In this second phase we have incorporated a new metric based on the coefficient of variation (CV) as a panel agreement estimate, since literature does not provide a single guideline to follow [16]. In fact, Shah and Kalaian [17] suggest that CV is the most appropriate test for studies of this type. Simultaneously, it is necessary to determine a threshold value that indicates the degree of consensus of the panel experts. There is no single criterion. For instance, Keeney [18] used a 75% consensus level, while Loughlin and Moore [19] suggested a value of 51%. This work has followed the recommendations published in [16] and [20] to build up five consensus categories: (i) $CV \leq 25\%$; very high agreement. (ii) $CV > 25\%$ and $\leq 50\%$; high agreement. (iii) $CV > 50\%$ and $\leq 75\%$; average agreement. (iv) $CV > 75\%$ and $\leq 100\%$; low agreement. (v) $CV > 100\%$; very low agreement.

3 Results and discussion

To the best of our knowledge, this is the first study in which a forum of these characteristics has been constituted, allowing to group different agents of the private sector for trying to define what is the role of design in agri-food industry. It is necessary to highlight that in 27 out of the 30 consulted items a high or very high degree of agreement has been reached, what is relevant considering the participation of two well differentiated areas: CEOs and managers of agri-food business and design professionals. The results obtained in this second phase are presented below, also providing a comparison between the trends detected in both studies (i.e. public and private sectors).

3.1 Presence of the design component in the agri-food industry

In this second phase the trend with respect to the study carried out in the first phase has been maintained [9].

If we conduct the comparison taking as reference the order of presence of the design component in the agri-food industry, design lacks presence in the projection of agricultural constructions both for the private and public sectors panel members (see Table 2, item 1), although the degree of agreement around this issue was greater in the first phase. With respect to corporate identity (item 8), the trend has not been maintained for the private sector, occupying position 5 in the design presence ranking. Note that in the case of the public sector it was ranked the first place. Furthermore, the private sector has given more importance to the item related to "Trade fair stands and materials" (item 7), followed by two new items introduced in this phase such as "Graphic application to existing packaging" (2nd position), and "Design of new packaging" (3rd position). In the main, the trend related to the degree of perception of the design component is maintained in the first positions in both sectors.

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

| <i>Order</i> | <i>Item</i> | <i>m</i> | μ | σ | <i>CV</i> | <i>Agreement</i> |
|--------------|-------------|----------|-------|----------|-----------|------------------|
| 1 | 7 | 6.5 | 6.05 | 2.03 | 33.7 | High |
| 2 | 5 | 6.5 | 5.59 | 2.38 | 42.6 | High |
| 3 | 6 | 6.0 | 6.00 | 1.75 | 29.1 | High |
| 4 | 4 | 6.0 | 5.45 | 2.15 | 39.5 | High |
| 5 | 8 | 5.0 | 5.45 | 2.04 | 37.4 | High |
| 6 | 3 | 5.0 | 5.23 | 1.85 | 35.4 | High |
| 7 | 2 | 5.0 | 5.18 | 2.08 | 40.2 | High |
| 8 | 10 | 5.5 | 5.14 | 2.10 | 40.9 | High |
| 9 | 9 | 5.0 | 4.82 | 2.42 | 50.3 | High |
| 10 | 11 | 4.0 | 4.77 | 2.31 | 48.4 | High |
| 11 | 1 | 3.0 | 3.59 | 1.89 | 52.7 | Medium |

μ = Arithmetic Mean; σ = Standard Deviation; m = Median; CV = Coefficient of Variation (expressed in %). Reference qualifiers: (1) Nothing Present - (9) Very Present.

3.2 Importance of design ranked by area and its benefits

Regarding the public sector, the Delphi experts agreed that design is quite or very important for large agri-food companies. This trend remains in this second phase for the private sector, also showing a high degree of agreement as can be seen in Table 3 (item 16-17). Table 3 is also depicting that consumers positioning is situated in the first place (item 18), while most experts pointed out that both Training Centers (undergraduate and postgraduate curricula) (item 12) and Government Authorities (item 14) considered that design is not a fundamental element for the innovation and improvement of the competitiveness of the agri-food sector. It can be added that these two issues aroused especially the interest of some participants.

In this phase a series of items have been included around the tangible and intangible benefits that could be obtained from the incorporation of the design component in the agri-food industry. For each of the benefits two different items were drawn up trying to reflect the same approach, subsequently obtaining the mean between both items to obtain the most reliable valuations possible. For example, for the item "Increase in competitiveness" (item 19) the panel members claimed: (i) The position of the Andalusian agri-food sector should be improved with respect to its competitors; (ii) the products of the Andalusian agri-food companies should gain competitiveness. Regarding the tangible benefits, the increase in competitiveness was the most valued with a high degree of agreement as can be seen in Table 4 (item 19). The item perceived as the least important turned out to be the reduction of the environmental impact (item 23), although good scores were obtained for all. Regarding the intangible benefits, the one that obtained the best evaluation was the improvement of the corporate image of the agri-food companies and organizations, as it is shown in Table 5 (item 30). Although very similar assessments were obtained in all cases, the improvement of quality (item 27) was placed in last position.

Table 3. Importance of design by area.

| <i>Order</i> | <i>Item</i> | <i>m</i> | μ | σ | <i>CV</i> | <i>Agreement</i> |
|--------------|-------------|----------|-------|----------|-----------|------------------|
| 1 | 18 | 7.0 | 6.68 | 1.64 | 24.6 | Very High |
| 2 | 17 | 7.0 | 6.23 | 1.72 | 27.6 | High |
| 3 | 16 | 6.5 | 6.18 | 1.56 | 25.3 | High |
| 4 | 13 | 5.0 | 4.73 | 1.78 | 37.6 | High |
| 5 | 15 | 4.0 | 4.45 | 1.74 | 39.0 | High |
| 6 | 12 | 4.0 | 3.77 | 1.95 | 51.7 | Medium |
| 7 | 14 | 3.5 | 3.64 | 1.97 | 54.0 | Medium |

Table 4. Tangible benefits obtained from the application of design in the agri-food industry.

| <i>Order</i> | <i>Item</i> | <i>m</i> | μ | σ | <i>CV</i> | <i>Agreement</i> |
|--------------|-------------|----------|-------|----------|-----------|------------------|
| 1 | 19 | 7.5 | 7.55 | 1.07 | 14.1 | Very High |
| 2 | 25 | 7.3 | 7.02 | 1.67 | 23.7 | Very High |
| 3 | 21 | 7.0 | 7.00 | 1.64 | 23.4 | Very High |
| 4 | 24 | 7.0 | 6.89 | 1.91 | 27.8 | High |
| 5 | 22 | 7.0 | 6.68 | 1.51 | 22.6 | Very High |
| 6 | 20 | 6.5 | 6.34 | 1.56 | 24.6 | Very High |
| 7 | 23 | 6.0 | 6.05 | 1.54 | 25.5 | High |

Table 5. Intangible benefits obtained from the application of design in the agri-food industry.

| <i>Order</i> | <i>Item</i> | <i>m</i> | μ | σ | <i>CV</i> | <i>Agreement</i> |
|--------------|-------------|----------|-------|----------|-----------|------------------|
| 1 | 30 | 8.0 | 7.82 | 1.05 | 13.5 | Very High |
| 2 | 26 | 7.5 | 7.57 | 1.07 | 14.2 | Very High |
| 3 | 29 | 7.3 | 7.57 | 1.00 | 13.3 | Very High |
| 4 | 28 | 7.0 | 7.09 | 1.43 | 20.1 | Very High |
| 5 | 27 | 7.0 | 6.93 | 1.09 | 15.8 | Very High |

μ = Arithmetic Mean; σ = Standard Deviation; *m* = Median; *CV* = Coefficient of Variation (expressed in %). Reference qualifiers Table 3: (1) Nothing Important - (9) Very Important; Table 4 and 5: (1) I totally disagree - (9) I totally agree.

From the results obtained it can be deduced that, in all the cases raised, the panel of experts attaches great importance to design as an element of non-technological innovation within the agri-food sector. Aspect that was not reflected in a study conducted in 2012 on innovation in Andalusian companies [21]. In this work was looking for sought to answer the question: how do companies innovate?, from a sample of 100 companies for the specific case of the agricultural sector. The results that were obtained were quite surprising, since only one variable was identified that favored clearly the level of innovation. Specifically, reference was made only to patents and other industrial properties. At this point it is important to mention that although everything points out that design in general is not incorporated in the sector, there are transversal aspects that have begun to be incorporated in recent years. For example, in a special edition of a multidisciplinary agriculture journal, it was very clear that Computational Fluid Dynamics (CFD) related to Computer-Aided Design is now close to maturity in the eyes of agricultural engineers [22]. Finally, it should be emphasized that the set of benefits studied in this work can help overcome one of the main limitations of agri-food products, the non-differentiation of the product in relation to the products of oth-

er agricultural holdings, ie the lack of a brand. Limiting very notably the application of other strategies related to marketing, as is the case of advertising [23].

3.3 What lines of design-sector action do you think are necessary?

In this second phase, the 7 design-sector action lines already raised in the first phase from the public sector were also included at this second stage [9]. The Delphi panel of the private sector determined that the most relevant line was the one related to eco-design as a tool for the development of new packaging in the agri-food industry ($\mu = 7.32$; $\sigma = 1.46$). The action line related to design as an analysis instrument for landscape planning and integration of agricultural facilities took the second place ($\mu = 7.05$; $\sigma = 1.70$). In both cases a high degree of consensus was obtained. As a result of this second phase, new lines of action have emerged such as: i) Design of a tourism-agrarian strategy. ii) Promote knowledge of design as a function of companies. iii) Design as a dynamic element in the new paradigm of the "Bio-economy". iv) Explore alternative methodological tools for design training from the teaching-learning point of view.

Regarding packaging, it would be very interesting to incorporate environmental variables in the design process by exploring the growing wave of the so-called emotional design [24]. For example, Tassina and Cacioppo [25] studied how the emotions of consumers were affected by the product (i.e. design results). Regarding the design line of developing tools and analysis instruments for planning and landscape integration, a very consistent coherence in the results was observed. In fact, it was the component to which less presence was assigned (item 1), and subsequently stands out as a necessary line to be developed in the agri-food sector. This proposal would be framed in the context of what is commonly called "Landscape Architecture", a research line started in Spain by mainly focusing on agricultural constructions with an important technical component ([26], [27], [28]). However, the applications of this promising research line on the specific case of plastic covered greenhouses areas and issues related to land planning is practically nonexistent. This is the reason why we have recently started a new research line in which widely known tools such as "Remote Sensing Techniques" and "Landscape Metrics (spatial)" are applied to develop a methodological proposal headed up to facilitate rural landscape evolution studies, land planning and monitoring, and policy management in areas of intensive agriculture.

Finally, and from an academic perspective, we propose the introduction of the "Design Process" as a topic to be incorporated in the subjects of the "Graphic Expression" module at degree or master level. This approach could allow the development of innovation and creative empowerment skills.

4 Conclusions and future research lines

Regarding the first question, the experts panel from the private sector considered that the design activities mostly present in the agri-food sector have to do with graphic design. It should be noted that in this case, unlike the Delphi panel from the public sector, they considered that the design component is more present in trade fair stands and materials where, in addition to the graphic design, the design of products and space plays a relevant role. With regards to the incorporation of design into organizations and companies in the agri-food sector, the group of experts considered that it is an interesting tool to be explored, an idea that is based on the good scores granted to tangible and intangible benefits which could be obtained from this approach.

Finally, the findings obtained in this work (putting together both public and private agri-food sectors) represent an indispensable preamble to get insight about the current situation regarding the presence of the design component in the agri-food industry. In this sense, an important background is already available so that further works will try to get a detailed picture of specific agri-food clusters to allow understand how design is present in the companies of the agri-food sector. This could favor the transfer of R & D & I results to the agents of the sector to increase the social impact of this work and the development of the design culture. In summary, the milestone provided by this new line of research seems to be very valuable as a diagnostic tool to characterize the design component in the agricultural sector. That in turn can help to discover and develop design as a tool of non-technological innovation and a factor of dynamization for the creation of environmental, social and economic value in the agri-food sector.

Acknowledgments

This work has been supported and financed by an FPI predoctoral fellowship (first author) granted in the framework of University of Almeria Research Programme. It also takes part of the general research lines promoted by the Agri-food Campus of International Excellence ceiA3. Thanks for the advice regarding the preparation of the exploratory phase of this study are due to the professors and researchers Emilio Galdeano and Laura Piedra, members of the research group "Economic Development and Agrifood Economy (SEJ-529)" of the Andalusian Plan for Research, Development and Innovation, thanks. Finally, the authors wish to sincerely thank the experts of the agri-food and design industry in Andalusia who made up the Delphi panel for their very valuable contribution to the results obtained in this work.

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