IMPORTED AEROSPACE SUPPLY PROCUREMENT – COMPARISON BETWEEN THE AEROSPACE QUALITY REQUIREMENTS AND THE PROCESS USED IN GOVERNMENTAL ORGANIZATIONS AIMED AT THE RESEARCH AND DEVELOPMENT FIELDS

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Abstract. *– This work analyses and describes the procedures to procure imported aerospace material for technical projects inside the Brazilian Air Force. This case study explores the process used by Aerospace R&D General Command, a public institution acting in the field of aerospace research and development. During the process to describe products and services that will be purchased in Brazil or abroad, the user request the goods and services based on quality requirements that, most times, will not always be considered, due to the governmental administrative rules applied to such process. The application of the Quality Function Deployment (QFD) tools allowed the definition of logistics requirements to suppliers and for the adjustment of administrative processes inside the governmental organization. Besides that, its usage will, in the near future, improve the current regulation concerning administrative process for the procurement of material and services related to R&D, by using the quality assurance methods.*

Keywords*: 1. QFD 2. Suppliers' requirements 3. Procurement 4. Management 5. Aerospace Program 6.Research and Development*

1. INTRODUCTION

According to the Programa Nacional de Atividades Espaciais (National Space Activities Program) PNAE 2005–2014, the importance of qualification in the space technology domain is strategic for the Brazil sovereignty development, be it by the information that it yields, in the form of images and data acquired over the nation's territory, be it by the effect of the innovation that comes from the procurement efforts and from the development of technologies for the advantage of the industry, development of the country and in the benefit of the Brazilian society.

The effort spent by the PNAE in the development of probing rockets and launching vehicles, and in the public domain of its associated technologies, seeks the assurance of access to space capability. It is employed on the following applications: Earth observation, scientific and technological missions, telecommunications and meteorology.

The Program is developed in accordance with the Sistema Nacional de Desenvolvimento das Atividades Espaciais (National System for the Space Activities Development – SINDAE), established by the Decree nº1953, of July 10, 1996, resulting on the conjunction of various institutions: Ministério da Ciência e Tecnologia (Science and Technology Ministry - MCT), Agência Espacial Brasileira (Brazilian Space Agency - AEB), Instituto Nacional de Pesquisas Espaciais (National Institute for Space Research - INPE) and the Comando da Aeronáutica (Aeronautical Command), having as the sector executive organism the Comando-Geral de Tecnologia Aeroespacial (General Command of Aerospace Technology - CTA) and its military organizations: Instituto de Aeronáutica e Espaço (Aeronautical and Space Institute - IAE), Centro de Lançamento de Alcântara (Alcantara Launching Center - CLA) e Centro de Lançamento da Barreira do Inferno (Barreira do Inferno Launching Center - CLBI).

1.1 The quality on PNAE

In accordance with the PNAE, since many space projects are developed by means of international cooperation mechanisms, it can be noted today a growing tendency for the adoption of technical standards that are commonplace, as the ones established by the International Organization for Standardization – ISO.

Concerning the standards directed for the space sector, the Programa de Apoio às Atividades de Normalização e à Qualidade (Support Program for the Standardization and Quality Activities) – QUALIESPAÇO - was created, which goal is to elaborate normative documents and their use, concerning primarily, the quality, safety, and the reliability of products related with space activity.

Among its principles, those that stand out are:

3 - adoption of safety and quality parameters compatible with the international standards.

5 – integration of industrial and academic institutions to the body of institutions direct or indirectly involved with the execution of the PNAE.

6 – strengthening of the institutions, direct or indirectly involved with the execution of the PNAE, with emphasis on:

i. Development, qualification and human resources allocation in a manner to promote the technological innovation and the improvement of management;

ii. Usage of methods, techniques and tools for the management of knowledge yield in the extent of these institutions; and

iii. Usage of strategic and technological planning methods, techniques and tools for the space sector."

These principles are in accordance with the regulations stated in the ABNT NBR 15100:2004 – Sistema da qualidade – aeroespacial – (Quality system – aerospace) quality assurance model for design, development, production, installation and associated services.

1.2 The Cruzeiro do Sul Program and quality management system in a research institution

After the accident that occurred on the Alcântara Launching Center in 2003, the Brazilian Space Program went through reformulations when it has begun to consider that the conclusion of the Satellite Launching Vehicle VLS-1 project will be the starting point of a new stage for the Brazilian Space Program on its satellite launching vehicles segment.

Several analyses were made for configuration proposals for the new launching vehicles that will replace the VLS-1, besides the development and manufacturing of liquid propulsion boosters of medium and large sizes. This will allow to strategically place Brazil in evidence at a world level, with a development plan that spans for 17 years, concluding in the year of the Independence of Brazil Bicentennial (2022) anniversary. The studies resulted in a proposal program for satellite launching capable vehicles, dubbed the CRUZEIRO DO SUL PROGRAM, launched nationwide on October 24, 2005. The program is based on the definition of a family of satellite launching capable vehicles with the capability to attend the PNAE missions.

Five new vehicles named after the Cruzeiro do Sul stars constitute the launchers family: VLS ALFA, VLS BETA, VLS GAMA, VLS DELTA E VLS EPSILON. The program final goal is the development of a launching vehicle capable to place satellites up to the size of the Brazilian Geo-Synchronous Satellite (SGB) in geo-synchronous transfer orbit (GTO) up to the year 2022.

In 2005, after the institutional rearrangement of the previous Centro Técnico Aeroespacial (Aerospace Technical Center - CTA), which became the Comando-Geral de Tecnologia Aeroespacial (General Command of Aerospace Technology - CTA), it was elaborated the Management Guide Plan for the Aeronautical and Space Institute, which redefines its mission:

"To broaden the knowledge and the development of scientific and technological solutions to strengthen the Aerospace Power, through the means of Research, Development, Innovation, Aerospace Vehicles Launching Operations, Test Operations of New Defense Systems and Specialized Technological Services in the Aerospace sector."

In the midst of its new organization proposal, the Quality Management Manual – MGQIAE – revision 2, was reissued on November 27, 2006, which defines IAE's main directives regarding quality, referencing to the procedures that will be followed by all the Divisions/Coordinations.

According to the same manual, the IAE Quality Management System scope is distributed as follows:

Aeronautics:

- ***Research, Design, Development and Test of:***
  - ***-Materials***
  - ***-Air Defense Systems***
- ***Research, Design, Development, Production and Test of Aeronautics Systems.***

Space:

Research, Design, Development, Prototype Production, Integration, Tests and Operations related to Space Vehicles and Ground Support Resources.

In accordance with the same manual, under item 1.2 – APPLICATION, it is stated that all items of the ABNT NBR ISO 15100:2004 are to be adopted, with the exception of items 7.4.1 and 7.5.1.5.

1.3 Foreign procurement process

In the establishment of the requirements for the missions foreseen, at the initial phase of product design, the Aeronautical and Space Institute needs to procure materials and services abroad, since Brazil still does not have a space technology complex that fulfill these demands.

This type of procurement process starts with the outline of what the need is and where it will be acquired. For the cases where the materials/services have their origin abroad, CTA uses the logistical process of the Aeronautical Command, which allows participation in bid processes closer to foreign suppliers.

For these instances, the Aeronautical Command has a Military Organization in the United States of America, on Washington D.C., named Comissão Aeronáutica Brasileira em Washington (Brazilian Aeronautical Commission in Washington - BACW).

Established through the Decrees n° 19.447 of August 21, 1945, and 70.303 of March 20, 1972, it is the Aeronautical Command Organization goal to centralize, inside its acting field, the logistical activities of support services, management of agreements and deals, as well other activities that may be determined, of interest and responsibility of the Aeronautical Command.

In accordance with its Administrative Regulation, under its article four, it is entitled to the Commission the accomplishment of the management activities for material and services procurement for military use, carrying out previous market inquiries, in order to assure the best price, quality, delivery time and payment conditions.

Through a totally computerized international bidding process (*e-commerce)*, the BACW receives the requisitions of all the Military Organizations in the electronic format through its Internet site and, in accordance with the Bidding and Administrative Contracts Law nº 8.666/93, selects the companies that will take part on the bidding process.

When these companies first register on the CABW, they are sorted by the group of products by them commercialized, for instance, computer material, aeronautical material, armaments material, etc. The requests of these Organizations are inserted in the system under each group, letting the bidding process to randomly select the companies.

The structure of the Aeronautical Command divides the Military Organizations in Unidades Gestoras Responsáveis (Leading Management Units - UGR) and the Unidades Gestoras Executoras (Executive Management Units - UGE).

The UGR are the ones that posses the money contingency, however they do not perform the management directly, since they need the support of the UGE to perform the bidding process, payment to suppliers, payroll duty, etc.

In the case of the Science and Technology sector of the Aeronautical Command, the Grupamento de Infra-Estrutura e Apoio de São José dos Campos (Infrastructure and Support Group of São José dos Campos - GIA-SJ), is the UGE in charge of procurement inside the country, while the Brazilian Aeronautical Commission in Washington, is the one accountable for the procurement abroad for the Aeronautical and Space Institute, which, in this case, is the UGR.

Even that the Aeronautical and Space Institute Quality Management Manual, under its item 1.2 – APPLICATION, informs that item 7.4.1 – Procurement Process – of the ABNT NBR ISO 15100:2004 standard is not applicable, since the acquisitions are processed through the GIA-SJ, the possibility of application of the QFD method to determine the parameters for choosing suppliers, allows a better planning, improvement of the characteristics of products and/or services, and consequently, of the product that will be used.

2. OBJECTIVE

By using the QFD tool, verify the possibility of the selection process of suppliers, aimed to fulfill the requirements of imported materials/services that are applied on the aerospace sector, to be performed based on previously defined quality requirements, with the adjustment of the bidding edicts and, consequently, in a better product/service applied to defense strategic products.

3. METHODOLOGY

The QFD methodology first appeared in Japan in the sixties, being primarily used by Mitsubishi-KOBE Shipyard on ship manufacturing, being closely followed by Toyota and other Japanese companies. The first papers and publications

appeared in the seventies with Dr. Yogi Akao, Japanese scientist, a scholar of the subject up to now, and considered to be one of this methodology pioneers (Akao, 1996).

The work was developed through a field research performed in two Institutes belonging to the General Command of Aerospace Technology where, through an open and a closed questionnaire, sent to researchers, masters of science, engineers and technicians that work on S&T projects, the stages 1 and 2 could be executed, respectively called the Customers Identification and Listening to the Customer Voice, stages which among the rest, were suggested by Ribeiro *et al* (2001), where the intent is the development of the Quality Matrix (House of Quality), where the various steps to its formation are the following: **Customers Identification; Listening to the Customer's Voice – market research; Unfolding of the Requested Quality, Importance of the requested quality items (IDi); Strategic evaluation of the requested quality (Ei); Competition evaluation of the requested quality items (Mi); Preordination of the requested quality (IDi*); Unfolding of the quality characteristics (quality indexes); relationship of the requested quality with the quality characteristics (DQi); Up-to-date specifications for the quality characteristics; Quality characteristics relevance level (IQi); Evaluation of the difficulties to take action over the quality characteristics (Dj); Competitive evaluation of the quality characteristics (Bj) and Arrangement of the priority of the quality characteristics (IQj*).**

In the open questionnaire, composed of four questions, it was asked what the customer considered to be important when a supplier is chosen; which information he expects to receive from the supplier during the pricing request; which criteria is important for a company to accomplish when items are being supplied and finally, after the delivery, what is expect from the "post-sales" service. In this manner, a tentative to embrace the purchase process as a whole was tried, since the beginning, at the pricing request, up to the technical support, after the fulfillment of the sale.

After this first research, it was moved on to the closed questionnaire where it was noted the importance imputed by the customers for the secondary unfoldings and, after that, the tertiary unfoldings.

4. RESULTS AND DISCUSSION

From the answers obtained through the questionnaires, Table I was elaborated with the Unfolding of the Requested Quality by the Customer, where the tertiary level characteristics were transformed in the House of Quality heading. Through this representation, which is one of the seven quality management tools, it was identified in a crescent degree of detail (primary, secondary and tertiary) all the items that have intertwined relationship. (Moura, 1994)

Table 1. Unfolding of the Requested Quality by the Customer

LEVEL		
PRIMARY	**SECONDARY**	**TERTIARY**
Product Definition	Product quality	High durability and reliability Correct technical characteristics Up-to-date technical manuals Compatibility with the application
	Relationship	Company integrity Fulfillment of the order requests Present clear information Quick-response to inquiries Fast and easy communications channel Knowledge of the customer
	Technical Support	Adequate service Quick response to routine inquiries Service evolution feedback Spare parts Efficient equipment training In Brazil technical support
	Price	In accordance with the market practices Fulfillment of the delivery dates Acceptance of the customers purchase conditions

In the course of the research, it was verified that in the definition of the Corrected Importance of the Requested Quality (IDi*) items, high durability and reliability of the items have the highest importance with respect to the others. This demonstrates the importance given to this issue when of the definition of the item to be supplied. It were also specified the quality indexes currently in use for each requested quality, as shown in Table 2.

It can be verified that acquisitions made abroad suffer with the low representativity of the foreign companies in Brazil, which can be verified by the small percentage of quick-responses for the inquiries and feedback.

Table 2. Unfolding of the Requested Quality Characteristics by the Customer – partial

REQUESTED QUALITY	QUALITY CHARACTERISTIC	PRESENT SPECS
High Durability and Reliability	% of occurrences of problems/year	1%
Correct technical characteristics	nº of customer complaints due to the lack of information	Low
Up-to-date technical manuals	nº of modernizations	1/year
Accomplishment to the order requests	% of deliveries contrary in relation to the order	10%
Quick-response to inquiries	% of inquiries replied inside a one week time	40%
Easy and fast communication channel	Access time to the customer	100%
Knowledge of the customer	Visits made to customer/year	6/year
Service evolution feedback	% of the information response by the suppliers	40%
Spare parts	availability of the item in stock	70%
Efficient equipment training	relation between practical/theoretical training	Satisfactory
In Brazil technical support	nº of technical representatives in Brazil	20%
Fulfillment of the delivery dates	% of late delivery dates	30%

Based on the Quality Characteristics it was performed the arrangement by priority through the Corrected Importance Index (IQj*) where it was verified that high durability and reliability, correct technical characteristics, in Brazil technical support and training, represented more than 70% of the corrected importance (22%; 18%; 17% and 15% respectively). These topics are important information that should be contained in the bidding edicts that concerns materials/services for the S&T sector.

Nowadays, after the companies that take part on the bidding process have sent their respective quotations to the Brazilian Aeronautical Commission in Washington, there is the analysis, by the solicitant, if the offered product is in accordance with what was specified. What happens is, since the bidding edict do not observe all these quality parameters, it is determined as the winning bid the company that offers the material/service by the lowest price.

The suppliers' benchmarks were not evaluated since the bid process was performed based on acquisitions made abroad, where those companies are the only suppliers for the materials/service in question.

5. CONCLUSIONS

With the QFD technique application, it was glimpsed the possibility of a better selection process of the companies that take part on the bidding process for the procurement of imported materials/services that serve the aerospace sector of the Air Force Command, where it was verified the following:

- the need for the use of quality characteristics when selecting companies that will receive the bidding edicts for items applied on the strategic defense area;
- the lack of relevant quality characteristics on the bidding edicts;
- the quality criteria allow a better analysis of the possible bid winning proposals, before the adjudication to that winner;
- the need of the improvement of the federal law in current use, regarding the bidding procedures to be followed for the procurement of materials/services applied to the strategic defense area; and
- more participation of the materials/services solicitants during the evolution of the bidding process.

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