Interaction between design processes and innovation in the gastronomic equipment industry in Peru

Interação entre os processos de design e inovação na indústria peruana de equipamentos gastronômicos

César Antonio Lengua Huertas¹
Miguel Domingo González Álvarez²

Abstract
In Peru, in recent years, significant progress has been made as part of the objective of eliminating obstacles in the gastronomy value chain and identifying, in the current offer, factors that improve its quality, proposing actions to improve competitiveness. Meanwhile, the metalworking industry has shown a pronounced growth in recent years, also recovering exports, but has had less encouraging results in innovation indicators, which places Peru in the 89th place, out of 140, of the economies of the most competitive countries worldwide. Therefore, the main objectives of this research are the identification and analysis of the advances of gastronomic equipment developed in Peru, due to the enormous gastronomic growth evidenced as a result of the contribution of the State, the Academy and the Private Company. A descriptive research and a qualitative characterization of four specific cases of the cities of Lima and Arequipa is carried out, determining the opportunities that the sector has to improve its competitiveness and innovation. Product innovations developed in recent years and which have highlighted technical aspects of engineering design processes are examined, where the metallurgical sector involved is mainly represented by the small company. Thus, the way design is applied during innovation processes has been determined

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and key topics of study have been identified, as well as its impact on the interaction between design and innovation processes, through a proposed model using the diagram IDEF0 (Integration Definition for Function Modeling).


Introduction

In industrialized countries, the need to rapidly develop better or new products has resulted in various design theories and methodologies. Systematic design and design is an
almost routine task, as competition forces companies in these countries to rationalize and automate production. Currently, the existence of numerous methods, both design in engineering and innovation, make designers / innovators able to solve engineering problems methodically, which leaves little room for chance or intuition and thus confront forcefully ever stronger competition, standardization and rationalization of products, as well as increasingly strict regulations and customers with higher demands.

Meanwhile, Peru remains a country dependent on exogenous technology (Vega, 2003; Villarán, 1989). In other words, the importation of machinery and equipment has contributed to increased productivity and provided opportunities for reverse engineering (Odagiri, Goto, Sunami, and Nelson, 2012). This has also meant that, over the years, the design of machines and equipment is also a task that has been developed based on the designer's own experience, perhaps as a result of the lack of knowledge or low level of training in the use of design methodologies in engineering. However, the search and acquisition of technological knowledge has emerged as a key and complex aspect within the strategy of business innovation (Vega, 2008).

In 2018, Peru was ranked 89th out of 140 nations, according to the World Economic Forum's Global Competitiveness Index (GCI). The World Economics Forum (WEF) ranked 89 out of 140 nations. Meanwhile, the National Survey of Innovation in Manufacturing Industry 2015 conducted by the National Institute of Statistics and Informatics INEI, 2017 shows that 61.2% of manufacturing companies carried out activities for innovation, of which 50.2% carried out technological innovations (product and process), 43.8% carried out non-technological innovation (organization and marketing) and only 5% are non-innovative companies (that have carried out some management or have activities in process).

The study carried out by González (2016) in addition, regarding the advances in the supply of equipment and utensils in the Peruvian gastronomic sector, indicates that in the business structure of the sector in 2014, microenterprises represent 86.48%, small businesses 11.53% and medium-sized enterprises 0.3% of the total, reflecting the high informality of the sector. Among its main results, small and medium-sized manufacturers have managed to develop quality products in workshop-type organizations and most of them are located in the city of Lima. On the other hand, due to the informality of microenterprises and small enterprises, they impose greater weight on low prices than on product quality. It was also shown that there is an unmet demand regarding the level of national equipment in its different classifications; compared to the imported product, the national product has to improve mainly in quality, due to the lack of improvements in finishing and introduction of certifications.
Among other aspects that stand out is the reasonable price, but with a deficient after-sales service and life time, as well as a low diversified offer.

Given the above, it is notable that Peruvian companies are in the search for innovation processes that allow them to improve their products and expand their customer portfolio. However, at present, there are few studies related to the interaction of design processes and innovation processes in equipment development, the study of this interaction could identify how innovative and convenient a company's products can be in the international market. Therefore, the purpose of this article is to contribute to the knowledge on the interaction between the design and innovation processes of gastronomic equipment in the metalworking industry of Peru, identifying key issues through a qualitative research methodology and case study.

**Theoretical Fundamentals**

The main characteristics of the design and innovation processes and the study topics that govern the interaction of these as two distinct parts that underpin this research are presented.

2.1 Design and Innovation Processes

The development of new products is a current challenge for companies to cope with the nature of their markets and the increasing competition. In this respect, the design process and the innovation process are often linked, so that it has been proposed in the Table 1, from the various stages of the evolution of the product Birkhofer, 2011, where you can see the phases of the design process according to Ullman (2010) and the phases of the different models of innovation processes given in six generations.

According to Birkhofer (2011) in addition, for many years the boundaries of design have been extended more and more to product development, however, currently the development and creation of products are analyzed in terms of efficiency and effectiveness. This results in blurred borders and a life cycle that extends to the production of the product. In addition, individual activities can be grouped and therefore overlapping, as would occur in the design of the product as part of its development due to concurrent engineering, as both processes aim to obtain the best possible product.
Ullman's design process (2010), one of the most used and currently in force, was initially published in 1988 and represents the life cycle of a product summarized in six phases, regardless of the product that is developed or modified in the industry. The first five phases are also known as engineering design, which, according to Paul and Beitz (2007), is a multidisciplinary activity that is present in all areas of human life, uses laws and knowledge of science, is built on experience, provides prerequisites for the physical realization of ideas and solutions and, finally, requires professional responsibility and integrity. Over the years a wide variety of design theories and methodologies (DTM, *Design Theory and Methodology*) have been developed and proposed and, although there is no clear definition of this, a classic view of design theory is that it deals with how to model and understand design, while design methodologies deal with how to design or how design should be (Tomiyama et al., 2009).

Besides, Birkhofer (2011) indicates that the design methodology has been extended to a product development methodology and that the term is retained only as an established label.

As for the process of innovation, it has a historical evolution in theories or models of innovation processes (IPM, *Innovation Process Model*). Its main antecedent comes from the evolutionary theory that, in turn, is presented in Schumpeter's works and has passed since its conception through several stages, varying the way the process is assimilated by the economic environment. In addition, in the light of Drucker's comments Drejer, 2002 In addition, the term innovation refers to both a process and its outcome.
Interaction between design processes and innovation in the gastronomic equipment industry in Peru

Table 1: Comparison of design processes with innovation and study methodologies.
Source: Own elaboration from the sources indicated.

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</tr>
</thead>
<tbody>
<tr>
<td>Innovation Process (Barbieri &amp; Teixeira Álvares, 2016; Chesbrough, 2006; Kline &amp; Rosenberg, 1986; Rothwell, 1994)</td>
<td>Market Need</td>
<td>Development</td>
<td></td>
<td>Production</td>
<td>Marketing / Sales</td>
<td></td>
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<tr>
<td>1st Generation Linear Model - Drive Technology</td>
<td>Generating ideas</td>
<td>Invention and/or basic design</td>
<td>Detailed design and pilot test</td>
<td>Redesign, Demo &amp; Production</td>
<td>Marketing / Sales</td>
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<tr>
<td>2nd Generation Linear Model - Market Pull</td>
<td>Home / Marketing</td>
<td>Research</td>
<td>Product Development</td>
<td>Production Engineering</td>
<td>Component Launch</td>
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<tr>
<td>3rd Generation Mixed Model - Kline</td>
<td>Marketing &amp; Sales / Finance</td>
<td>Research and development</td>
<td>Engineering and production</td>
<td></td>
<td>Marketing &amp; Sales / Finance</td>
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<tr>
<td>4th Generation Integrated model</td>
<td>Internal and external technology base</td>
<td>Research and development</td>
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<tr>
<td>5th Generation Networked model</td>
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<tr>
<td>6th Generation Open Innovation Model</td>
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In recent decades literature has described different generations of innovation models, most of them referring to Rothwell (1994) as one who specifically classifies them in five generations, between the decades of 50 to 90, from the analysis of various accepted and outstanding models. For Barbieri and Teixeira (2016) Moreover, the Rothwell classification is the starting point for a comparison with other recognized classifications, showing the existence of the sixth generation of innovation models, such as the open innovation model. Currently, with the emergence of the innovation model of the Big Picture developed by Lercher, the debate has opened for the existence of a seventh generation Taferner, 2017, but this one is not shown in the Table 1.

2.1.1 Interaction Between Design and Innovation Processes

Process interaction requires some commonalities to address current and future challenges such as globalization, saturated markets, shorter product life cycles, and increased price competitiveness. That is why there is a need to have a degree of novelty of the product, mainly looking for original designs, as well as adaptations and variants, where new tasks and problems are solved using new or novel combinations of known solution principles. Achieving successful products will therefore be the best way to master this growing competitive pressure, where maintaining a high standard of living in industrialized countries will be possible only if companies succeed in developing and distributing innovative products. However, being innovative in developing new products is not easy, because many ideas are rejected in product development. Even if the idea has been introduced to the market, there is still a risk of failure. (Birkhofer, 2011; Hidalgo, León and Pavón, 2014; Pahl et al., 2007). Likewise, the interaction of processes in recent years has been related to radical innovations (Yannou, Jankovic, Leroy, and Kremer, 2013) and incremental innovations Philipson, 2016, both for engineering and industrial design.

Ahora, para dar un orden a la información obtenida en la revisión sistemática para la interacción buscada, se propone el uso del modelo IDEF0 (Integration Definition for Function Modeling), utilizado para describir procesos o actividades. De acuerdo a Šerifi, Dašić, Ječmenica y Labović (Šerifi et al., 2009), la descripción del modelo IDEF0 es considerada como la combinación de cinco magnitudes definidas. La propia caja que contiene el proceso o actividades, y las magnitudes conocidas con sus siglas como ICOM: Entradas (Input), Control, Salida (Output) y Mecanismos. Figure 1 which represent and allowed sample Table 2
2.2 Topics of Study

2.2.1 Inputs and Outputs

They understand the entry of new ideas into the processes and involve the achievement of a new balance between the associated risks and the potential for success, because if an organization does not change what it offers and how it offers it could risk its survival and be overcome by others who do (Kamrani and Nasr, 2013). Also considered are customer reviews with an annual assessment and feedback from key employees, supplier suggestions, benchmarking and responses to technology center challenges, which constitute the entry into the development of new products (Leite and Braz, 2016). Thus, marketing information is
strengthened to be present throughout the design process and, in turn, to maintain the product's capacity for innovation (Ozaltin, Besterfield-Sacre, Kremer, and Shuman, 2015).

2.2.2 Monitoring

It is geared towards metrics and indicators such as individual and team performance for design projects (Škec, Cash and Štorga, 2017) and, subsequently, the definition of metrics related to the quality and viability of the innovative idea Fulbright, 2017. Planning for a conceptual design also involves having key performance indicators to ensure that you have the elements you need to continue the creative phase of the product design (Vila y Albiñana, 2016). It also raises the need to maintain adequate planning in the early stages of projects (Bacciotti, Borgia, Cascini and Rotini, 2016). In the case of Product Lifecycle Management (PLM) meta-product design, the project metrics and key indicators must, in a first phase of the project, be related to the product performance to satisfy the customer (price, weight, accuracy...) and the project (number of iterations, tests, failures, cost...) (Elhariri, Sekhari, and Bouras, 2017). The Performance Measurement System (PMS) in research and development has allowed companies to measure performance for different purposes: motivate researchers and engineers, monitor the progress of activities, assess the profitability of projects, promote coordination and communication, and stimulate organizational learning (Chiesa, Frattini, Lazzarotti, and Manzini, 2009).

2.2.3 Human Resources

It encompasses both individuals and the organization. Regarding the person, personality traits, attitudes against risks and creative idea generation skills in a work team are studied (Toh and Miller, 2016). It also studies the role that engineers can play during an innovation process, including their problem-solving, design and business behavior (Ferguson and Ohland, 2012), without leaving aside their experience in projects (Bigand, Deslee, and Yim, 2011). Some studies of the participation of external designers in small manufacturing organizations show that they contributed significantly to interactions during process dynamics in setting goals and developing ideas (Berends, Reymen, Stultiëns, and Peutz, 2011), which allows through an integration of expert knowledge, the exchange between engineering designers to have innovative solutions that improve products and minimize design changes (Zhang, Gregory, and Shi, 2014).
2.2.4 Methodological Resources

Its use aims to accelerate and obtain better processes in the management of creativity and innovation, as well as linking skills and understanding of the market (Rivera and Vidal, 2008). Concurrent engineering may be associated with methods of knowledge capitalization based on the impact of feedback from previous projects (Marcandella, Durand, Renaud, and Boly, 2009); reverse engineering is used as a way to compensate for the designer's lack of knowledge in the ability to abstract and define functions, also used in reconstructing parts or a way to adapt technology to make technological changes (Montanha, 2011). Open innovation brings with it an experience to drive an eco-design development community Bonvoisin et al., 2017. Likewise, some studies propose using prototype experimentation as a tool of continuous innovation to obtain advances in an evolutionary way through the acquired knowledge and design performance, through documented design activities and improved communication with reviewers and coaches (Camburn et al., 2017; Skogstad and Leifer, 2011). In aspects of continuous improvement tools and environment, we propose to support designers for the early estimation of energy performance and noise level, managing to support eco-innovation and improve product sustainability (Cicconi, Landi, Germani, and Russo, 2017).

2.2.5 Technological Resources

They are linked to software and information systems. PLM-based software and enterprise resource planning (ERP) software use computer-aided design (CAD) geometric modelers through which all product features can be managed. This allows for progressive convergence by increasing designers' possibilities to integrate new knowledge into innovation (Roucoulles and Tichkiewitch, 2015). A software program applied to a design method can improve the management of a product's innovation process during a design process, guide the design of innovation, and provide solutions to problems Feng, 2017.

Likewise, it is indicated that technological solutions in engineering design have proven to be powerful multipliers for effective design efforts, thus proposing a digital data ecosystem through the use of clouds to reinforce information management, teamwork, communication and ability to handle fundamental design principles, as well as being a technology capable of alleviating reprocessing and productivity interruptions related to the process (Steingrimsson, Jones, Estesami and Yi, 2017).
Methodology

According to its purpose, this research is descriptive with a qualitative characterization (Hernández, Fernández y Baptista, 2010) based on the methodology of multiple case studies with multiple units of analysis, according to the interpretation of Yin's approach (2009). We considered a theoretical sample made up of four cases, which makes the research type 3, holistic (single unit of analysis) and multiple case design.

So, in order to understand the phenomenon of the interaction of design and innovation processes in Peru in the small gastronomic equipment industry, the research plan asks the following question: How do the design and innovation process in the metalworking industry interact for the gastronomic sector?

In the Table 3 The proposed proposals are shown according to the lines of interaction in Figure 1 for each ICOM magnitude. In turn, these were built according to the guidelines of CIMO logic following the work done by Denyer, Tranfield and Van Aken (2008) and whose components are Context (C), Intervention (I), Mechanism (M) and Results (O, Outcome).

<table>
<thead>
<tr>
<th>Topic of study</th>
<th>Item</th>
<th>Proposition</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs and Outputs</td>
<td>Q1</td>
<td>To maintain market competitiveness and successful marketing, these companies constantly include new product improvement ideas to processes.</td>
<td>(Kamrani and Nasr, 2013; Ozaltin, Besterfield-Sacre, Kremer and Shuman, 2015)</td>
</tr>
<tr>
<td>Control</td>
<td>Q2</td>
<td>Their business strategies are based on the fulfillment of objectives set while maintaining adequate control of the information for the timely delivery of their products.</td>
<td>(Škec, Cash and Štorga, 2017)</td>
</tr>
<tr>
<td>Human resources</td>
<td>Q3A</td>
<td>They maintain organizational and training policies to train staff with skills and experience, which makes possible the dynamism of processes.</td>
<td>(Bigand, Deslee and Yim, 2011; Toh and Miller, 2016)</td>
</tr>
<tr>
<td>Methodological Resources</td>
<td>P3B</td>
<td>Reverse engineering with ecological policies is used for the design and development of gastronomic equipment.</td>
<td>(Cicconi et al. 2017; Montanha 2011)</td>
</tr>
<tr>
<td>Technology Resources</td>
<td>P3C</td>
<td>The use of already developed designs is implemented which is making companies increasingly have more standardized products internally and modular.</td>
<td>(Hagedorn, Grosse and Krishnamurty, 2015; Ma and Kremer, 2016)</td>
</tr>
</tbody>
</table>

Table 3. Proposals for case studies in small metallurgical companies.
Source: Own production.

Development

4.1 Selection Criteria

The companies were selected considering their trajectory in the Peruvian market, that is, the quantity and variety of equipment they have sold for the gastronomic sector over time.
On this basis, ten companies were selected, a database was built analyzing the sector, telephone calls were made for a first contact and, finally, formal invitations were sent by e-mail. All the companies contacted offered to guarantee the confidentiality of the information and the anonymity of the business name. Only four companies accepted the invitation, three companies ignored it and three others did not accept to be interviewed for internal policies.

4.2 Data Collection

Semi-structured interviews were conducted, lasting approximately 60 minutes, with open-ended questions for the managers or people responsible for the design and innovation processes of each company, which were selected between the Peruvian cities of Lima and Arequipa, chosen for being of small business category according to the National Superintendence of Customs and Tax Administration (SUNAT, 2021) and have experience in the manufacture of gastronomic equipment such as cooking equipment, cold, support and extraction. Data collection covered the following:

- Company details.
- Information on the design and innovation processes for the gastronomic equipment with more sales in the company.

Results

In the Table 4 some relevant data obtained through the research questions of four case studies of metallurgical companies oriented to manufacture gastronomic equipment are shown.

<table>
<thead>
<tr>
<th></th>
<th>Case A</th>
<th>Case B</th>
<th>Case C</th>
<th>Case D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main gastronomic equipment</td>
<td>Grilled Chicken Oven</td>
<td>Grilled Chicken Oven</td>
<td>Bakery ovens</td>
<td>Cooling</td>
</tr>
<tr>
<td>Interviewed</td>
<td>Operations Manager</td>
<td>General Manager</td>
<td>General Manager</td>
<td>General Manager</td>
</tr>
<tr>
<td>Number of employees</td>
<td>40</td>
<td>29</td>
<td>15</td>
<td>26</td>
</tr>
<tr>
<td>ISIC Rev 4.0</td>
<td>2511</td>
<td>2599</td>
<td>2511</td>
<td>2599</td>
</tr>
<tr>
<td>Business Strategy</td>
<td>Manufacturing and import</td>
<td>Manufacturing</td>
<td>Manufacturing</td>
<td>Manufacturing and import</td>
</tr>
<tr>
<td>Export your products</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
Interacción entre procesos de diseño e innovación en la industria de equipamiento gastronómico del Perú

<table>
<thead>
<tr>
<th>Patentes en los últimos 10 años</th>
<th>Sí</th>
<th>Sí</th>
<th>No</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desarrolló proyectos con el Estado y la Academia</td>
<td>Sí</td>
<td>Sí</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

**Tabla 4. Datos relevantes de las empresas estudiadas.**

Fuente: Datos propios de SUNAT y entrevistas.

Además, la evidencia recogida durante el estudio se muestra en la Tabla 5. Estos fueron evaluados por el análisis cruzado propuesto por Yin (2009), primero delineando conclusiones cruzadas en las líneas de interacción entre procesos de diseño y innovación en pequeñas empresas de metalurgia de la industria gastronómica, lo que se presenta en la siguiente sección.
<table>
<thead>
<tr>
<th>ID</th>
<th>Interview Questions</th>
<th>Case A</th>
<th>Case B</th>
<th>Case C</th>
<th>Case D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>How do processes feed into better products?</td>
<td>Technological surveillance and participation in fairs.</td>
<td>Technology surveillance.</td>
<td>Participation in fairs.</td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>How do you bring innovation to your business?</td>
<td>General and Operations Management start the process, but anyone can contribute ideas.</td>
<td>General Management starts the process, but anyone can contribute ideas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>How do I receive design feedback?</td>
<td>Sending drawings to the customer.</td>
<td></td>
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</tr>
<tr>
<td>Q1</td>
<td>How does the commercial and after-sales area relate to design and innovation?</td>
<td>Customer feedback.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td>How do you measure design productivity?</td>
<td>Production planning and quality control of drawings.</td>
<td>No indicators are used.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td>How do you measure the productivity of innovation?</td>
<td>Customer is the primary indicator when showing interest in improvements or new products.</td>
<td>No metrics and indicators defined.</td>
<td></td>
<td></td>
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<tr>
<td>Q2</td>
<td>Do you use standards or certifications in your products?</td>
<td>Standards in drawing development and certification of products being exported.</td>
<td>Standards in drawing development. It does not use certifications.</td>
<td></td>
<td></td>
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<tr>
<td>Q2</td>
<td>How do you manage the documentary control of designs and innovation?</td>
<td>Parts are not encoded. A server and library are available. In the case of innovation, there is no defined repository.</td>
<td>Parts are not encoded. A server is available. In the case of innovation, there is no defined repository.</td>
<td></td>
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<tr>
<td>Q3A</td>
<td>How do you determine that the design staff has the competencies to be an agent of innovation?</td>
<td>Proactive with criteria. Handling drawing programs. Innovation has to focus on need and cost reduction.</td>
<td>Professional training and experience. In innovation, he should be a specialist in technological surveillance and foresight. Good investigator.</td>
<td>Creative, witty and detailed. Professional training, team experience, software management. In innovation you must be creative.</td>
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</tr>
<tr>
<td>Q3A</td>
<td>How do you consider the interdisciplinary approach in your innovations?</td>
<td>Essential for developing better products.</td>
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</tr>
<tr>
<td>Q3A</td>
<td>How do you evaluate innovative and problem-solving behavior?</td>
<td>Direct observation.</td>
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</tr>
<tr>
<td>Q3A</td>
<td>How do you organize the design or engineering department?</td>
<td>An engineer, a cartoonist-designer and an assistant.  Head of plant, an engineer and a plant technician.  General Manager and a cartoonist.  Outsource engineering services.  General Manager, a cartoonist and a plant technician.</td>
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</tr>
<tr>
<td>Q3A</td>
<td>How do you receive training on current design-innovation methodologies?</td>
<td>It has not received training in methodologies. Only software and each brand of computer that matter.  It has not received training in methodologies. Computer programs only.</td>
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</tr>
<tr>
<td>P3B</td>
<td>How do you work on environmental issues in your designs and innovations?</td>
<td>Designing and developing ecological equipment. There is no work with pollutants in manufacturing. Designing and developing ecological equipment.</td>
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</tr>
<tr>
<td>P3B</td>
<td>How does the design process develop in your company?</td>
<td>The design is developed from an idea or reverse engineering.</td>
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</tr>
<tr>
<td>P3B</td>
<td>How do you develop partnerships with other companies to innovate your products?</td>
<td>In process. Manufacture locally products of current foreign origin to have a lower cost of sale.  It has no alliances to innovate.  It has no alliances to innovate, but it does to contract as a manufacturing service.</td>
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</tr>
<tr>
<td>P3B</td>
<td>How do you verify that the design meets the customer's expectations?</td>
<td>Functional prototypes are developed; the customer tests the product in the workshop and gives feedback to the designs. No lab testing is done.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3B</td>
<td>How do you supply modular parts for your products?</td>
<td>Equipment with modular parts is designed and used for different models and sizes.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>P3C</th>
<th>How do you do the drawings and calculations?</th>
<th>The drawings and calculations are done with the SolidWorks program.</th>
<th>Drawings and calculations are performed using the AutoCAD and Inventor programs.</th>
<th>Drawings and calculations are carried out by freehand and with the AutoCAD and Inventor programs.</th>
<th>A large number of standardized equipment is available. The AutoCAD and Inventor programs are used when they are new projects.</th>
</tr>
</thead>
<tbody>
<tr>
<td>P3C</td>
<td>How do you use technological resources in innovation?</td>
<td>Use only internet search engines.</td>
<td></td>
<td></td>
<td>Use search engines on the internet. Outsource an external technology surveillance service.</td>
</tr>
<tr>
<td>P3C</td>
<td>How do you use and apply technology in our market?</td>
<td>It buys certified electronic systems out of the country and consumes technology that can be obtained locally. It does not use touch panels.</td>
<td>Purchase certified electronic systems within the country. No touch panels are used.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3C</td>
<td>How do you manage your company's IT systems to improve innovation?</td>
<td>You have a server, but you do not use ERP and PLM.</td>
<td>You have a server. ERP used is not connected with engineering and production.</td>
<td>You have a server, but you do not use ERP and PLM.</td>
<td></td>
</tr>
</tbody>
</table>

**Table 5. Case study, presentation of evidence.**
Source: Own production.
Discussion and Analysis

It has been observed that it is usual to carry out technological surveillance with regard to the issues of entry and exit, including the participation in fairs. General management starts the innovation process with the idea that any employee of the company can participate in the process. Ideas are also generated by feedback from the customer after the approval of plans or maintenance carried out, thus linking the commercial and after-sales area with the design and innovation processes.

Regarding control, companies usually do not use indicators, with plant planning and quality control being the main way to measure production performance, as is the customer the main indicator for innovation. Design standards are used to control products, and exporting companies must comply with certain certifications. The documentary control of the products, passes by not having an encoding of the parts and they use server for drawing archive.

In human resources matters, design staff are typically recruited for their soft skills, professional training and team experience. However, when this staff is required to contribute to the innovation of a product, it must have analytical qualities, experience in the area of innovation, have initiative and, mainly, be creative. It must also be open to interdisciplinary approaches to developing better products. The organization of the design or engineering department is often not very clear in companies, being able to consider the same General Manager within the area, added to an engineer, a draftsman and considering, sometimes, plant technical staff available to support. Likewise, there is a low trend of outsourcing design or engineering services.

The methodological resources are focused on energy efficiency: it works with automatic equipment that allows the saving of energy, as well as with better materials compared to products of lower cost. Ecological equipment is designed to cover environmental issues, taking care not to use pollutants in the manufacturing process. Reverse engineering is usually followed for the design. Companies do not enter into alliances with similar partners, except for manufacturing support purposes. When it is a new product, functional prototypes are made that the customer tests to later feed back into the design process. You can also create products with modular parts.

Finally, with regard to topics of technological resources, drawings and calculations are usually made in CAD programs, in addition to the use of the Internet as a source of information search. However, electronic parts that can be procured locally are incorporated
into equipment design. Companies usually have a server, but ERP and PLM computing systems are not common.

As explained above, the five proposals presented in the Table 3 were verified: P1 and P3B verified in a total way; P2, P3A and P3C verified in a partial way. Therefore, the operating model shown in Figure 1 is proposed to describe the interaction of design and innovation processes in small metalworking companies in the Peruvian gastronomic sector. In turn, this answers the research question: how do the process of design and innovation in the metalworking industry interact for the gastronomic sector?

Thus, according to the analysis of the four cases studied, it can be said then that the interaction of processes is developed basically taking ideas from any employee of the company and, subsequently, feedback with the participation of customers, which allows projecting to the future marketing of the product. The activities evidenced indicate that the Kline mixed model for innovation is partially fulfilled (Kline and Rosenberg, 1986).

**Conclusions**

The research presented and the cases studied have allowed to identify how the interaction of design and innovation processes develops in the small business and industry of Peruvian gastronomic equipment. Although both processes are closely linked, the case study found that, in general, companies do not recognize innovation as a process, but rather it falls within the area of design or engineering; reverse engineering is used without recognizing that it is a process and the existence of a methodology to develop it. Not having clear processes only evidences the possibilities of not being successful in the management of the productive process oriented to innovation. However, companies that have a broader organizational structure and have had links with the State and the Academy showed a greater knowledge of the design and innovation processes through the use of methodological and technological resources to manage their processes, a high participation in fairs and participation in activities to generate collaborative alliances with similar companies, which translates into the export of certified products.

**Referencias**

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