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Research article

Hybridization of the Kano model and business model canvas: aeronautical and metalworking industry in Bogota, Colombia

Jorge F. Montenegro *, Pablo A. Contreras, Fabiola Sáenz

School of Engineering, Universidad Distrital Francisco José de Caldas, 110231, Bogota D.C., Colombia

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ABSTRACT

The aeronautical and metalworking industrial sector lies within an active environment, which is a characteristic of globalization as well as the implementation of new, innovative, and revolutionary technologies that allow for the dynamization of endogenous and exogenous processes of organizations, thus reaping benefits for such companies. This study aimed to generate a generalized methodology that led to the hybridization of the Kano model and Business Model Canvas. A Kano questionnaire was implemented in 105 organizations of the aeronautical and metalworking sector in Bogota, Colombia to assess the attributes of a technology-based product (digital platform) to be offered by the company Aerospace Business Group LLC; its results were integrated into the Business Model Canvas. It was ascertained that all attributes contributed to customer satisfaction and were distributed into three blocks of the Business Model Canvas. This hybridization aids in the development of better structured businesses, thus reducing risks and maximizing opportunities.

1. Introduction

The aerospace industry, just like aeronautics, is considered one of the most powerful manufacturing industries in the world due to its production processes, which yields a high number of jobs and added value (Rocha-Lona et al., 2019). This industry's production processes are closely related to research and development (R&D) activities for new technologies, leading to the consolidation of innovations that support the industry's value chain (Hernández Chavarría et al., 2020) and projecting growth in design and development fields (Gilain et al., 2019).

Historically, the sector has shown great progress in its technologies; countries such as France in the 1960s became a forerunner of aviation and had established one of the most robust industries in Europe (Landoni & ogilvie, 2019). South Africa plays an important role because it has the largest aerospace industry of the African continent supported by research, design and manufacturing processes (Marais and Bam, 2019). In Latin America, the sector is spearheaded by Brazil, Mexico, Panama, Chile, Colombia and Peru (Rocha-Lona et al., 2019), an appealing region for investment and the upturn of the aeronautical and aerospace sector.

It should be pointed out that one of the risks of organizations within the aeronautical and aerospace sector is the competition that may spring up in both domestic and international markets (Turkina et al., 2016). Therefore, some aerospace manufacturing companies roll out strategic activities that generate added value to the company (Chang et al., 2013) and choose to outsource some of their processes through specialized suppliers for the design or manufacture of parts in order to ensure the satisfaction of the end customer (Jha et al., 2020) as well as compliance with the safety standards of control entities such as the European Aviation Safety Agency (EASA) or the Federal Aviation Administration (FAA) (Guyon et al., 2019). Suppliers can be specialized or intelligence-based SMSEs (Small and Medium Scale Enterprises) that support the productive environment of the contracting company, becoming strategic partners as well as key nodes in the supply chain (Moraes et al., 2019).

In this context, it is deemed important to generate businesses or business lines in companies within the aeronautical and metalworking industry that can offer digital products or services to organizations in the same network by taking the client's opinion and, consequently, their future satisfaction as an essential basis. One of the business models that is especially effective for startups and commercial players is the Business Model Canvas (BMC) (Prasetyawan et al., 2018), which rationally describes how value is built and delivered to the customer (G. Wang and Hwa, 2019) on a canvas consisting of 9 blocks divided into four groups: what, how, who, and how much (Azevedo et al., 2018). However, as propounded by (Capó Vicedo and Ortiz Rodríguez, 2015), one aspect to consider about the BMC is that it lacks depth in terms of its data.

* Corresponding author.
E-mail address: jfmontenegrob@correo.udistrital.edu.co (J.F. Montenegro).

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That being the case, customer satisfaction measured in terms of meeting the requirements of the product or service is a consequence of the generation of value based on the business idea and is a key element to gauge its growth and create differentiation against the competition (Gupta and Shri, 2018). In doing this, the Kano model allows for an exploration of the components of the product or service quality by assessing the attributes that directly impact customer satisfaction, as well as the role of such features in the perception of quality (Fajriyati et al., 2020).

The studies developed thus far regarding the Kano model and the BMC do not show the existence of a hybridization of both models (particularly regarding the use of the results from the Kano model as input in the different blocks of the structuring and systematization of the BMC to generate value in the business idea), thus correcting the negative aspect posited by (Capó Vicedo and Ortiz Rodríguez, 2015) as outlined previously herein. Likewise, it has been pointed out that the application of the Kano model in the aeronautical and aerospace sector is mostly restricted to the study of an assessment of the quality of the airlines' services in regards to customer satisfaction (Basfirinci and Mitra, 2015) and retention of clients (C.-H. Wang and Fong, 2016) and not specifically in the offer of aeronautical parts design or manufacturing services. A similar scenario occurs regarding the BMC in the aeronautical and metalworking industries.

Therefore, the purpose of this research is to develop a generalized methodology that allows for the hybridization of the Kano model and the BMC in such a way that the attributes of the product or service that generates satisfaction according to their categorization ("must be" (M), "one-dimensional" (O), or "attractive" (A)), resulting from the Kano model, can be used in the corresponding blocks of the canvas for the construction of the BMC. This research contributes significantly to academia since the business idea and the model as a whole are developed based on the requirements that will generate value in the product or service and are supported by a model that measures customer satisfaction. A greater probability of success in the implementation of the business idea is therefore expected.

For research purposes, an in-depth study was carried out through the offer of digital business by a company called Aerospace Business Group (ABG) LLC regarding the generation of a technology-based product (digital platform) to provide services of parts design, tools, structures and construction requirements for SMSEs in the aeronautical and metalworking sector in the city of Bogotá, Colombia. In order to do this, the Kano questionnaire is built. The questionnaire highlights the attributes of the technology-based product after processing the collected data and implementing the Kano model to determine the satisfaction and dissatisfaction indexes of categorized attributes. This is followed by integration of the Kano and BMC models to carry out the hybridization as described in the research method section of this paper. Finally, the BMC canvas is presented with its blocks indicating the key elements, necessary flows of resources and the relevant activities that generate value for the business idea.

Table 1. Related terms according to the thesaurus functions.

Main Terms			
Kano model	Business Model Canvas	Aeronautic sector	Metalworking sector
Kano's model	Canvas model	Aeronautical engineering	Metalworking industry
Customer satisfaction model	BM canvas	Aeronautic industry	Metal working industry
		Aerospace industry	Metal-working industry
		Aerospace engineering	
		Aircraft industry	

Source: Authors.

2. Literature review

The review questions were developed by the research team. Those questions were divided in two sections: firstly, a question corresponding to searching studies about the relationship between Kano model and Business Model Canvas (BMC). Secondly, the search was carried out around the use of the Kano model and Business Model Canvas in aeronautical and metalworking sector.

Review question 1:

- Is there a relationship between the Kano Model and the Business Model Canvas, where the results of one of the models are used in the other?

Review question 2:

- What are the applications of the Kano model or the Business Model Canvas in the aeronautical and metalworking sector?

2.1. Search strategy

The search approach in this review detailed below is according to the search strategy which will be applied in a different disciplines involved in the aim of this review (e.g. Business and Management, Industry, Aerospace and Aeronautics) (Betrán et al., 2005). This approach allows us to retrieve all pertinent available data and minimise the effect of bias.

2.1.1. Scoping

Preliminary scoping search was conducted in Scopus and Web of Sciences. Main search terms for the review were established and extracted from the Review question 1 and Review question 2 structured by the research team (Foli et al., 2014). From this exercise, the main terms were identified as "Kano model", "Business Model Canvas", "Aeronautic sector", "Metalworking sector". This scoping has been undertaken to assess the size of the literature and to define the terms associated with the main search terms.

2.1.2. Search terms

Thesaurus functions were used to prevent errors in search terms, thus, thesaurus offer broad or narrow concepts and can provide additional ways to discover overlooked words (Kugley et al., 2017). The thesaurus (UNESCO thesaurus, EBSCOhost Business Thesaurus, NASA Thesaurus) were applied to expand the main search terms set and identify additional terms (see Table 1).

The searches used the main terms and their synonyms obtained from the Thesaurus functions. Search string was adapted for the different databases to allow for differing wild cards (word truncation (*)).

2.1.3. Search string

After considering synonyms, alternative spellings, and non-English language (Spanish) terms within the search strategy, we proceed to structure the different search strings related to the main term using Boolean operators and wild cards where was necessary (see Table 2).

2.1.4. Databases

Database sources of different disciplines are involved in the aim of this review (Business and Management, Industry and multidisciplinary):

- Scopus
- Web of Science
- ScienceDirect
- IEEE

Table 2. Search equations with expanded terms as literature review input.

Question	Main terms	Expanded terms
Review question 1	Kano model, Business Model Canvas.	("Kano model" OR "Kano's model" OR "Customer satisfaction model" OR "Modelo Kano") AND ("Business Model Canvas" OR "Canvas model" OR "Modelo Canvas" OR "BM canvas")
Review question 2	Kano model, Business Model Canvas, Aeronautic sector, Metalworking sector.	a) ("Kano model" OR "Kano's model" OR "Customer satisfaction model" OR "Modelo Kano" OR "Business Model Canvas" OR "Canvas model" OR "Modelo Canvas" OR "BM canvas") AND ("Aero* sector" OR "Aero* Industry" OR "Aero* engineering" OR "Air* industry") NOT ("Aerosol") b) ("Kano model" OR "Kano's model" OR "Customer satisfaction model" OR "Modelo Kano" OR "Business Model Canvas" OR "Canvas model" OR "Modelo Canvas" OR "BM canvas") AND ("Metalworking sector" OR "Metalworking industry" OR "Metal working industry" OR "Metal-working industry")

Source: Authors.

- EBSCOhost
- Taylor & Francis
- Business Source Complete
- SpringerLink
- Scielo

2.1.5. Grey literature

The grey literature search was carried out in the ProQuest Dissertations & Theses database.

2.1.6. Inclusion criteria

Studies that report data about a relationship between Kano model and Business Model Canvas where the results of one of the models are used in the other, studies that report data about the applications of the Kano model or the Business Model Canvas in the aeronautical and metalworking sector with no limitation in publishing year.

2.1.7. Screening process and studies included in review

Once the search of the databases was performed, the respective screening of the papers was carried out in two stages, first, based on title, keywords, and abstract, and second, in full text wherein the aeronautical and/or metalworking sectors were associated with the Kano and BMC models. The information on the papers resulting from the screening has been laid out below (see Table 3).

2.2. Business model canvas

The Business Model Canvas, developed by Osterwalder and Pigneur (2010), is a tool that has been used in business growth due to its ability to provide an overview of the complete business model (Raharja et al., 2020). Its range of application includes its use in technology-based ventures (Startups and/or Spinoffs) and in business ideas that arise outside of this framework.

Currently, BMC applications are focused on developing a general conception of an idea, which it then tries to connect with other tools that facilitate a process of continuous project improvement Prasetyawan et al. (2018), as an example in the search for coupling between BMC and other business and production tools, propose a connection between it and the Manufacturing System Design (MSD), which is defined as a system utilized to prepare the capacity of the production system in order to respond to changes in the size of production, processes, or other specifications. In this context, BMC engages with MSD in improving the cost structure of a project, seeking out efficient and flexible processes that address any market fluctuations. This application and variation of the traditional BMC model allows for it to be extrapolated not only in manufacturing systems but also in any idea or business venture that focuses on reducing its cost structure as an element and as a differentiating factor in the market.

Table 3. Articles included in the literature review.

Year	Author	Keywords
(2009)	Shahin & Zairi.	Quality, Kano model, prioritization, airline industry, customer satisfaction
(2015)	Basfirinci & Mitra.	Service quality, airlines, servqual, kano, Turkey, USA
(2015)	Meng et al.	Kano model, service quality elements classification, fuzzy theory
(2016)	C.-H. Wang & Fong.	Customer satisfaction, customer retention, fuzzy Kano model, importance-performance analysis
(2018)	Puspitasari et al.	Quality of aviation services, risk quality, KANO model, contentment, interest, Failure Mode and Effect Analysis
(2018)	Prasetyawan et al.	Business model canvas, Manufacturing system design
(2018)	Urban et al.	Airline business model, business model canvas, airline performance, cluster analysis
(2018)	Go & Kim.	In-flight NCCI, kano model, service blueprint, flying frequency, airline industry
(2020)	Jain & Singh.	Sustainability, sustainable supplier selection, fuzzy Kano model, clustering, type IV Kano model, sustainable Kano cluster

Source: Authors.

Urban et al. (2018) propose its use in the airline sector as a tool that enables them to establish key factors for the business model of companies in the sector. BMC was used to set up business strategies primarily at Low Cost Carriers (LCC) and Full Service Network Carriers (FSNC) as the readily recognizable clusters in the industry; however, within the research proposal, the BMC can be used to establish key activities, resources and relationships for clusters that are in the middle range of this spectrum limited by the LLC and FSNC stakeholders.

From the literature review, it was clear that the BMC has been used as a generator of the differentiating idea of the companies that use this model; it was determined, nonetheless, that although it has been utilized in technology-based startups, its use has yet not been carried out specifically in the field of design within the aeronautical or metalworking sector.

2.3. Kano model

The Kano model, proposed by Kano et al. (1984), is a tool widely used by automobile and electronics companies for the development of new products (Shahin and Zairi, 2009); however, and despite its wide use in an industry that offers tangible products, this model also allows for its application in the services market by facilitating the understanding of customer requirements and thus leading them to become satisfied within the process of value generation. In the context of the iron and steel industry, the application of the Kano model has been focused on establishing supplier selection criteria to improve the value-generating service through the improvement of the supply chain (Jain and Singh, 2020). Works such as those of Jain and Singh (2020) and Meng et al. (2015) evince the current use of the tool to improve the service offered, once the product quality requirements have been met; hence, the new approach of the model lies within the service provided by the companies and not only within the technical compliance of requirements related to the product.

In the aeronautical sector, Basfirinci and Mitra (2015), Shahin and Zairi (2009), Go and Kim (2018) and Puspitasari et al. (2018) draw upon the Kano tool to determine the quality attributes in the air transport service, understanding that service quality attributes do not have a linear relationship with customer satisfaction, and thus, being able to improve the services offered in the passenger air transport market. Authors such as Meng et al. (2015) and Wang and Fong (2016) make use of fuzzy logic linked to the Kano tool to enhance the uncertainty in their study and their understanding of the client because "it is more effective in processing the psychology of vagueness and uncertainty of clients than the traditional Kano model" (Meng et al., 2015).

As established, the Kano model is featured, in literature and in practice, as a model for understanding customer requirements in the metalworking sector with regards to a product and in the aeronautical sector for the improvement of the services provided. In passenger air transport, however, the implementation of the model in understanding the industry and its needs for the offer of design services is scarce, where the latter is focused as a need to be addressed for the strengthening of the industry. Understanding the sector and its requirements in the first links of the supply chain generates value to the subsequent links and the overall improvement of the products and services offered. From the literature review and the structured search strategy, it was clear that the hybridization of Kano Model and Business Model Canvas has not been reported in the literature, therefore, the presente research will significantly contribute to academia.

2.4. VOSviewer

VOSviewer is software for the construction of bibliometric networks and their visualization. This tool draws upon direct records from academic and scientific databases; such networks are built based on citations, bibliographic relationships or co-authorship relationships (Van Eck and Waltman, 2019).

In the literature review, this tool was used to develop a science mapping related to the topic being discussed (Kano and BMC model) in this section in order to determine the topics that, according to the records downloaded from the databases, are the ones related to the models mentioned above.

As a result (see Figure 1 and Figure 2), it was determined that, according to the bibliometric network, there are no nodes with words related to the descriptors used in the search equations detailed in previous lines or concepts related to the problem addressed by this research. In other words, the Kano and BMC models have not been used for the development of a technology-based product linked to the offer of design services based on CAD/CAM systems for the aeronautical and metalworking sector, since the pivotal concepts of "Business Model Canvas" and "Kano Model" are not associated with design concepts within productive environments of the aforementioned sectors. In addition, it has been concluded that there is no direct relationship between the Kano model and the BMC, so the implementation of this project will significantly contribute to academia as new knowledge is being generated.

3. Research method

3.1. Methodology of generalized hybridization for the Kano model and the business model canvas

The methodology described below intends to perform a hybridization of the Kano and BMC models in order to generate a solid and sustained business proposal that is useful in the decision-making process. Next, the methodology is described in a general manner.

3.1.1. Identification of attributes according to Kano results

An identification and organization of each attribute of the product or service is implemented with its respective classification of the quality categories resulting from the application of the Kano model (see Table 4).

3.1.2. Exclusion of attributes according to their Kano quality classification

It is necessary to take only the attributes that contribute to customer satisfaction into account since, within the BMC, it is not

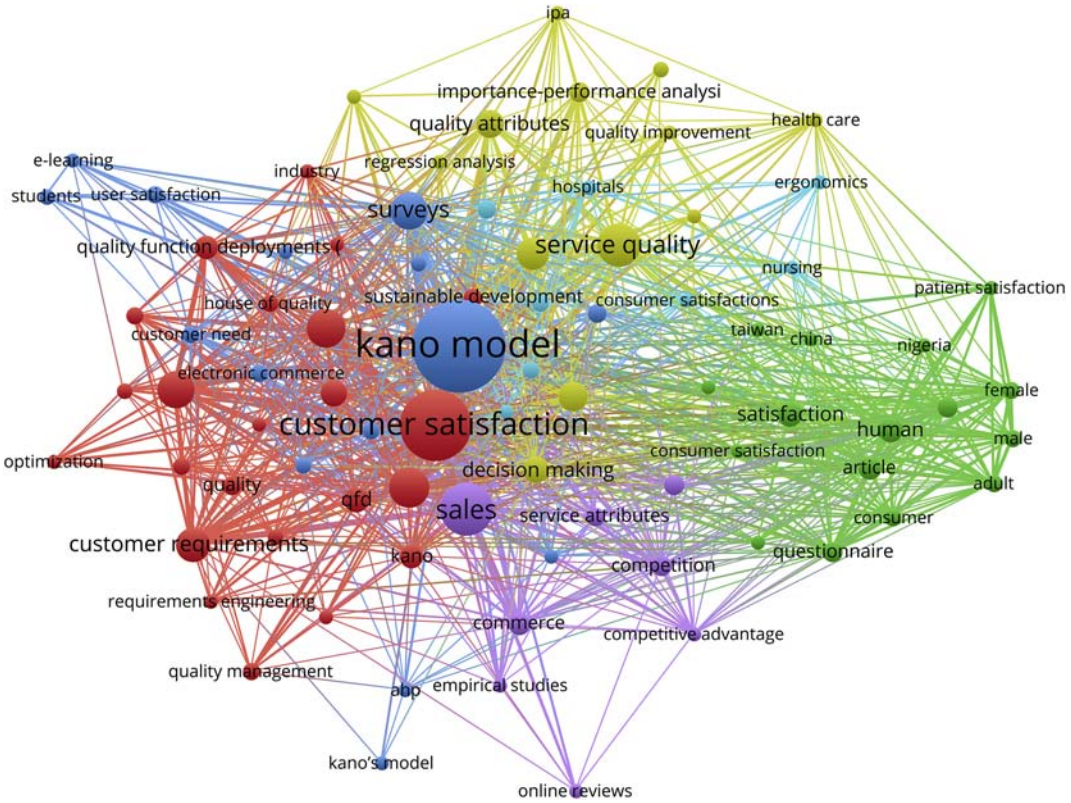

Figure 1. "Kano model" bibliometric network. *Source: Authors.*

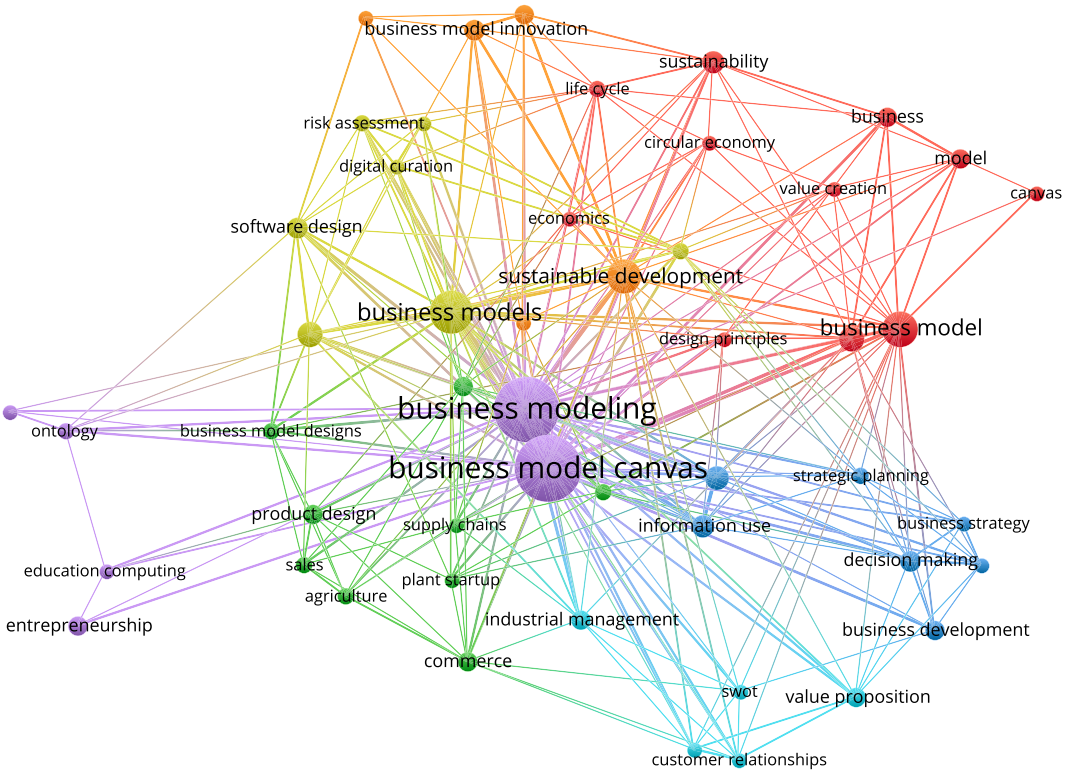

Figure 2. "Business model canvas" bibliometric network. *Source: Authors*.

effective to incorporate indifferent attributes and it is obviously harmful to incorporate reverse and questionable attributes; therefore, it is necessary to exclude any attributes that do not fit the above consideration.

That is, the exclusion is implemented to the indifferent (I), reverse (R), and questionable (Q) attributes. The indifferent attributes, as pointed out by Cheng et al. (2019), fail to generate satisfaction or dissatisfaction whether or not they are present. By the same token, it has been indicated that the reverse attributes, if present, will cause dissatisfaction in the clients because the absence of this attribute generates customer satisfaction. Lastly, as for the questionable attributes, it has been claimed that it is unclear if customers expect to get such attributes as they gave unusable responses due to misinterpretation of survey questions or from mistakes in completing the questionnaire (Bauk, 2015).

3.1.3. Organization of attributes that contribute to customer satisfaction in groups of the business model canvas

The Business Model Canvas is a visual method used to capture the business model of a company (Fritscher and Pigneur, 2014b), it is a technique that facilitates the understanding of what is to be delivered to the client and the way in which it will be carried out. In a rapidly evolving business environment, companies need a new method to help them rethink their business strategy (Fritscher and Pigneur, 2014a), that is why the BMC is emerging as an easy-to-understand method for all stakeholders in the business. The choice of the BMC lies in its ease of understanding because it effectively models explicit information on tangible and intangible aspects of the business and communicates this information in a highly accessible way to parties who are not familiar with the modeling technique (Fritscher and Pigneur, 2014a).

The BMC is used in processes of restructuring a business idea that is already underway, but also and with greater application to the creation of a new business or area of it, that is why the primary focus lies in the creation of new ideas for the offer of value to the customer; The BMC is an increasingly popular business design tool, especially for a startup and new business players (Prasetyawan et al., 2018). The investment process for this new business idea begins with the identification of a business opportunity and continues until the investment, establishing phases for this process such as: identification, preparation of the entrepreneur, meeting with the investor and feedback round (Sort and Nielsen, 2018). BMC is the methodology that facilitates the stage of meeting with the investor in the investment process. Additionally, a BMC is not unique and it can have multiple modifications for a particular business idea, thus generating a dynamic vision of the tool (Fritscher and Pigneur, 2015). On the other hand, Joyce and Paquin (2016), presents additional dimensions such as *life cycle environment* and *social stakeholders*, generating a greater vision of the impacts generated in society by the proposed idea.

BMC is based on a canvas consisting of 9 blocks (see Figure 3) divided into four groups: What?, How?, Why? and How Much? (Azevedo et al., 2018). This canvas is the graphic representation of the tool and is constituted as follows (León et al., 2016):

- The "What" group presents the *value proposition* block, which considers the value that will be offered to meet customer requirements.
- The "How" group consists of the blocks: *key partners*, those agents that will allow us to provide the added value we want to the client, *key activities*, those actions and events that are essential for the client to

Table 4. Example of attribute identification as per Kano results.

Attribute	Classification
X_1	C_j
X_2	C_j
…	…
X_i	C_j

Note. X represents the attribute of the product or service; "i" is the attribute taken into account in the application of the Kano questionnaire; "C_j" represents the classification result of Kano for each X_i having (A, M, O, I, R, Q) as options for "j". Source: Authors.

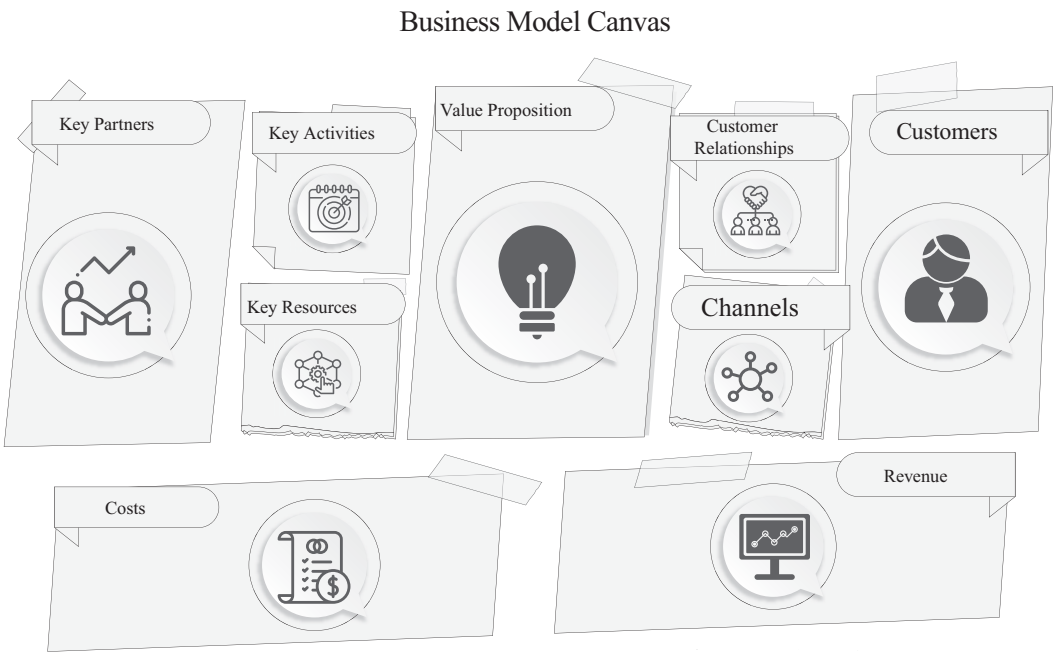

Figure 3. The 9 building blocks of business model canvas. Source: *Authors*.

receive the added value we want to provide and *key resources*, those elements that, together with the key partners and key activities, will allow to satisfy the requirements of the target market.

- The "Why" group is the set of blocks that focus on the business idea, whose requirements will be supplied. It is made up of the blocks: *customer relationships*, which establishes the links to be established with the target market, *customer segment*, which explicitly presents the target market and the center of the entire operation, and *channels*, that allows to establish the form of interaction between those who will offer the satisfaction of the clients' requirements and the clients themselves.
- The group "How much" is the group of blocks that specifies the costs associated with the idea, *cost structure*, and where we will receive money, *revenue streams*.

In this sense, to interrelate the two models, it is necessary to know in which ways they are alike. First off, what the Kano model seeks is to classify the characteristics of a product or service according to the impact they exert on customer satisfaction (Martí Bigorra et al., 2019); thus, it can be said that it tries to get to know the customer better and measure how they feel about the product or service. Secondly, as we aforementioned before, the BMC was created to establish a logical relationship between each of the components of the organization and all the factors that influence its success or lack thereof (Sort and Nielsen, 2018). It is important to point out that the BMC is made up of 9 modules, separated into 4 categories (What? How? Who? How much?) (Azevedo et al., 2018), which leads to the results given by the Kano model serving as a substantial input that is fed into the described groups and modules of the BMC thus achieving their enrichment.

It is relevant to make clear that said organization is carried out if the "X_i (C_k)" attribute corresponds to the group determined in an evident and logical way, taking both the knowledge and expertise of the researcher into account. Therefore, the attributes organization in each of the BMC groups will depend solely and exclusively on the nature of the product or service and its attributes evaluated in the Kano model, that is, the researcher will analyse the "X_i (C_k)" attribute that will be included at the BMC group, as follows:

In the group "What"; if the "X_i (C_k)" attribute solves a customer problem or satisfies a customer need through a distinct mix of elements catering to that segment's needs. In the "How" group, if the "X_i (C_k)" attribute allows creating and offering a value proposition, it is necessary for the successful operation of the company or it promotes the creation of a network of suppliers and partners that allows the business works. In the group "Why" if the "X_i (C_k)" attribute allows the establishment of a communication, distribution, or sales interface of the company with the customer segment (Relationships can range from personal to automated). The group "How much" if the "X_i (C_k)" attribute represents some fundamental characteristic of the cost structure or revenue streams in the business idea (Osterwalder and Pigneur, 2010) (see Table 5).

3.1.4. Distribution of attributes into blocks of the business model canvas

Being in a certain group of the BMC (What?, How?, Why?, How much?), the X_i (C_k) that can be disaggregated into the respective blocks of the model are identified, taking the fact that said distribution is made if the "X_i (C_k)" attribute corresponds in an evident and logical way to the determined block into consideration along with both the knowledge and expertise of the researcher and the respective theoretical considerations (see Table 6). The attributes of the product or service can be disaggregated into each of the BMC's building blocks, taking into account the following considerations proposed by Osterwalder and Pigneur (2010):

Table 5. Example of organization of attributes that contribute to customer satisfaction into blocks of the business model canvas.

Grupo BMC	Attribute (Classification)
What?	X_1 (C_k), X_2 (C_k), X_4 (C_k), X_6 (C_k), X_9 (C_k), X_{10} (C_k)
How?	X_3 (C_k), X_8(C_k)
Why?	X_5 (C_k), X_7 (C_k)
How much?	X_i (C_k)

Note. "C_k" reflects the Kano classification that contributes to customer satisfaction for each X_i, after applying the exclusion criteria; having (A, M, O) as options for "k". Source: Authors.

Table 6. Example of distribution of attributes into BMC building blocks.

BMC Block	Attribute (Classification)
Value proposition	X_1 (C_k), X_2 (C_k), X_4 (C_k), X_6 (C_k), X_9 (C_k), X_{10} (C_k)
Key partners	X_3 (C_k)
Key activities	-
Key resources	X_8(C_k)
Customer relationship	X_5 (C_k),
Customer segment	-
Channels	X_7 (C_k)
Cost structure	-
Revenue Streams	X_i (C_k)

Source: Authors.

In the "Value Proposition" building block, if the "X_i (C_k)" attribute contributes to customer value creation. Values may be quantitative (e.g., price, speed of service) or qualitative (e.g., design, customer experience). Other values may be Newness, Performance, Customization, Brand/status, Cost reduction, Risk reduction, Accessibility, Convenience/usability.

In the "Key partners" building block, if the "X_i (C_k)" attribute contributes for creating different types of partnerships (e.g., Strategic alliances between non-competitors, strategic partnerships between competitors, Joint ventures to develop new businesses and Buyer-supplier relationships to assure reliable supplies). In the "Key activities" building block, if the "X_i (C_k)" attribute contributes to the key activities required to the successful operation of the company (e.g., Production, Problem solving, Platform/network). In the "Key resources" building block, if the "X_i (C_k)" attribute contributes to the key resources which allow an enterprise to create and offer a Value Proposition, reach markets, maintain relationships with Customer Segments, and earn revenues (e.g., Physical, Intellectual, Human, Financial).

In the "Customer relationship" building block, if the "X_i (C_k)" attribute contributes to the establishment of different types of relationships with a specific customer segment, some categories of customer relationships may be: Personal assistance, Dedicated personal assistance, Self-service, Automated services, Communities, Co-creation. In the "Channels" building block, if the "X_i (C_k)" attribute contributes to the strengthening of any of the 5 phases of Communication, distribution, and sales Channels. The phases are as follows: Awareness, Evaluation, Purchase, Delivery, After sales. In the "Revenue Streams" building block, if the "X_i (C_k)" attribute contributes to the several ways to generate Revenue Streams (e.g., Asset sale, Usage fee, Subscription fees, Lending/Renting/Leasing, Licensing, Brokerage fees, Advertising).

The "Cost structures" building block, no "X_i (C_k)" attribute can be considered because this block depends directly on the Key Resources, Key Activities, and Key Partnerships of the business idea. In the "Customer segment" building block, no "X_i (C_k)" attribute can be considered because, prior to the establishment of the product or service attributes and the application of the Kano model, the customer segment should already be defined.

Table 7. Attributes of the design service offered by ABG LLC (digital platform).

Attribute	Notation
Low cost design	A1
Service swiftness	A2
Generation of construction drawings	A3
Generation of 3D drawings or video	A4
Preparation of specialized reports	A5
Technical visits towards the completion of the project	A6
Eye-catching, dynamic and interactive interface	A7
Service performance status control	A8
Simple form for requesting services	A9
Drawing as design guide supplied by customer	A10
Payments by Credit Card, PayPal, PSE	A11
Non-disclosure agreement	A12

Source: Authors.

3.1.5. Deployment and generation of the BMC canvas

The canvas of the BMC model is built taking into consideration the X_i (C_k) distributed into the blocks (*Distribution of attributes into BMC blocks*) and the other items, elements, aspects and data to be taken into account for the final structuring of the BMC. Lastly, the graphic representation of the BMC is made by filling in the canvas blocks.

4. Results case study ABG

This section shows the results achieved in the application of the Kano model for the creation of a technology-based product (digital platform) in order to offer design services of parts, tools, structures and construction requirements aimed at SMSEs in the aeronautical and metalworking sector in the city of Bogota, Colombia and the subsequent implementation of the generalized hybridization methodology of the Kano model and Business Model Canvas for the structuring of the new business line of the company Aerospace Business Group LLC through the BMC.

4.1. Population and sample

The population under study is made up of a set of 47 companies in the aeronautical sector in Bogota, Colombia referenced according to the aeronautical directory (ABC Aeronáutico of 2019–2020), within the area of structures, as this is the area that demands CAD/CAM design services due to their need for the manufacture of special components required for their operation; from the metalworking sector, the set is based on 96 companies supplied by the Bogota Chamber of Commerce as per the International Uniform Industrial Classification Code C2599 (CIIU, for its Spanish acronym).

In determining the sample size, Eq. (1) was used in the simple random sampling specified by (Parga Dans and Alonso González, 2018), taking into consideration that the population is finite, at a confidence level of 95%, a population size of 143 companies (47 companies from the aeronautical-aerospace sector and 96 companies from the metalworking sector), a maximum variability of the population specified p = q = 0.5, and a sampling error rate of 5%.

$$n = \frac{z^2 * N * p * q}{N * E^2 + z^2 * p * q} \quad (1)$$

Simple random sampling with a finite population. This calculates the sample size (n) for a finite population. A confidence level (z) of 95%. The size of the population (N), the maximum variability of the population (p = q = 0.5), while assuming a 5% sample error rate.

Then,

$$n = \frac{1.96^2 * 143 * 0.5 * 0.5}{143 * 0.05^2 + 1.96^2 * 0.5 * 0.5} = 104,2 \cong 105 \quad (2)$$

The sample size was 105 companies (see Eq. (2)) which represented the population described above.

4.2. Deployment of the Kano model

4.2.1. Construction of the Kano questionnaire

For the implementation of the Kano model, a questionnaire is utilized, which is made up of a total of twenty-four (24) questions, out of which twelve (12) are categorized as functional questions, while the remaining ones are dysfunctional questions (Wang and Fong, 2016), thus generating a functional-dysfunctional pair of questions for each attribute indicated

(see Table 7). An example of the general makeup of the structured questions in the questionnaire is outlined below (see Table 8).

4.2.2. Customer satisfaction and dissatisfaction coefficient

The Kano quality classification for each respondent was determined by merging the answers of the functional and dysfunctional questions of each attribute: "A" for attractive, "O" for one-dimensional, "M" for must be, "I" for indifferent, "R" for reverse, "Q" for questionable (Jain and Singh, 2020); see the decision-making method in Table 9. The classification of each attribute, according to the category, allowed for the establishment of the customer satisfaction or dissatisfaction level of said attribute through the satisfaction and dissatisfaction indexes (Go and Kim, 2018), respectively. By way of example, the manner of classifying the twelve (12) attributes proposed for the research is shown according to the answers of 6 respondents (see Table 10).

The satisfaction coefficient (see Eq. (3)) is an indicator that leads to awareness of the proportion of respondents who rated an attribute as attractive or one-dimensional in relations to the classification set of attributes according to the Kano model. This coefficient is set within a range from 0 to 1, with 0 being a nil classification by the respondents for the attribute within the "attractive" or "one-dimensional" options, whereas a satisfaction coefficient of 1 will reflect a top rating by the respondents indicating that they relate to this attribute as being fully "attractive" or "one-dimensional"; that is, the higher the satisfaction coefficient for the attribute, the greater importance will be awarded to the attribute towards the satisfaction of customer requirements.

On the other hand, the dissatisfaction coefficient (see Eq. (4)) is an indicator that swings within a range of -1 and 0, where a value of -1 in the coefficient implies that the attribute must be supplied in the development of the service so that the client displays an acceptable level of satisfaction; in other words, it is extremely important to include this attribute in the service offer so that it meets the minimum demands submitted by the client. If the indicator has a value of 0, it represents, in some way, the null importance of the attribute in satisfying the customer's requirements.

$$SI = \frac{A + O}{A + O + M + I} \tag{3}$$

$$DI = -\frac{O + M}{A + O + M + I} \tag{4}$$

4.2.3. Kano model results

It was possible to establish that, within the evaluated Kano model attributes (see Table 7), 75% of attributes were classified as one-dimensional, and 16.66% as attractive, while 8.33% were sorted out as "must be – mandatory"; therefore, none of the specified attributes for the study reached a different classification (indifferent, reverse, or questionable; see Figure 4). The "*simple form for requesting services*" attribute was the one with the highest unanimity at the time of its assessment, being classified as a one-dimensional attribute, whereas the "*Non-disclosure agreement*" attribute was met with the least unanimity, as it was classified as a "must be – mandatory" attribute. The satisfaction coefficients exceed the value of 0.5 in all attributes, while the dissatisfaction coefficients exceed -0.4, thus keeping in agreement with the classification of the attributes indicated above (see Table 11).

Table 8. Example questions from the Kano questionnaire.

Item	Satisfied (1)	It must be this way (2)	I'm indifferent (3)	I can live with that (4)	Dissatisfied (5)
1.a) How would you feel if the online platform offers low-cost design?					
1.b) How would you feel if the online platform doesn't offer low-cost design?					

Source: Authors.

4.3. Hybridization methodology of the Kano model and the business model canvas

4.3.1. Identification of attributes according to Kano results

Following the methodology proposed in Section 3.1. of this paper, the implementation of the Kano model was rolled out in order to ascertain the requirements put forth by the customers for whom the technology-based product proposed herein is intended. Accordingly, and thanks to the results obtained by this model, the quality attribute can be determined for each characteristic, which is key information for the development of the integration between the Kano and BMC models (see Table 12).

4.3.2. Attribute exclusion based on their Kano quality classification

No attributes have been classified as indifferent, reverse, or questionable.

4.3.3. Organization of attributes that contribute to customer satisfaction into groups of the business model canvas

According to the methodology generated in this paper, the attributes that contributed to customer satisfaction were sorted out into the groups that make up the BMC (see Table 13), as follows:

In the group "What" the attributes: A1 (A), A2 (O), A3 (O), A4 (O), A5 (O), A7 (O), A8 (O), A9 (O) and A10 (O). According to Gupta and Shri (2018) the kano model provides a mechanism to prioritize customer requirements for the development of satisfaction and loyalty and determines how attributes add or subtract value to the product or service. Therefore, the attribute "Low-cost design" (A1) was classified according to the results of the Kano model as attractive (A), that is, once this criterion is met, customer satisfaction increases multiple times (Jain and Singh, 2020). On the other hand, the attributes "Service swiftness" (A2), "Generation of construction drawings" (A3), "Generation of 3D drawings or video" (A4), "Preparation of specialized reports" (A5), "Eye-catching, dynamic and interactive interface" (A7), "Service performance status control" (A8), "Simple form for requesting services" (A9), "Drawing as design guide supplied by customer" (A10); were classified as one-dimensional (O), that is, from the customer's perspective, compliance with these requirements is directly proportional to the customer's level of satisfaction. The attributes classified under this group satisfy the needs of the customer segment through the offer of value propositions.

In the "Why" group the attributes: "Technical visits towards the completion of the project" (A6 (O)) and "Non-disclosure agreement" (A12 (M)); the latter classified as "Must-be", that is, it is an essential customer requirement that the product or service must have. The attributes classified under this group allow the establishment of a communication interface of the company with the customer segment. In the group "How Much" the attribute "Payments by Credit Card, PayPal, PSE" (A11 (A)) represents a fundamental characteristic of the revenue streams in the business idea.

4.3.4. Distribution of attributes by blocks of the Business Model Canvas

Once the attributes have been classified into the different groups of the BMC, they are classified according to the different blocks of the model (see Table 14), as follows:

In the "Value Proposition" building block, the inclusion considerations of the attributes are expressed in the contribution of these to customer value creation detailed in section 4.3.3. from this manuscript: "Low-cost design" (Cost reduction, Price, Accessibility), "Service swiftness" (Customer experience, Convenience/usability), "Generation of

Table 9. Assessment table for attribute classification.

		Dysfunctional				
		Satisfied	It must be that way	I'm indifferent	I can live with that	Dissatisfied
Functional	Satisfied	Q	A	A	A	Q
	It must be that way	R	I	I	I	M
	I'm indifferent	R	I	I	I	M
	I can live with that	R	I	I	I	M
	Dissatisfied	R	R	R	R	Q

Source: Authors.

Table 10. Example of Kano category for each attribute of the respondents' answers.

Respondents	*Attributes*											
	A1	*A2*	*A3*	*A4*	*A5*	*A6*	*A7*	*A8*	*A9*	*A10*	*A11*	*A12*
E1	A	O	O	O	O	I	M	O	O	A	M	O
E2	I	I	I	I	M	M	I	I	M	A	M	M
E3	A	O	O	O	O	O	O	O	O	O	M	M
E4	A	O	O	O	I	I	I	A	I	A	I	I
E5	A	O	A	A	I	A	A	A	O	A	I	O
E6	M	O	I	I	M	A	I	I	A	A	I	I

Source: Authors.

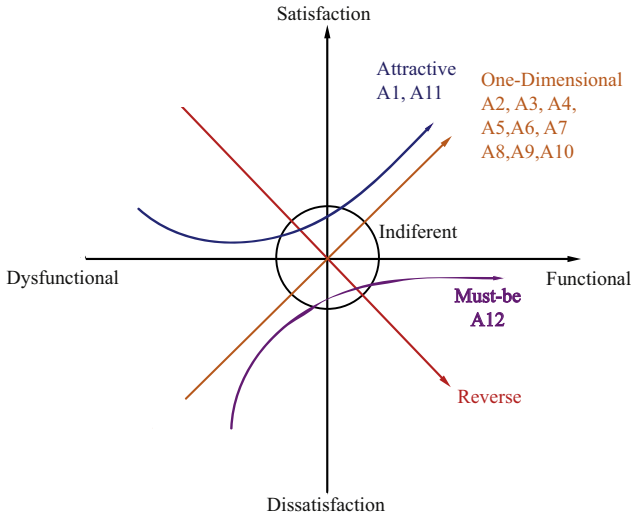

Figure 4. Graphic result of the Kano model. *Source: Authors.*

construction drawings" (Design, Customization), "Generation of 3D drawings or video "(Design, Customization)," Preparation of specialized reports "(Customization)," Eye-catching, dynamic and interactive interface "(Customer experience, Convenience/usability), Service performance status control" (Customer experience), "Simple form for requesting services" (Customer experience, Performance, Convenience/usability), "Drawing as design guide supplied by customer" (Design, Customization).

In the "Customer relationship" building block, the inclusion considerations of the attributes are expressed in the establishment of different types of relationships with a specific customer segment: "Technical visits towards the completion of the project" (Personal assistance, dedicated personal assistance) and "Non-disclosure agreement" (Personal assistance, Dedicated personal assistance).

In the "Revenue Streams" building block, the inclusion considerations of the attributes are expressed in the several ways to generate Revenue Streams: "Payments by Credit Card, PayPal, PSE" (Brokerage fees).

4.3.5. Deployment and generation of the BMC canvas

It was evident that the Kano model supplied and enriched the model into the BMC, where the different attributes were cataloged into the modules in the value proposition with 75%, income flow with 8.3%, and customer relationship with 16.66%. Upon an analysis based on the four basic questions of the BMC, the following rates of the attributes that generate customer satisfaction were determined: "What?" determined 75%, "who?" determined 16.66%, and "how much?" determined 8.33% (see Figure 5).

It is necessary to highlight the fact that generating value is a concept that includes not only the product or service offered but also the relationship with customers, prices, competitive advantages and other elements. On the other hand, the value proposition was fed substantially by the vast majority of results produced by the Kano model as well as the characteristics and classifications of these as attributes that can generate a competitive advantage for the organization.

In the BMC "customer relationship" block, the attributes of technical visits and non-disclosure agreements were entered. The former, if present, will improve customer satisfaction and, if absent, will cause a great deal of dissatisfaction. The latter, on the other hand, is a characteristic classified as "must be" since, if not present, leads to a high level of dissatisfaction. Finally, in the block of "Revenue Streams," the "Payments by Credit Card, PayPal, PSE" attribute was entered, which constitutes a key element to generate customer satisfaction because it is supported by digital tools.

5. Discussion and conclusion

The attributes of the technology-based product (digital platform) offered by the design service assessed by means of the Kano model contribute, as a whole, to customer satisfaction according to the satisfaction and dissatisfaction indexes outlined above, based on the fact that they are in classification categories such as attractive, one-dimensional or must be. The technology-based product must thereby have such attributes to ensure complete acceptance by the customer.

A high percentage of product attributes were distributed into the BMC "value proposition" block since, according to the criteria of the expert researcher and the respective theoretical considerations, such attributes were assessed in the population under study and are considered to be

Table 11. Kano quality categories and customer satisfaction and dissatisfaction coefficients for each attribute of the design service offered by ABG LLC.

Attribute	Distribution of the Kano quality categories						Total	Classification	SI	DI
	A	M	O	I	R	Q				
	(%)	(%)	(%)	(%)	(%)	(%)				
A1	46	13	30	15	0	1	105	A	0.731	-0.413
	(43.81)	(12.38)	(28.57)	(14.29)	(0.00)	(0.95)				
A2	18	14	55	16	0	2	105	O	0.709	-0.670
	(17.14)	(13.33)	(52.38)	(15.24)	(0.00)	(1.90)				
A3	29	8	43	22	1	2	105	O	0.706	-0.500
	(27.62)	(7.62)	(40.95)	(20.95)	(0.95)	(1.90)				
A4	23	8	49	23	1	1	105	O	0.699	-0.553
	(21.90)	(7.62)	(46.67)	(21.90)	(0.95)	(0.95)				
A5	26	12	41	23	2	1	105	O	0.657	-0.520
	(24.76)	(11.43)	(39.05)	(21.90)	(1.90)	(0.95)				
A6	34	11	39	18	2	1	105	O	0.716	-0.490
	(32.38)	(10.48)	(37.14)	(17.14)	(1.90)	(0.95)				
A7	20	14	48	21	1	1	105	O	0.660	-0.602
	(19.05)	(13.33)	(45.71)	(20.00)	(0.95)	(0.95)				
A8	28	12	45	19	0	1	105	O	0.702	-0.548
	(26.67)	(11.43)	(42.86)	(18.10)	(0.00)	(0.95)				
A9	14	15	56	18	1	1	105	O	0.680	-0.689
	(13.33)	(14.29)	(53.33)	(17.14)	(0.95)	(0.95)				
A10	30	9	47	17	1	1	105	O	0.748	-0.544
	(28.57)	(8.57)	(44.76)	(16.19)	(0.95)	(0.95)				
A11	43	24	21	16	1	0	105	A	0.615	-0.433
	(40.95)	(22.86)	(20.00)	(15.24)	(0.95)	(0.00)				
A12	29	32	23	19	2	0	105	M	0.505	-0.534
	(27.62)	(30.48)	(21.90)	(18.10)	(1.90)	(0.00)				

Source: Authors.

Table 12. Attribute identification based on Kano results for design services.

Attribute	Classification
A1	A
A2	O
A3	O
A4	O
A5	O
A6	O
A7	O
A8	O
A9	O
A10	O
A11	A
A12	M

Source: Authors.

Table 13. Attributes that contribute to customer satisfaction into groups of the canvas model for design services.

BMC Group	Attribute (Classification)
What?	A1 (A), A2(O), A3(O), A4(O), A5(O), A7(O), A8(O), A9(O), A10(O)
How?	-
Why?	A6(O), A12(M)
How much?	A11(O)

Source: Authors.

Table 14. Crossing of satisfaction contributing attributes with BMC blocks.

BMC Block	Attribute (Classification)
Value proposition	A1 (A), A2(O), A3(O), A4(O), A5(O), A7(O), A8(O), A9(O), A10(O)
Key partners	-
Key activities	-
Key resources	-
Customer relationship	A6(O), A12(O)
Customer segment	-
Channels	-
Cost structure	-
Revenue Streams	A11(O)

Source: Authors.

differentiated and innovative aspects. Therefore, the business idea achieves a greater likelihood of success alongside the "customer relationship" block, which is essential as it is a cornerstone of the business idea. This provides the customer with confidence through the establishment of suitable communication channels supported by digitalization and the use of information and communication technologies. It should be mentioned that, at the stage of distribution of attributes by blocks of the Business Model Canvas, a case may occur wherein an attribute is relevant for more than one block; hence, the researcher must make the decision if that attribute is to be included in a single element of the canvas or, on the contrary, whether it is to be positioned in such a way that it can go into both blocks.

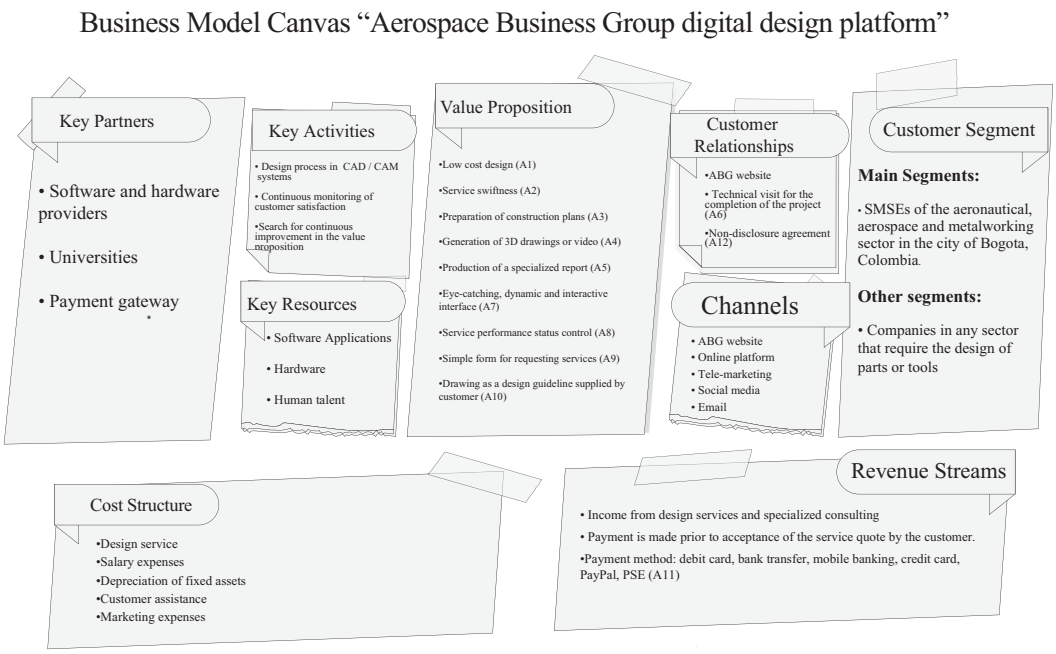

Figure 5. Business model canvas of aerospace business Group's new business line. Source: Authors.

Finally, this paper contributes to the existing research on business models, particularly in the different developments of the Business Model Canvas, by providing a generalized hybridization methodology of the Kano model and the BMC. This deepens the approach of each of the canvas blocks based on the opinion and preferences of the client at whom the product that will be offered within the business model is aimed.

It should be noted that hybridization supports the development of better structured business ideas, which hinges on an assessment of the viability of services or products, thus minimizing risks and maximizing opportunities.

It can be claimed that the BMC can be enriched through hybridization with the Kano model, as presented and sustained in this research, by correcting the deficiency that, at the time, was posited by (Capó Vicedo and Ortiz Rodríguez, 2015) with reference to the lack of depth in its data, so that it contributes to improving business decision processes regarding the offer of products and services, whether technology-based or of a different nature.

The Quality Function Deployment (QFD) is a planning and development method of a project, product or service considering the client's requirements (Wolniak, 2018), it is used to translate the client's needs and then meet the characteristics or engineering requirements in the design of the product or service (Ishak et al., 2020).

As a future development and improvement of our study, the QFD can be integrated with the kano model, where the use of the kano model allows to refine the requirements expressed by the client to simplify the process and QFD analysis in order to improve the quality of the product (Ishak et al., 2020), in such a way that the company can appropriately allocate resources aimed at prioritizing design characteristics (Ji et al., 2014) and consequently increase customer satisfaction by meeting their different needs (Neira-Rodado et al., 2020), by integrating the kano model with QFD, greater support for decision-making is obtained by prioritizing design features/actions whose effect will be reflected in the inclusion of said characteristics or attributes in the BMC thus improving the coupling of information regarding what is wanted for the business (Sort and Nielsen, 2018). Likewise, as a future task it can be considered as proposed by Wang and Fong (2016), Jain and Singh (2020) and Meng et al. (2015) the incorporation of the concept of fuzzy theory to the Kano model would allow handling the properties linguistics of subjective human perception of the traditional kano model.

This research, therefore, opens up the possibility of continuing to further delve into other research projects in different fields of business idea generation, and to obtain valid, reliable and in-depth data, which lead to the production of competitive strategies for penetration into new markets within the aeronautical and metalworking sector.

Declarations

Author contribution statement

Jorge F. Montenegro: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Pablo A. Contreras and Fabiola Sáenz: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

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Data availability statement

The data that has been used is confidential.

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The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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