

An approach to define formal requirements into product development according to Gestalt principles

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Abstract: The definition of form requirements has a close relation with customer psychological behavior with respect to what image is associated with the product. The present work investigates on the subject of form requirements definition of new products. The purpose of this study is to determine a preliminary model that can be used to help define form requirements based on the principles from the Gestalt school. This association is not addressed by any design methodology - the main reason for realizing this study. The model was tested in preliminary applications with several types of products from the home fitness market.

Keywords: product design, industrial design, design methodology, perception, Gestalt.

1. Introduction

Several discussions have been conducted involving competitiveness considering globalization issues. How to keep the business profitable, offering products and services that, beyond fulfilling the customers needs, provide differentiation and innovation, is one the major challenges faced by several organizations. Additionally, facilitation for purchasing facilities and extensive number of offers have increased the market competition, forcing companies to reduce costs and develop products that excel. Therefore, products that are easy to use, encompassing distinct functions and features, tend to be more successful than those with a more conventional presentation.

From this context, companies must provide quick and suitable answers for the market demands, which involve marketing, commercial department and, mainly, the product development office. Usually, the product development team receives from other sectors a document containing the customer needs and requirements that have to be fulfilled by the product to be developed. From this information, certainly there will be issues related to the form of the product (i.e. its appearance) and how the clients will perceive it. To define properly an approach to address form is an activity that can confer to the new product better chances to become a success. However, this is a complex task, since to represent the customer demands in terms of product's appearance, usually involves subjectivity, which often leads to a wide range of solutions.

A sound approach to define the form of a new product would be to follow a suitable design methodology. However,

design methodologies available in literature and practice do not deal with the form issues in specific and detailed steps. This can occur due to the difficulties that appear when establishing the metrics to assess form when it has yet to be created or defined. Even methodologies proposed by distinguished authors in the Industrial Design field do not facilitate this activity.

Sources of information (e.g. surveys, target-market and its values) can help to contextualize the form issues. However, there must be a point in the product development process where it is necessary to define which and how form parameters have to be considered.

Therefore, the main aim of this work is to propose a preliminary model that helps to define form requirements, considering an association of the laws of organization from Gestalt School with the data gathered from potential customers and targeted market.

This paper progresses as follow. Section 2 addresses how design methodologies deal with form issues at the early stages of design. A special attention is drawn to the laws of organization from Gestalt School and their relations with the product development process. Section 3 describes the proposed approach to encompass the Gestalt laws of organization into a stage of a systematic procedure for defining form requirements. An application of the model envisaged is described in Section 4. Finally, Section 5 contains the closing remarks about the findings in this work.

2. The formal requirements definition considering the main product design methodologies

This section presents the main features of the most representative design methodologies that can be found in literature and in a company, studied in this work. Additionally, product design requirements are analysed, focusing on the form requirements.

2.1. Design methodologies

Several product design methodologies have been suggested in literature, representing different approaches towards achieving a solution for an opportunity identified (ULLMAN, 1997; PUGH, 1991; ULRICH; EPPINGER, 1995; ROOZEMBURG; EEKELS, 1995).

One of the most popular design methodologies in academia and industry has been proposed by Pahl et al. (2005). This product development model shows a structured number of stages that follow a logic order of reasoning, and demand a set of information that have be distributed to each of them. The main stages are: i) task clarification: which the main objective is to produce a list with the product specification according to the customer needs identified; ii) conceptual design: this stage, seeks to define a conceptual solution for the opportunity identified; iii) embodiment design: from the conceptual solution selected in the previous stage, the dimensioning and material selection takes place; and iv) detailed design: at this phase, drawings are produced and detailed specifications are allocated.

The product development structure is directly related to the process involved: the systematic procedure in each stage starts with a qualitative nature and as the process evolves, it becomes more quantitative. Furthermore, since the stages are sequential, control mechanisms are of easy application. If a stage is not fulfilled the whole process is hindered.

2.2. Conceptual design according to design methodologies

The conceptual design is the stage of a design methodology where from the identification of essential problems via abstraction, by the establishment of function structures and definition/ combination of working principles a solution principle is devised (PAHL et al., 2005). At this stage, there is no need to detail components and specify technically a solution. Actually, the design principles of the new product that should be formulated and addressed (BAXTER, 1998).

The conceptual design stage demands creativity from the team members, since it encompasses a holistic thinking of the new product (i.e. from function to form point of view). Additionally, conceptual design can vary according to the design context, once it is closely connected to the market opportunity identified. For instance, if a company needs to develop a low end version of an existent product, there is no

need to formulate a new concept (ULRICH; EPPINGER, 1995).

The requirements definition plays a fundamental role when developing and generating conceptual solutions. However, abstraction, intuition, imagination and logic thinking also integrate this stage (BAXTER, 1998).

Iarozinski Neto and Favaretto (2005) present an example in Table 1 of four different levels of abstraction for a concept of a chair. The first and second alternatives allow a wider range of possible concrete solutions. The third and fourth, are almost the conceptual solution itself.

According to Back et al. (2008), there are several approaches to deal with conceptual design: i) employing pure intuition and talent; ii) with intuitive methods (e.g. *brainstorming*); and iii) systematic methods (e.g. morphologic matrix, catalogues). Additionally, it is emphasized that during this stage, a large number of concepts should be explored, in order to filter those that can fulfil the requirements list and also present distinguishable features (PUGH, 1991). Usually, conceptual design is a low cost activity and can be finished more quickly than other stages during product development (ULRICH; EPPINGER, 1995).

Also, conceptual design can be divided into well defined parts: i) function and functionalities development. This is a fundamental issue, since the product should be thought as implementing firstly, the basic functions, and next, the secondary ones. The function structure definition is a desirable output. To address functionalities to the product, systematic methods, company's best practices and reuse of information from previous developments should be employed; ii) form and industrial design definitions. They occur in parallel to the function clarification and representation activity, foreseeing the product form aspects

Table 1. Representation of a chair concept, considering different levels of abstraction from Iarozinski and Favaretto (2005).

Several levels for an abstraction of a concept for a chair		
1	Something to accommodate the body	
2	Something to accommodate the body with comfort	
3	Something to seat with comfort	
4	A structure with feet and a surface, that fits the body with comfort	

and their interaction with the final user. In this case, it should be considered issues of ergonomic, interface, symbolic and semantic character, related to the form of the product. Thus, the conceptual solutions generated should merge the functionalities envisaged with style demands.

Once the conceptual solutions have been defined, the assessment and selection activities should take place. There are several approaches to conduct them (PAHL et al., 2005; PUGH, 1991; STARKEY, 1992). Most of them, involve a systematic procedure associated with weight for each requirement. An overall result should highlight the concept with the best potential to realize the final product. Pugh (1991) states that this is an iterative process, where the merging of different concepts is not a rare occurrence.

Baxter (1998) indicates that the conceptual design stage can only be considered finished when a set of function principles, function structures and form aspects have been embodied into the product as a whole, satisfying the product design specification.

Finally, it is important to state that it is during conceptual design stage that several form and appearance issues are addressed, considering the defined list of requirements. However, it is not necessary to completely define the product's final form, but explore several aspects of the form treatment.

2.3. Product design requirements according to design methodologies and practice

The literature review (PAHL et al., 2005; PUGH, 1991; SHILLITO, 2001; ZALTMAN, 2003) has indicated that the form requirements definition usually occurs in a more qualitative approach. At this stage, because of its subjective character, product design is too complex to establish metrics for form definition. It is only possible to assess quantitatively the different form issues when the form features are properly conceived.

From practical cases examination the same scenario has been identified (SANTOS, 2006). However, the entry data are more specific and the context in which the product will be manufactured is more influential. Thus, several definitions are established according to the company's profile and its market positioning.

Thus, literature and practice approaches, deal with form requirement definition, but they present typical difficulties in determining them quantitatively. Also, when analyzing form requirements from literature, links to Gestalt principles have been identified. They will be treated in a separate section.

The main perception is that the psychological aspects of product form are decisive in the rendering of the product's image to the targeted consumers, from its form composition through colours and graphic arts to be used.

2.3.1 The importance of form product design requirements

To define adequately the form requirements is fundamental to conceive products that can be attractive to the clients (TJALVE, 1979). One of the first interactions that occur between the product and the customer is due to the form perception of the product (BACK et al., 2008). Because of that, it is so important to determine the product's visual language and fully understand how it is perceived by the customer.

According to Iarozinski Neto and Favaretto (2005), the form of a product is understood as the answer to the aesthetics, ergonomic and functional needs portrayed by the customer. For Baxter (1998) the product's attractiveness depends basically of its visual features, since the visual sense prevails over the others.

In a competitive market, where it is necessary to distinguish a object/product (i.e. call attention to it), the aesthetics features are strongly considered by the buyers. Very often, the aesthetics features are more actively considered during the buying decision than those of practical expression, which usually will only be fully perceived when the customer arrives at home. Löbach (2000) states that aesthetics features perform a relationship between the user and the product in the field of sensorial processes.

Finally, Kotler (1998) declares that the buyers will feel comfortable to pay a premium for products that are attractive in terms of form and aesthetics.

2.4. The Gestalt school

The Gestalt is a School of Experimental Psychology. The main names behind this school are von Ehrenfels, Max Wertheimer, Wolfgang Kohler and Kurt Koffka (GOMES FILHO, 2000). One of the aspects studied by Gestalt is the perception phenomenon, how it occurs and which are the associations involved. What has been realised is that what the brains perceives is different from what happens in the retina. Additionally, it has been understood that the human central nervous system shows a self regulatory dynamism that seeks its stability, aiming at organizing form aspects in coherent and unified scope. By means of several systematic experiences, the Gestalt researchers have formulated theories related to perception, language, intelligence, learning and memory, amongst others.

Considering the perception phenomenon, there is no absolute qualitative parameter (i.e. colour, brightness or form). There are relations between the parameters and each of them exerts influences on the others (i.e. the parts cannot be separated from the main scope and they cannot be considered isolated from others). The Gestalt School states that it is not possible to describe the things by the sum of their parts; thus, the parts are influenced by where they are and by what surround them.

The Gestalt theory suggests several answers on why the things are seen in a specific mode instead of the others. The objects look like what they appear to be due to the organisation of the field that is originated by the distribution of the proximal stimuli (KOFFKA, 1935). This organisation occurs in an internal process in the brain, following several patterns established. The proximal stimulus takes place in the physical field (i.e. external), where the retina receives the light from the object.

Table 2 shows a set of examples where the resulting optical illusions from one object are dependent on the other parts.

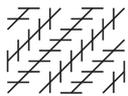
The industrial design should consider the product's image perception by the customer targeted. To fully understand this perception will allow a better addressing of product's form during the whole development. One approach to that, is to analyse the basic principles that rule the arrangement of the internal forces that structure the laws of organization proposed by the Gestalt School. These laws are derived from identified constants (also known as patterns) in the internal forces, which define the order on how the forms are psychologically perceived. Next section will present the laws of organization.

2.4.1 The laws of organization

The laws of organization, according to the Gestalt Theory, aim to explain the natural behaviour of the brain, when this acts during the perception process. The main laws (or principles) of organization are KOFFKA (1935):

- a) Closure: this law states that the good form tend to be seeing as a complete figure, that closes over itself. The closure concept is related to the visual final form, as the object presents a familiar pattern, even though the brain has received incomplete information.

Table 2. Representation of the dependency relations of one object considering other parts from Gomes Filho (2000).

Relations that illustrate the dependency of one part from another		
1	A rectangle looks smaller than the other, because there is a dependency relation of their positions inside the lines that configure a triangle	
2	The horizontal line above looks smaller than the one below. However, both have the same size	
3	Both inner circles have the same diameter. However, the circles around them causes the impression that they are of different dimensions	
4	The oblique lines do not look parallel, because the smaller lines are placed in several directions	

The closure occurs when the drawing of an object suggests a logic extension or finishing (e.g. an arc of 350° suggests a circle). Figure 1 contains a set of examples representing the closure principle. The geometric shapes are completed even if there are missing lines.

- b) Continuity: this principle describes the preference for continuous figures. This is related to the coincidence of directions or form alignment. If various elements point to one specific quadrant the final result will flow more naturally to this direction, which facilitates the understanding. Harmonic elements will produce a more harmonic object. Continuity in Figure 2, is better represented (i.e. more harmonic) in the arc on the right instead of the one on the left.

Figure 2 contains an example of the continuity principle from Gomes Filho (2000):

- a) Proximity: in this case, the objects are grouped according to the distance that separates each other. Those that are closely arranged are likely to be perceived as a group, more than those that are more distant. This reasoning is shown in Figure 3, where: in a) the small squares are perceived in a horizontal position, because they are nearer to each other in this direction. On the contrary: in b), since the squares are nearly positioned in the vertical direction, they are recognized as a vertical line.
- b) Similarity: this principle indicates that things which share visual characteristics such as shape, size, color, texture, value or orientation will be seen as belonging together. Thus, objects that are similar tend to appear as a group. These characteristics can be explored when it is intended to establish relations when composing a picture or object. From other point of view, if it is used improperly, it can become a hindrance to the visual perception. Figure 4 contains an example of the similarity principle.
- c) Pregnancy: this law establishes that gestaltic organization produces perception of the simplest and immediate figures, in which the perceptual data can be configured. Thus, the forms tend to be recognized by its simplest character, such as to address geometry features to an object, from known geometric forms. This is a natural simplification approach towards the perception process. The simplest the form, the easier to assimilate it. As an example, in a drawing the part naturally understood is the one which is more regular, requiring less simplification. Figure 5 shows a high level of form pregnancy since its attributes of balance and harmony are well resolved. On the other side, Figure 6 presents a low level of pregnancy composition, since it requires a lot of simplification in order to counteract the disharmony, disorder and visual pollution.

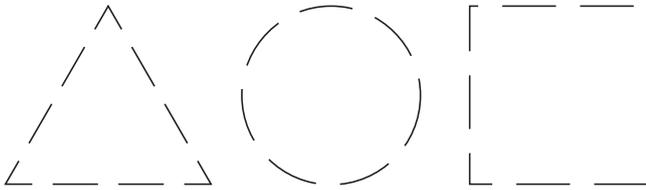


Figure 1. Closure principle by Kofka (1935).

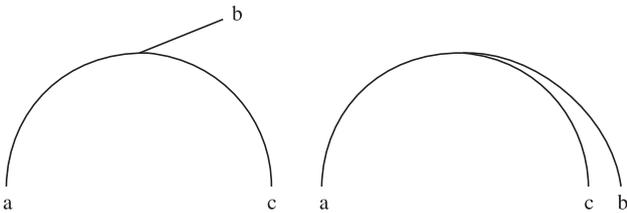


Figure 2. Example of the continuity principle from Gomes Filho (2000).

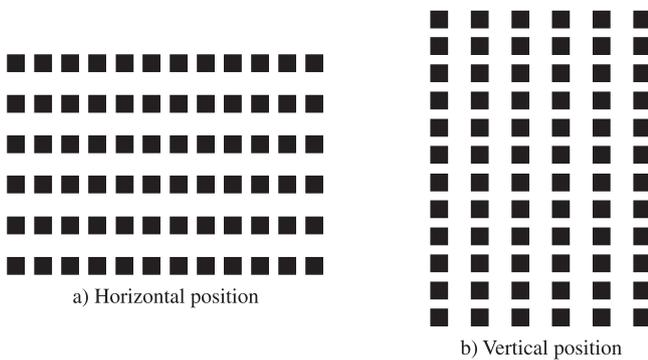


Figure 3. The proximity principle, according to Baxter (1998).

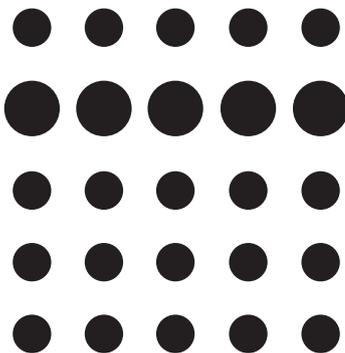


Figure 4. Similarity principle addressing size, from Gomes Filho (2000).

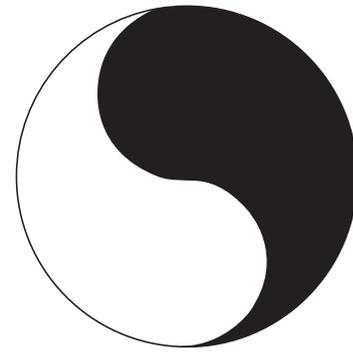


Figure 5. The pregnancy law. An example of high level of pregnancy, extracted from Gomes Filho (2000).



Figure 6. An example of low level of pregnancy, extracted from Gomes Filho (2000).

2.5. Opportunity identification

From the literature review on the Gestalt Theory and the laws of organization, it is observed that perception is a key factor on the way how the elements related to form, colour and texture, amongst others, are perceived by the human brain.

The examination of form requirements definition as implemented in literature and practices in industry has revealed that form plays an important role in the product's acceptance in the market, contributing for increasing the sales. All the approaches investigated present a gap when treating the form requirements because they address the issue in a broad manner. It has been observed that information from product and customer must be considered when defining the form language of the product (i.e. that attracts the clients and drives to the product a desirable character).

The opportunity envisaged in this context is to correlate the laws of organization from the Gestalt School with the form requirements definition (as seen in the design methodologies) during the product development process.

3. The model “form, function and Gestalt laws”

In order to formulate a preliminary model that can contribute to the form requirement definition inside a design methodology the following aspects from literature have been considered: i) the problem definition, considering form issues as stated in design methodologies; ii) identification of characteristics that exerts influences on the product’s form definition; iii) association of these issues with the laws of organization from the Gestalt School; and iv) literature review on the products available for the home-fitness market.

The form requirements definition and the proper form addressing during the product development process is mandatory for any company that develops and manufactures goods for a targeted market. Therefore, the main aim of the proposed model is to facilitate and ensure rigour to the activity of form definition at the early stages of product design.

3.1. The model description: considerations and presentation

To configure the proposed model (see an example in Figure 7), the following aspects are central for its functioning: i) a general rule formulation, representing the chosen targeted market; ii) a core part that contrasts issues about the potential customers and the aimed product. They are placed side by side and must be unique (i.e. the choice of an option implies that the other cannot be selected); iii) the Gestalt laws of organization that can be associated with those issues assigned in ii). The following sections discuss in more detail these topics, always having as a reference the home-fitness segment.

3.1.1 General rule

It is a statement, based on robust references and definitions that will drive the overall analysis and support the decision-making. The general rule should be derived from a consensual understanding of the topic undertaken. Therefore, a company can establish a set of general rules

that comply with its identity and supply consistent guidance for the design team.

3.1.2 Core part definition

In order to define the core part of the model, the first phase of the design process as proposed by Löbach (2000), has been carefully analysed. This stage, it is known as “*Preparation*” and focus its activities on the design problem analysis and the definition of its derived elements (see Table 3). This table contains the proposed sequence for the needed analysis that should be conducted during the product development. For the core composition, those analyses related to the form requirements definition (issues linked to the customer and the envisaged new product) have been depicted.

Next, examining these issues a set of associations can be proposed. An example is shown in Table 4.

From the identified associations and their connection with the definitions referred to each line, it is possible to establish different adjectives (usually, the left and right allowed limits), considering the targeted market and the aimed product. Table 5 the results for an analysis conducted for the home-fitness segment.

3.1.3 Gestalt laws associated

With the set of adjectives drawn, the next step consisted in relating each of them to a specific Gestalt law. For the case focused in the present study, the structure shown in Table 6 has been produced.

Figure 8 contains the structure of the model instantiated with information gathered for the home-fitness segment. Next, several rules and recommendations are described to assign the suitable options, according the required specifications.

To produce an overall scenario from the analysis performed, each option per line (ranging from 2 to 6, in Figure 8), must be identified, highlighting which of them is best fitted to the Gestalt laws, related to the family product

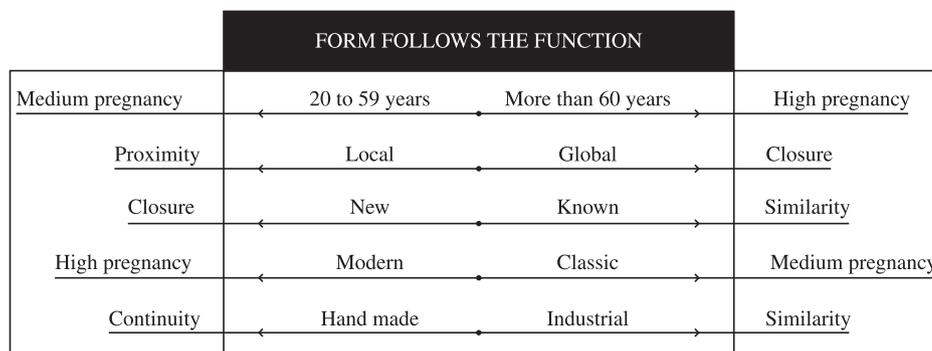


Figure 7. The diagram illustrating the model form, function and Gestalt laws.

Table 3. Representation of the initial stages of design process, according to Löbach (2000).

Creative process	Solving problem process	Design process (Product development)
1. Preparation phase	Problem analysis Knowing the problem Information searching process Information analysis	Design problem analysis
		Identified needs analysis
		Requirements of new product
		Social relations analysis (man-product)
		Relations with the environment analysis
		Historic development
		Market analysis
		Function analysis (practical functions)
		Structural (construction)
		Configuration analysis (aesthetics)
		Material and manufacturing processes
		Patents
		Product system analysis
Description of new product's characteristics		
Delivery, assembly, services		

Table 4. Set of associations derived from the analyses conducted.

Associations with the design process analysis		
Social relation analysis (man-product)	→	Target-customer
Relations with the environment analysis	→	Place
Market analysis	→	Image of the product to the target-customer
Configuration analysis (aesthetics)	→	Style
Material and manufacturing processes	→	Manufacturing strategies

Table 5. Set of adjectives related to the proposed associations (considering targeted market and aimed product).

Adjective that can be derived from the identified associations					
Target-customer	→		20 to 59 years old	↔	More than 60 years old
Place	→		Local	↔	Global
Image of the product to the target-customer	→	Can be:	Unknown	↔	Known
Style	→		Modern	↔	Classic
Manufacturing strategies	→		Hand made	↔	Industrial

Table 6. The identified design dualities and their connection to the laws of organization from Gestalt.

Relations for the opposite adjectives considering the laws of organization	
Adults - from 20 to 59 years old	Medium pregnancy: visual language and commands interface easily read and with low level of complexity
Old people - more than 60 years old	High pregnancy: visual language and command interface easily read
Local	Proximity: close elements are grouped depending the distance they are placed
Global	Closure: the fine form complete itself
Unknown	Closure: the fine form complete itself
Known	Similarity: similar objects tend to group themselves
Modern	High pregnancy: visual language and command interface easily read
Classic	Medium pregnancy: visual language and commands interface easily read and with low level of complexity
Hand made	Continuity: alignment of harmonic forms
Industrial	Similarity: similar objects tend to group themselves

Adapted from Ferreira (1986).

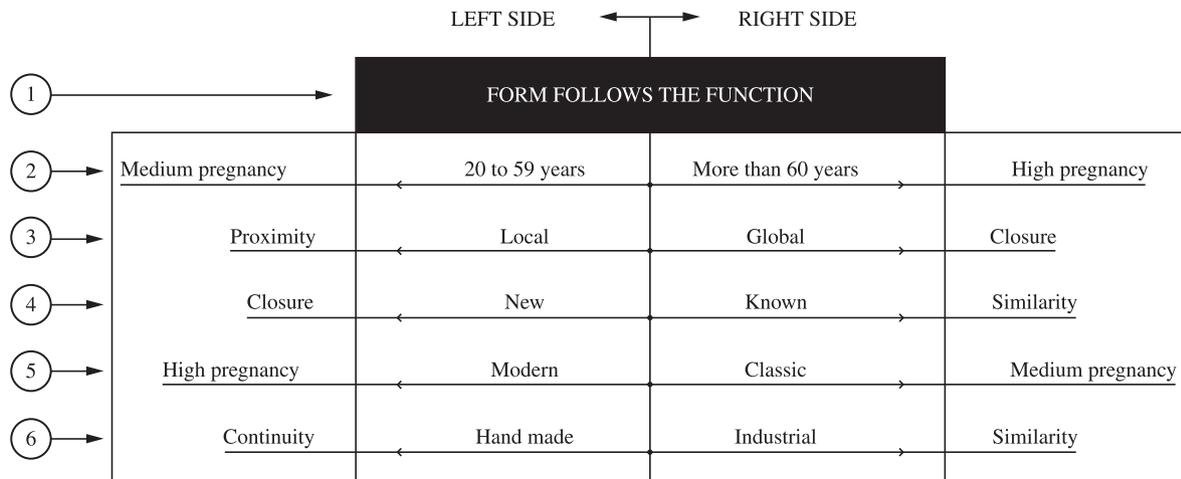


Figure 8. Instance of the form, function and Gestalt laws model, for the home-fitness segment.

envisaged. The marking must comply with the following recommendations:

- a) The guidelines established by the Marketing Department: the involvement of the whole organization when starting a new project for product development is of fundamental importance. Therefore, the Marketing Department can guide the specification process according to the company's strategic plan (BAXTER, 1998);
- b) Manufacturing structure available: the production technologies must be identified and evaluated. Those unavailable should be assessed for subcontracting;
- c) The design development team knowledge: the team must know the principles that support the Gestalt laws as well as the adjectives related to them.

3.1.4 The form, function and gestalt laws: using the proposed model

Once the main structure is complete, the design team should place a mark in the column of adjectives (i.e. left side or right side) that best fit the product design specification. It must be noticed that for each line only one adjective must be chosen, since they are conflicting.

For each marked line, there is an associated Gestalt law that should guide the form addressing for the related adjective. For instance: if the "industrial" option is marked, the associated Gestalt law is "similarity", which states that similar objects tend to group themselves. The adjective "industrial" can be translated into "producing in large scale and with same characteristics". Therefore, the final product can be similar in terms of form, varying its applied colours.

Considering the home-fitness market, the use of the model should consider the layout shown in Figure 8 and the following recommendations:

- 1) For this segment, form and function are issues on high demand. According to Back et al. (2008) the appearance of a product should reflect functionality and never hinder its efficiency. From this statement, it is established that: the form should follow the function definition: this assumption is fundamental in the proposed model and will guide the decision making process alongside the model usage. It is likely that other class of products will demand other rules;
- 2) Line 2 indicates the set of potential customers for the new product. Therefore, the design team should mark the option where the majority of clients are placed;
- 3) Next issue deals with the locality (i.e. where the product will be distributed and marketed). From the option chosen, it is possible to foresee those customizations that will be directed towards the particular aspects related to the trading of the product;
- 4) Following, line 4 refers to the products image to the target-customer. Thus, the decision involves either to maintain those forms that are recognizable by the customer or experiment innovative shapes;
- 5) The product style will be dealt in line 5. The form language can be, in this case, expressed as modern (i.e. contemporary and easily read) or classic (i.e. with more details and complex reading);
- 6) Finally, line 6 permits to check the demand for the new product, which will affect directly the quantity to be manufactured.

As stated, the lines from 2 to 6 in Figure 8, contain adjectives that are opposite to each other. The objective is to identify which of them are more suitable to the new product development, thus helping to define the form requirements.

3.2. The model considerations

In order to use the proposed model, the design team must be familiar with the Gestalt laws of organization. Additionally, the proposed model does not have to be the unique source for defining the form requirements but should be employed in parallel with other tools available for the product development, during this related stage.

Also, difficulties in using the model can arise when the Marketing Department cannot provide clear definitions about novel product to be distributed in a new market. The obtained results may not reflect the reality and conduct the process to a halt.

Finally, the proposed model can work in a reverse mode. That is to say: from the requirements the form is specified. Next, the suggested forms are assessed with the target-customer. This is a context where a company is willing to test a product base on its experience about the market. This procedure is defined by Back et al. (2008) as potential demand.

4. The application of the model “form, function and gestalt laws”

A preliminary application of the model involved products from the home-fitness market segment. This choice was due to the experience in developing the industrial design of this kind of products, in a company that creates and manufactures them. Thus, the existent body of knowledge, as well as the needed information to use the model, were factors that leveraged the application.

4.1. The home-fitness market segment

The products directed to the home-fitness market are devices for muscular and aerobics activities, designed to the users that prefer exercise their bodies in the comfort of their houses instead of going to an academy. The products in this class (e.g. ergo metric treadmills and bicycles; elliptics and wellness equipments) are characterised for: i) personal use; ii) low number of users. Also, these products can be employed for rehabilitation (from surgeries) or training (athletes or old people). Figure 9 shows a set of products related to the home-fitness market.

The main applications of each equipment are briefly described next:

- a) Ergo metric bicycle: it offers means for improving the respiratory conditions with low impact. Its use is recommended to pregnant, old people, overweight people and those with spine problems;
- b) Wellness station: allows toning and elasticity improving for several muscles, including those with specific purposes.

The products in this class, once addressed to a domestic user, should present show: i) customizable functions;



Figure 9. Main products for home-fitness available in the Brazilian market, according to Moviment (2006).

ii) form features that are in harmony with a domestic environment. Accessories (e.g. chest belt to monitor the heart beating and a safety key to be attached to the body) are also common in these products. Usually, the use of Gestalt laws of organization are not considered, resulting in lower pregnancy and without similarity.

4.1.1 Case 1: ergo metric bicycle

The product ergo metric bicycle has been analysed in order to understand the form issues that actually have been addressed

Therefore, Figure 10 presents the model “Form, function and Gestalt laws” filled with data that would better indicate which form requirements should be addressed.

The form requirements for the ergo metric bicycle

Thus, according to the options indicated in Figure 10 and the mappings with the Gestalt laws of organization, the following form requirements can be established:

- a) for the chosen target market, the commands interface should be easily read and with low level of complexity;
- b) since the product is addressed to a global region, the form should present elements of universal design, thus facilitating the use of the equipment by those diverse markets where it will be traded;
- c) the option for an original form can be translated as the need to be innovative in terms of shapes and structures. The product must address the form issues differently from any other in the same class in the market;
- d) the modern style envisaged imply forms that have to permit easy understanding and simplicity. Additionally, it has to be related to the up-to-date trends considering the form language presented by correlated products (such as electronic appliances and home furniture);

e) the option for an industrial scenario, means that the form of the product should allow the use of mass production techniques, avoiding components that are complex to manufacture and assembly.

From these considerations, the ergo metric bicycle to be developed should be directed to adult customers, that can be traded in several markets, with an innovative and modern appearance, which can be manufactured employing large scale production techniques. Once the form requirements are defined the product specification document can be completed accordingly and can be used for guiding the whole development process (e.g. as prescribed by PAHL et al. (2005)).

4.1.2 Case 2: wellness station

In this case, if the product would target people that are 60 plus years old, that aim to keep the muscle toning, the model should be filled observing other adjectives and Gestalt laws, as presented in Figure 11.

The form requirements for the wellness station

For the wellness station, considering the aimed target-consumer, the model signals for the following form requirements:

- a) for people that are 60 plus years old, the commands interface should be of easy reading, without complexities and a clear form treatment;
- b) the components and the whole product should present form aspects that allow quick understanding of the functioning principles, without need of formal training or complex instructions;
- c) the option for “known” can be translated into the need of using recognizable forms, that are similar to other products and can be assimilated by elderly people;
- d) the classic style implies the use of form that can be associated to products that present a sober and traditional language;
- e) the handcrafted option indicates that the product should present forms that can be implemented using low scale production techniques and small industries.

FORM FOLLOWS THE FUNCTION			
Medium pregnancy	← X 20 to 59 years	More than 60 years →	High pregnancy
Proximity	← Local	Global X →	Closure
Closure	← X New	Known →	Similarity
High pregnancy	← X Modern	Classic →	Medium pregnancy
Continuity	← Hand made	Industrial X →	Similarity

Figure 10. Model “form, function and Gestalt laws” applied to an ergo metric bicycle analysis.

FORM FOLLOWS THE FUNCTION			
Medium pregnancy	← 20 to 59 years	More than 60 years X →	High pregnancy
Proximity	← X Local	Global →	Closure
Closure	← New	Known X →	Similarity
High pregnancy	← Modern	Classic X →	Medium pregnancy
Continuity	← X Hand made	Industrial →	Similarity

Figure 11. The form requirements for a wellness station for people that are 60 plus years old.

In this example, the product demands form requirements for a well defined market segment, characterized by specific places and customers that present a familiar appearance, with conservative aspects and that can be manufactured in small batches.

4.2. The model performance analysis

The model “form, function and Gestalt laws” must be used as a complement to other product development tools available to the team. It should never be used as a unique source of information to define the form requirements during product development process. Additionally, it is imperative that the development team should be familiar with the Gestalt laws of organization.

If the marketing department cannot supply complete information about the targeted market difficulties might occur in using the model, since the obtained results cannot reflect the reality envisaged.

Furthermore, the model “form, function and Gestalt laws” can be used in a reverse mode, i.e. from the overall requirements the form of the product is defined. Next, the proposed form is assessed considering the results from the model and the correlation with the target-market.

This approach is suggested by Back et al. (2008) and it is known as potential level of demand. The basic procedure is to verify the product form considering the company’s experience in the aimed market.

5. Closing remarks

Develop novel products are fundamental for nowadays business survival. Additionally, an appropriate definition of product’s form, associated to other attributes, can be crucial to sell a product to the targeted customer. An approach to adequately address the products appearance can establish the difference in the market, mainly from concurrent companies.

From an extensive literature review considering the topics: i) design methodologies; ii) products form requirements definition (i.e. from literature and practical approaches); and iii) the laws of organization from Gestalt (which are well known in the academy and can configure a framework for form definition); it has been identified that psychological factors related to form issues have influence in the product development process.

This work proposes a model, called “form, function and Gestalt laws” that aims at helping the form requirements definition that relates the Gestalt laws of organization, the products form and its function. The model definition involved the following stages: i) analysis of form issues; ii) characteristics related to form that present duality; iii) form adjectives and their meaning; and iv) analogies between products and Gestalt laws of organization.

A preliminary application of the model has been conducted focusing on two home fitness products. The

results indicated that the model helps to identify the form requirements for a novel product.

The model should be used complementarily to other product development tools, since form and function are demands equally important in product development process.

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