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PRODUCT INFORMATION PROJECT: MULTIFUNCTIONAL HAMMER FOR REFLECTIVE NEUROLOGICAL ANSWERS

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Abstract: The object of this study was a Multifunctional Hammer for reflexive neurological responses, seeking to meet market needs, as the available offers risks of contamination to users and few functions. Designing a competitive product, amidst technological advances, increasingly requires the application of methodologies and tools dedicated to the project scope. There is a consensus that the initial phase, after planning, is the informational one, in which sets of activities with a beginning and an end are developed in order to solve a problem. In this perspective, this work, which was carried out in a discipline of the Masters in Biotechnology, at the Federal University of Tocantins, presents a systematization applied to that phase, aiming at the promising technical characteristics for the generation of a new concept for the product. With this, eight customer needs were investigated, which were transformed into requirements (technical language). These data were ranked using the "Mudge Diagram" tool and worked on the "1st Quality House Matrix – QFD", whose result presents the project requirements to be prioritized throughout the product development. Finally, the technical specifications were determined, which established measurable and attainable goals for each project requirement, defining the aspects to be avoided and the forms of evaluation, when implementing these characteristics in the product.

Keywords: QFD, Mudge Diagram, Requirements, Needs.

INTRODUCTION

Neurological tests were developed over a century ago to enable the assessment and identification of disorders that may be affecting the nervous system. Through relatively simple procedures, and generally non-invasive, it is possible to assess responses to stimuli from the brain, spinal cord and peripheral nerves. Depending on the type and extension of the lesion, a different or altered response is expected.

According to Gusmão et al. (2007), reflexes are automatic reactions that occur upon stimuli, are involuntary and do not depend on purposeful brain order. The stimulus travels through sensory nerves to the spinal cord and from there responses are transmitted through motor nerves, which arrive at a specific muscle structure, triggering the reflex.

The sensitivity test is used to assess the ability to respond to touch or contact with another material or structure. Whether it's a light, skin, or painful contact, the response must occur immediately. Lehman et al. (1997) state that neurological damage can change the patient's response to the stimulus caused.

The neurological test hammer was developed as a simple and useful tool in the search for neurological responses in different ways. Ebstein produces a hammer designed to research reflexes and sensibility, being produced in wood, ebony, ivory, whale bones, brass and other metals. The first hammer conceived by the medical community was that of John Madison Taylor, produced in 1988. Some time later, the French school, through its researcher Joseph François Félix Babinski, produced the Babinski hammer (Babinski, 1912; and Lanska et al.,). 1999). With an indefinite date, the Buck model appears, without a defined inventor. The three with different and specific functions evolved in format, materials, inclusion and exclusion of gadgets, but with the same objective, investigation of various types of reflexes and sensitivity.

The justification for the development of a new product is that what is available on the market offers risks of contamination to the health professional and the patient, and few functions. The project's problem lies in the characterization of the product available on the market, defining the possible type of test, which can increase its functionality with sensitivity tests for light and painful touch, pressure tests for adults and children, and reflection tests for children and adults muscle bundles.

METHODOLOGY

This work comes from classroom activity of the discipline "Product Design Methodology: Informational and Conceptual Phase - CBI721" of the Master's Degree in Biotechnology at the Federal University of Tocantins, so there were no Questionnaires and Interviews with groups of users according to Back et al. (2008) recommends. But in an analysis with students who researched the product's area of operation and application and professionals who use it, needs were identified that could be improved.

Customer requirements was one of the activities developed in the informational project phase, in which, after a search for information and a clear definition of the project problem, it was possible to have knowledge of the customers' needs, and only then could transform the information obtained in customer requirements, using team meetings as a tool, so that the team could transform more "raw" information into data with language more coherent with engineering, making the excess of information simpler and better understood. This process was carried out in a simple way using the verbs: "to be", "to be" or "to have" for the transformation of information, where, based on the need, one of these verbs is placed followed by the need (noun). According to Pahl et al. (2005), using this information deployment tool, the team can often transform a need into two or more requirements, or join redundant needs to just one requirement, making the information clearer for the next steps of the informational process. According to Back et al. (2008) requirements can be formulated by answering the question "What?", which refers to "what customers want in the product".

After defining the requirements of the customers, the Mudge Diagram was used as a tool for ranking the requirements, in which it was possible to carry out pairwise comparisons, where two questions must be asked in each comparison:

- Which requirement is most important for the product's success?
- How much more important is this requirement?

So, from this tool, it was possible to identify the degree of importance of the requirements found and the processes can be prioritized and continued. Soon after using the Mudge Diagram, the transformation of customer requirements into project requirements was performed, which emerged to meet one or more customer requirements, to transform the "what?" the customer needs in "how?" to meet this need, for this reason the project requirement must have a measurable characteristic, that is, a metric.

To rank the project requirement, the "1st Quality House Matrix - QFD" was used, as can be seen in Figure 1, to ensure the quality of each stage of the project, correlating the customer's wishes with the engineering characteristics, through of systematic methods, which provide solutions to group activities more efficiently.

RESULTS AND DISCUSSION

As a result of the analysis of the Mudge Diagram, a hierarchical table 1 of customer requirements was generated, identifying how much (%) each requirement is more important. Although the requirement for item 8 received a "zero" score on the Mudge Diagram, the project team decided to keep this requirement as it deems it to be an important feature for product development.

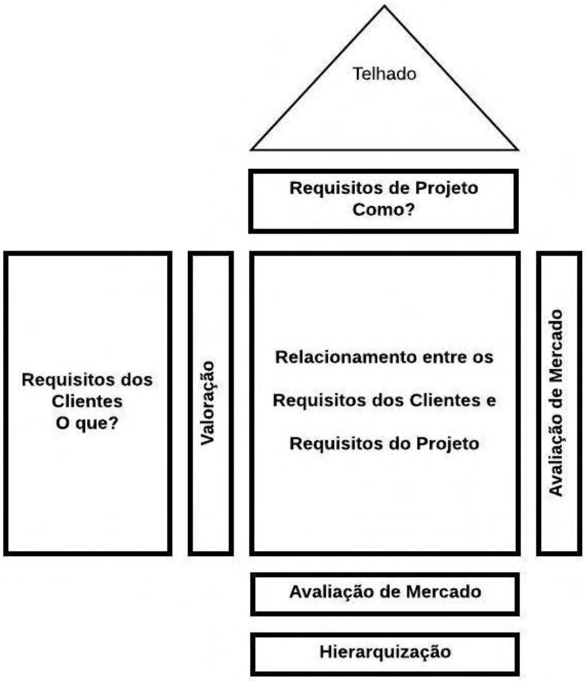

Figure 1 - 1st Quality House Matrix - QFD

Number	CUSTOMER REQUIREMENTS	VC RC	%VC RC
1	To be durable	18	30,51
2	To have more functions	13	22,03
3	To be easily asepsis	10	16,95
4	To be easy to maintain	8	13,56
5	To be easy to assemble	4	6,78
6	To Have weight consistent with its function	4	6,78
7	To have low acquisition investment	2	3,39
8	To have single storage for the product	0	0,00

Table 1 - Hierarchy of Customer Requirements

Following the QFD, the matrix roof was used, in which it was possible to verify the correlation between the project requirements, representing how much the application of one characteristic may interfere with the other.

In the body part of the Casa da Qualidade Matrix, the field relates the customer's needs with the project's requirements, as represented in the figure below. (Figure 2)

The step referring to the hierarchy, used the values obtained from QFD, where the customer requirements introduced in the 1st QFD Matrix, together with the valuation obtained in the Mudge diagram, were later correlated with the project requirements, in order to obtain indicatives (values) of how much each user need affects or is affected by a given project requirement. After the information relationships, equation 1 was used in order to obtain the hierarchy of the project requirements.

$$RP_j = \Sigma_i^n \, pru_i \, x \, v_{i,j} \; (i = 1 \; a \; n \; e \; j = 1 \; a \; m)$$
(Equation 1)

In which:

RP_j is the importance value of the requirement of the project j;

pru_i is the weight of percent importance of the i user requirement;

$v_{i,j}$ is the value of the relationship between project requirement j and user requirement i;

m is the total number of project requirements

The stage referring to the market assessment was performed only as goals to be achieved by the product, classifying each

RELAÇÃO DE DEPENDÊNCIA	FRACA=1 MÉDIA=3 FORTE=5		DIAGRAMA QFD – REQUISITOS DE PROJETO	Material resistente a produtos químicos	Número de componentes	Custo de produção	Peso	Ciclos de uso	Tempo de troca de peças	Peças de reposição	Embalagem
DIAGRAMA DE MUDGE – REQUISITOS DOS CLIENTES				1	2	3	4	5	6	7	8
				%	n	R$	G	n	s	n	n
				+	+	-	-	+	-	+	-
N°R	REQUISITOS DOS CLIENTES	VC RC									
1	Ser de fácil assepsia	10		5	0	5	0	3	0	0	3
2	Ter mais funções	13		5	5	5	3	3	5	5	3
3	Ter baixo investimento de aquisição	2		5	5	5	3	3	1	5	3
4	Ter peso coerente com sua função	4		3	5	5	5	0	0	3	0
5	Ser durável	18		5	5	5	3	5	3	5	0
6	Ser de fácil montagem	4		0	5	5	1	3	5	5	3
7	Ser de fácil manutenção	8		3	5	3	0	5	5	5	3
8	Ter armazenamento único para o produto	0		1	5	5	1	3	5	5	5

Figure 2 - House of Quality Matrix Body

requirement with values from 1 to 5, where the greater the better the requirement.

To meet this phase of the methodology, there is a division where the objectives are linked to the project requirements, thus defining more refined information as a target value to be achieved by the requirement, where a measurable one is created, which will be the form of evaluation of the goal, to highlight the success or failure of the goal. According to Back et al. (2008), this phase also takes into account constraints, which are internal and external factors associated with the project scope that limit the project management team's options. Examples of restrictions, product size, cost, legislation, among others.

According to IBC (2018), in order to better understand this phase of the methodology, it is essential to understand the goal, which is the objective in a quantified manner, that is, specific tasks that need to be performed regularly to achieve the determined objectives are temporal and strictly linked to deadlines, that is, they are the small actions that need to be carried out daily, weekly and monthly, in order to reach the proposed final objective, in an organized and planned manner.

The definition of the target value is a process of refinement (improvement), and this information proposed by Back et al (2008) better illustrates this issue, as shown in table 2, with the data obtained after all the procedures.

The project team met to discuss the project's measurables, after the QFD work carried out, where quantities were found and established to measure the project's needs, all of which were established together and with viable and achievable values.

CONCLUSION

Through the systematization and tools used, it was possible to obtain the technical information deemed necessary and promising for the development of a new concept for the "Multifunctional Hammer" product. Data that will support the method of functional synthesis to be used in the next phase, known as "Conceptual Project".

It was observed such importance for the methodology established by Back (2008) for the ultimate success in launching a product. Factors such as cost and material showed the need for prior planning to achieve an efficient and profitable product.

	PROJECT REQUIREMENTS	**UNIT**	GOAL VALUE	APPRAISAL METHOD	ASPECTS TO AVOID
1	Chemical resistant material	%	<90	Chemical test	Cost increase
2	Number of components	N	6	Counting	Excess component
3	Production cost	R$	60	Financial economic analysis	Quality commitment
4	Weight	g	150	To gage	To cause damage to the user
5	Use cycles	N	10000	Counting	To lose credibility
6	Part change time	s	10	To clock	Cost increase
7	Spare parts	N	6	Counting	Customer dissatisfaction
8	Label	N	1	Counting	Cost increase

Table 2 - Technical project specifications

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