USE OF MANAGEMENT TOOLS IN A PROJECT OF UNIVERSITY EXTENSION: THE CASE OF STAFF SKYWARDS AERODESIGN-UFV

Tatielle Menolli Longhini tatielle.longhini@ufv.br
Idamar Cobianchi Nigro idamar.nigro@ufv.br
Federal University of Viçosa (UFV) - Peter Henry Rolfs Avenue, unnumbered, University Campus, Viçosa-MG.

Eliene Oliveira Lucas eliene.lucas@ufv.br
Federal University of Viçosa (UFV) - Peter Henry Rolfs Avenue, unnumbered, University Campus, Viçosa-MG.

Abstract. *The complexity of operation in organizational systems that do not have a properly configured system management has emerged as a negative aspect to the achievement of competitiveness. Given the requirements of SAE Aerodesign Competition, who put the students in direct contact with the real world of professional acting, and the continuing necessity to innovate procedures and methods for developing efficient and effective of project (marked by the multidisciplinar character) the Skywards Aerodesign UFV team, undertook the implementation of a set of management tools - whether the Development Project and Product, Knowledge Management and Project Management - resulting in a number of competitive advantages to the team. Thus, through an exploratory research, by introducing features of a technical survey, focused on solving the problem of global analysis: project management Aerodesign Skywards through processes.*

Keywords: *Aerodesign; Development Project and Product ; Management Tools; Knowledge Management; Project Management; competitive advantages; innovation; exploratory research.*

1. INTRODUCTION

The engineer's training and regulation of their practice should take into account the needs of the nation and the welfare of society. Based on this principle, the process of training and professional qualifications of the framework requires a greater knowledge, combined with the ability to analyze more deeply about the political, social, legal, cultural, economic and environmental, and other skills required to live in the modern world (Cordeiro et al, 2008).
The Department of Mechanical and Production Engineering (DEP), Federal University of Viçosa (UFV / MG) administers studies of Production Engineering and Mechanical and present a wide spectrum of objectives that include a set of skills and expertise for each courses. The mechanical engineering course aims to train engineers of high technical and methodological knowledge related to the various branches of physical science, chemistry and mathematics, able to carry out the activities of design, design, construction and maintenance of machines and mechanical systems considered the economics, management, safety and environment, and able to respond quickly to the demands of the various productive sectors and society with ethics and social responsibility. Meanwhile, the Course of Production Engineering seeks to train professionals capable of developing the design, implementation, operation, improvement and maintenance systems and integrated production of goods and services, involving men, materials, technology, information and energy, that associate the skills to specify, predict and evaluate the results of these systems on society and environment, supported by expertise in mathematics, physics, humanities and social sciences and the principles and methods of analysis and engineering design.

To meet the objectives established in each undergraduate teaching projects in the DEP / UFV, actions are developed whose intent is to combine efforts in the fields of Education and Research. These actions find to accommodate the specific goals of training future professionals complementing the set of skills and competencies that are developed in the areas of the curriculum for each undergraduate course. In the Extension field actions are driven by projects: Aerodesign, Baja, Solutions Consulting Junior Company of Mechanical Engineering and Production, CREA Junior Engineers Without borders, directory and Academic Center, in addition to the Tutorial Education Program of Production Engineering (PET - Production).

The performance of teachers and students in extension projects stimulates, among the many desirable skills for future professionals, the prospect of teamwork. For Castells (1999 *apud* Borchardt, 2009) is expected of any professional training, a competent performance very close to the state of the art of existing knowledge in ways that can address current problems and future is in the workplace or in society. It is therefore essential to work the concept of learning in several dimensions (Teaching and Research) that are present in the university and thus seek to complement the technical training of future professionals providing, through projects, similar terms to be faced in everyday professional organizations: interaction with others, set goals and objectives to be met, people management and processes, in addition to real problems restricted resources. The preparation of projects that simulate a professional environment can complement the skill set desirable in future work.

This study aimed, in general, the proposal for the project management of Skywards Aerodesign - UFV to the SAE Aerodesign competition, which aims to integrate the project to the objectives proposed in the pedagogical projects of Production Engineering and Mechanics. Specifically addressed will be a range of issues associated with management such as process management and quality of knowledge, development of strategic planning and product design. The prospect of this approach is to support the group's goal of Skywards Aerodesign UFV-development in the university setting, a radio-controlled aircraft and unmanned.

2. PROPOSED METHODOLOGY

For Gil (2005), there are several reasons to perform a search, among them the lack of information that respond to a problem or else the clutter of information is such that it needs some sort to be related to a problem. It also affirms that the fundamental objective of the research is to find answers to problems through the use of scientific procedures. Also establishes a set of criteria for classifying a search. The work developed here, takes on characteristics of a research project with technical features of an action research in according, in function of proposition, find a collective problem solving: the management Skywards Aerodesign project through processes.

3. BASIC CONCEPTS

3.1 PRODUCT DESIGN AND DEVELOPMENT

According to Pahl (2005), the procedure that enables the discovery of new product goes through a methodical approach, which requires better management of costs and time for planning and product development.

Can we predict, briefly, what steps inherent in the definition of design of any product or service are: the concept of the product or service; sorting concept, preliminary design of the product or service, assessment and improvement of the preliminary design, prototyping and final design.

Under these conditions defines the methodology for the production of light aircraft and subsonic developed by Barros (2000), which determines that the first four phases of project development - requirements and specifications, preliminary draft and design - are up as generic steps and to the overall project management, while the three established - fabrication, ground testing and flight tests - appear to be necessary for the adequacy of conceptual design to real flight condition.

Specifications and Requirements

At this stage, it is necessary to assimilate perfectly the requirements of competition, set annually by Regulations issued by the committee of SAE Aerodesign Brazil, responsible for such. So, it comes to the aircraft with their respective characteristics through the missions to be fulfilled - the predictability of performance characteristics of aircraft, whether for departure, taxiing and takeoff, climb to the altitude of operation, navigation, normal descent, and landing traffic - deprecated and performance - marked mainly by the maximum speed in level flight, maximum rate of climb, the power delivered by all rotary-wing, distances takeoff and landing, maximum life - finally setting, project development itself - contemplated the use of the resources involved to do so, be they financial, human and terms for you to set a constructive development, the final cost of the aircraft, maintenance requirements, the flying qualities and the level of passive safety.

Preliminary Studies and Steps Draft

According to Barros (2000), this step philosophies to design the project itself appears so often antagonistic, making it impossible to gather the best conditions in terms of aerodynamics, and electrical performance, stability and control and structures. It is necessary to define the project's set of priorities for establishing the scope to be developed, meeting, so many aspects such as easy constructive, issues of safety and maintenance of the aircraft itself must be evaluated without being penalized or another feature.

Once defined the scale of priority, the project reaches a stage which it can provide both the general configuration and the working methodology to be employed, as a form of optimizations are lifted, in conceptual and operational levels, and a correct allocation resources, addressing, finally, that which converges to improved design.

The definition of project scope of an aircraft order to discern and compare, between existing projects, characteristics apply to what will be developed, if it is not purely innovative settings, which start from nothing. Innovate also understand how to act to improve what already exists, building new projects. Thus, it is important to gather indicators - whether through charts and graphs - that facilitate the comparison of parameters and provide a choice of which are aligned to the requirements. This in itself does not guarantee that the aircraft is necessarily good, but conditions for such convergence.

It is worth noting that the technical aspects, together with the aspirations of a talented designer, includes the anointing of knowledge in the art itself.

- Fact Sheets aircraft - three views, photos and relevant technical data, enabling the execution of an overall evaluation.
-Comparative table

- Estimation of Basic Parameters
- Comparative methods
- Graphics-linear (parameter versus aircraft)
- Graphics parametric (parameter versus parameter versus aircraft)
- Contraposition views on the same scale plant.

Project step

Once completed the preliminary phase, we proceed to detailed design, through detailed calculations and detailing of components that should be used in aircraft. As a result, specific calculations are proceeded in aerodynamics, performance and stability and control, in addition to scanning of roll control, recovery into a tailspin, directional stability and control, structural design and calculation of charges - with the latter to consider the various alternatives to loading the aircraft which will be subject, either aerodynamic load, weights, inertia loads and loads of reaction with the soil. Barros (2000) says that the establishment of these parameters is given by reworking the design until the final configuration to reach a satisfactory result.

3.2 KNOWLEDGE MANAGEMENT

According to Von Krogh (2001) Knowledge Management consists of a discipline that has attracted progressively organizational significance over the past decades, emerging with a large recovery area. In the same sense Graysson Junior & O'Dell (2000) define that by providing conditions for the use of knowledge by establishing goals and objectives, it is to consolidate as a process full of benefits both to internal and external users the system, and the organization as a whole.

By promoting knowledge management in the organizational intend to, to provide favorable systemic conditions, establish the search for continuous performance improvement. This last point contains a large contribution by examining the PDCA cycle - Plan , Do, Check and Act - functioning as an instrument which one understands the production processes and improve them generating organizational knowledge as a product. Moreover, the cyclical nature of PDCA determines that:

> *"The continous improvement of course implies an endless process, questioning and repeatedly requestioning the work of an operation".* (Slack *et al*, p. 462, 1999)

Thus, we start from the assumption that organizations need to be registered and documented knowledge of employees, and keep track of best practices and dissemination of knowledge generated.

Consolidating a project of knowledge management thus requires the formulation of an organizational objective through proper allocation of people, technology and knowledge content, it naturally has a charge of conducting the project, which stands as the foundation focus on knowledge as distinct from information, making it possible, finally, access to best practice - commonly prescribed for Benchmarking. The latter, according to Slack *et al* (1999) provides foster creativity and encourage a stimulus that enables the continuous improvement of operations, so as to give the organization more competitive.

Then taking the lessons learned and developed, it is the organization chart the implicit knowledge and identify skills and make them accessible to the rest of the organization.

3.3 PROJECT MANAGEMENT

Project management is formed by the application of knowledge, skills and techniques to develop activities related to achieving a set of predefined objectives, within a certain period, with certain cost and quality. According to Sisk (1998), these new lines drove the drastic change in production relations propelling himself, sequentially, a series of transformations where the purpose culminating pointed to the requirement in administering a new economic structures, in which, through strategic planning enables It is learning how to learn, and introduced in organizations search for excellence and competitiveness through improved processes and methodologies.

3.4 MANAGEMENT PROCESS

Given the view of what is implemented and observed within the organizational environment, continually undertakes a distinction between what is identified as routine and as improvement.

According to Campos (1992), the routine is nothing more than the maintenance of what is done daily, reproducing the same results and impact over time. This feature, although it will bring stability and predictability of the system as a whole, compose a short-sighted to limit the management process in pursuit of innovations and improvements. Regarding the implementation of the latter, it is the organizational system continuously aim at ensuring quality in the development of new products, services and processes, to ensure a visible market competitiveness.

10 One of Deming's Quality Principles (1982) is the management by processes, by bringing the concept of supplier chain - process - client, in a horizontal view of organizations (the systemic view), which integrates the various existing functions in the institutions. A systemic approach is almost always beneficial in decision making. Stevenson (2001) says that a system can be defined as a set of interrelated parts that need work and integrated. Therefore, the group that operates in Aerodesign project can be considered a system composed of several subsystems (eg, the subsystem of marketing, management and product design), which in turn are composed of smaller subsystems.

Stevenson (2001) states, though, the systems approach gives emphasis to the interrelationships between subsystems, but its essence is that the whole is greater than the sum of the parts, when considered individually. Thus, under the systems approach, the outputs and objectives of the organization as a whole takes precedence over those of any subsystem.

4. CASE STUDY IN A UNIVERSITY EXTENSION PROJECT: SKYWARDS AERODESIGN-UFV TEAM

4.1 ORGANIZATIONAL STRUCTURE

Team Composition

The specific studies and development, which will later be crossed for the implementation of the project influenced the definition of how to compose the team into sub-sectors, they are: Aerodynamics, Management, Stability and Control, Electrical and Performance and Loads and Structures (see figure chart of the team). Thus, the plurality of processes and information generated by ordering the definition of a product development methodology that enables the meeting of qualities that, together, establish better end features designed for the aircraft.

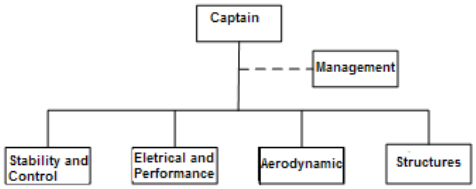

Figure 1. Team Organization Chart.

Responsibilities of sectors

In general, we can divide the responsibilities of the sectors as follows:

AERODYNAMICS
Design of Wings (Choice of Profiles, Determination of Geometry Wing Height Wing) Development of stabilizers (Choice of Profiles and Determination of Geometry Alar) and its positioning; Fuselage (configuration).

ELECTRICAL AND PERFORMANCE
Choice of engine and propeller; Analysis Wing proposals (correlation with the analysis of score); Determining the aircraft's drag polar; Curves Traction and Power Available and Required; performance takeoff and landing; Ascent Performance Aircraft; Performance Glide; see Diagram of maneuver; Performance curve, Graphic Payload; Study of electrical installations (choose from mild servants, high torques).

STABILITY AND CONTROL
Analysis of Wing-tail sets available; Wings pre-selected; Asa chosen; Location of Center of Gravity of Aircraft; Longitudinal Stability, neutral point and static margin; static directional stability, lateral stability, dynamic stability.

STRUCTURES
Loads on Wing; Sizing main spar, stringer sizing the ends of the wing, the wing structure, the tail loads, structure of the tail; Landing Gear; fuselage.

MANAGEMENT
Implementation of Management Tools, Marketing Planning, Financial Planning, Document Management, Search by Sponsors, Development Short Courses, Conducting Selection Process, Managing the Organizational Planning and administrative routines; Develop Process Management, Management Design, Product Development, Managing Construction routines.

4.2 DEVELOPMENT OF TECHNICAL REPORT - PROCESS MAPPING THE BASICS

The linkage of the main design features is only possible from an initial configuration with a set of components that aerodynamics delivered to the other sectors, so that they are examined by the other sectors – Eletrical and Performance, Stability and Control Structures and - as way to drive a better match of the final design, combining the best features as far as possible.
a) Aerodynamics: Delivery of configurations to be compared after analysis procedure parameters of other aeronautical projects - docking of new features and factors that will be analyzed.
b) Stability and Control: an analysis of delivery and note those settings that best fit, both for their conditions, as the structural characteristics.
c) Power and Performance: optimized determination of electrical installation, with less impact in terms of weight for the aircraft, in addition of course of study in terms of performance score to be reached by aircraft and other factors that sequence best flying qualities , landing, taxiing and takeoff.
d) Structures: on the settings you choose, and your chances of good construction quality and structural breaks for the choice of materials by tensile tests and tension which the aircraft will be subjected under conditions of flight loads. It seeks to maximize the positive X Structural Lightweight Stand tensions.

The logic established for the development of components of aircraft structures – wings, fuselage, empennage, wheels, landing gear and tailwheel run through the following process steps, involving the design and definition:

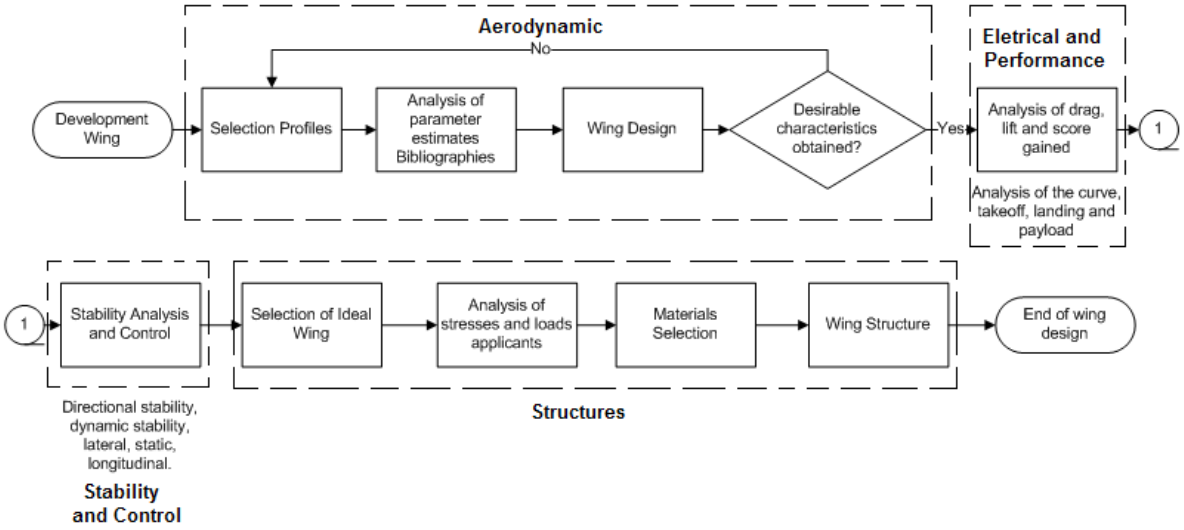

Figure 2. Mapping process - the development wing.

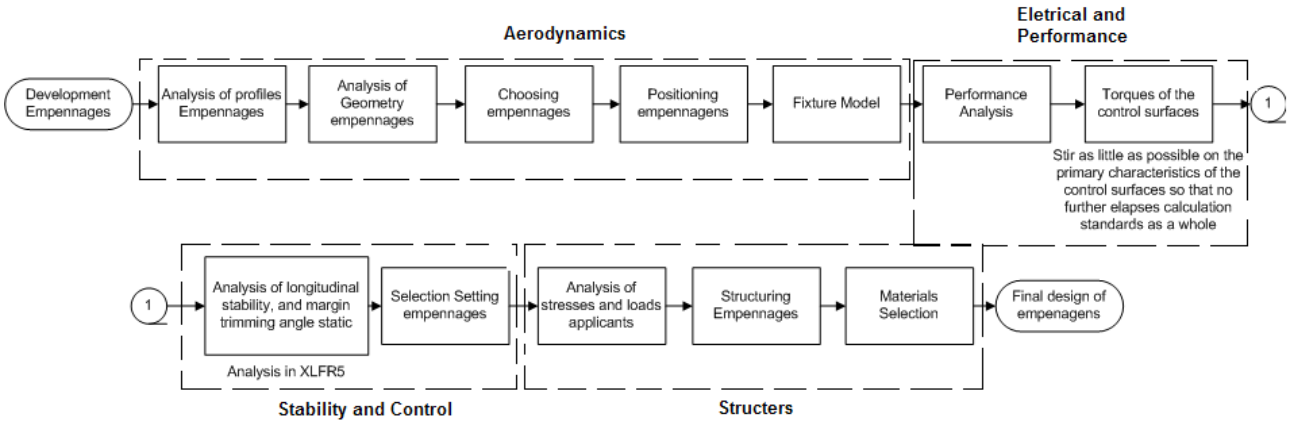

Figure 3. Mapping process - the development of stabilizers.

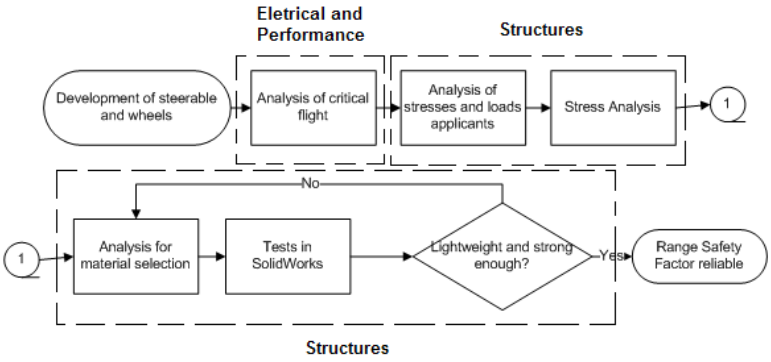

Figure 4. Mapping process - the development of steerable and wheels.

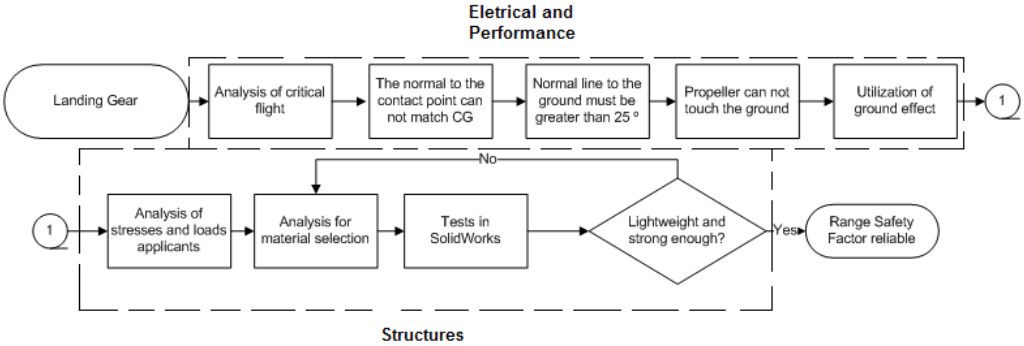

Figure 5. Mapping process - the development of landing gear.

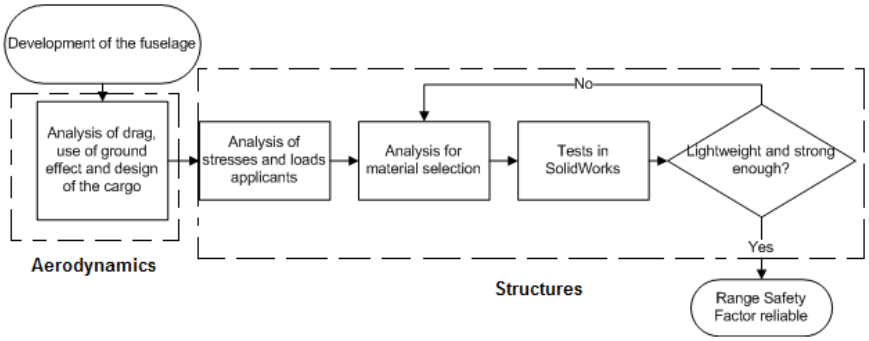

Figure 6. Mapping process - the development of the fuselage.

Once completed these procedures, the settings obtained are widely compared according to the achieved performance - in terms of maneuverability and ideal situations and flight score gained under such conditions - as we see below:

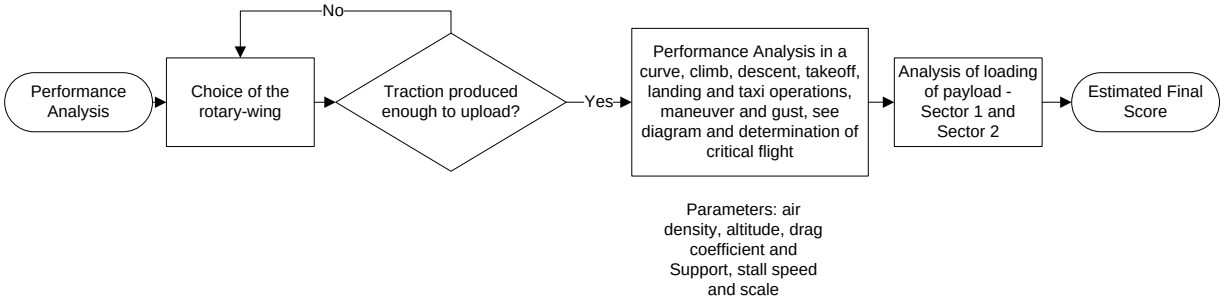

Figure 7. Process mapping – analysis of aircraft performance - the sector of Electrical and Performance.

The stages of the project, understood by the conceptual content, preliminary and detailed, respectively, reference, succinctly, the evolution that has for the development of aeronautic project itself. As was proposed in the literature review, it is known that the best features alone are not necessarily the best features together.

Thus, the link information is performed as follows:

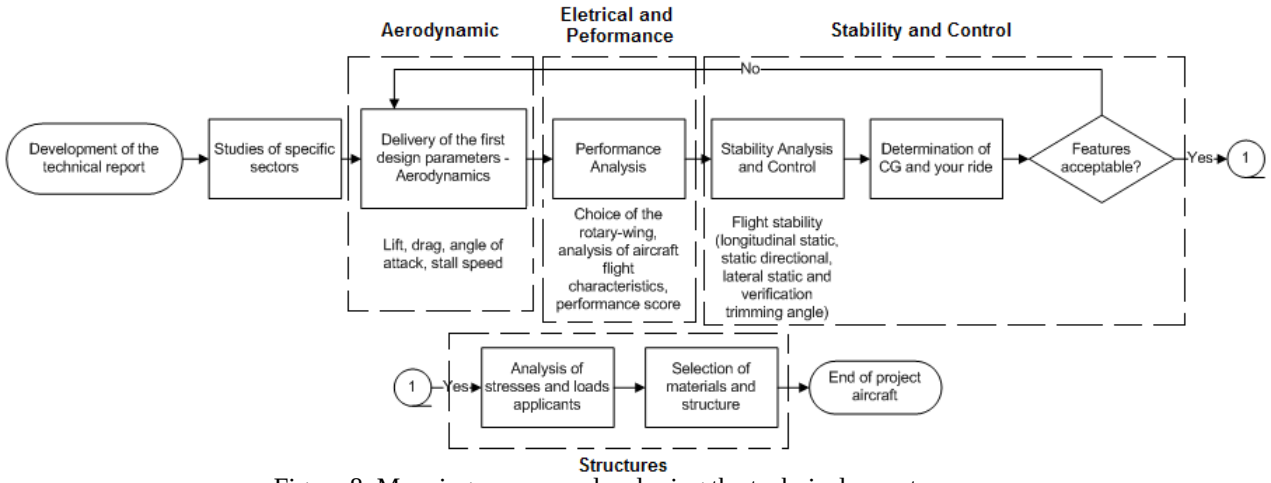

Figure 8. Mapping process – developing the technical report.

The technical report of project development occurs in conjunction with product development, so that these traits and performance are analyzed together, giving the final model that will be manufactured from the complete breakdown of materials that will be employed and settings described in plants.

Importantly, at this stage, the team carries out its construction activities in a manner divorced from the product development. This is because there sources that are needed to perform the manufacturing process are available only at a time subsequent to delivery of the final technical report, and the distortions of the project and adjustments - for the perfect building – an act performed in the aircraft manufacturing.

4.2.1 PRODUCT DEVELOPMENT PLAN

Will be regular meetings between members of the technic all are as to implement the stages of product development, after some initial QFD, where you draw the main conclusions.
The same, there are steps, activities and tasks outlined and completed by sector and are set forth for the next dates of completion, the same being unified in a subsequent meeting.

Will be designated a fortnightly meeting between industry leaders and staff responsible for implementation of management tools in the team of Skywards Aerodesign-UFV, so that direct the execution of the project – see your ideal sequencing of activities and developments - for better choice joint characteristics and completion of the project itself.

Listing requirements of the competition - QFD Analysis

See restrictions defined by the Competition regulations and other requirements that will arise as a result there of, performs the analysis of Quality Function Development, better known as QFD, where strategic decisions will be designated as a way of giving the direction of the process as a whole.

QFD Analysis	Maximization of the curves CI = alpha	Maximum use of ground effect	Maximization of the curves CI (3 / 2)	Torque test	Test Battery	Endurance tests on materials	Technical drawing well prepared	Engine layout	Weight of boom	Weight of stabilizers	Testing for stroll CG	Practical tests of the control surface	Test bench	Use of brakes	Dynamic Test	Degree of importance
Maximization of payload into 50 Takeoff	5	5	5	1	0	0	0	0	3	3	0	1	5	3	5	5
Vide electrical analysis	0	0	0	1	5	0	0	0	0	0	0	0	3	0	1	4
Proper design of t.d.p	0	3	0	0	0	3	0	5	0	0	0	0	0	1	0	5
Proper positioning of the servants	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3
Fizing and proper sizing of the wheels	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	4
Positioning C.G.	0	0	0	0	0	0	0	5	5	5	5	0	0	0	0	5
Sizing and deflection of control surfaces	0	0	0	3	0	0	0	0	0	0	0	5	0	0	0	5
Analysis of loads on control surfaces	0	0	0	0	0	0	0	0	0	0	0	5	0	0	1	4
More aerodynamic data	5	5	5	0	0	0	0	0	0	0	0	1	1	0	1	3
Facility constructive	0	0	0	0	0	3	0	1	1	1	0	0	0	0	0	5
Appropriate structure of the wing	1	1	1	0	0	5	0	0	0	0	3	1	0	0	0	5
Low cost	0	0	0	0	0	5	0	0	3	3	0	0	1	0	0	4
Appropriate tests of motor	0	0	0	0	5	1	0	0	0	0	0	0	5	0	5	4
Easy component replacement	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	4
More detailed plans	0	0	0	0	0	0	5	1	0	0	5	0	0	0	0	5
Takeoff Distance: 50 m	0	3	0	0	0	0	0	0	0	0	0	0	0	5	3	5
Landing distance: 50 m, 75 m, 100 m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Analysis of tests: strength for the accuracy and the computation of	0	0	0	0	1	0	5	0	0	0	0	0	0	0	0	3
Electrical diagram	0	0	0	0	5	0	0	0	0	0	0	0	1	0	0	4
Scaling of the critical load required	0	0	0	5	0	0	0	0	0	0	0	0	1	0	0	3
Tests to measure the torque of the servos.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Restriction of the minimum volume of the compartment: CP / BV <9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Maximum width of 400 mm	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Block standard	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	3
Geometric constraints: D = L + H +ΣB sendo 5000 ≤ D ≤ 6500 mm	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	4

Figure 9. List of requirements stipulated by the rules of the competition.

Plan Prioritization Methodologies

From the very definition of degree of importance of items from the establishment of the QFD analysis, wevisualizedtheprojectprioritizationdeprecatedseetherequirementsofcompetitionlegislation.

Through this configuration, you define the progress of product development, and the fundamental steps to configure it in the links between research findings and best features to ensure the final aircraft.

It is noteworthy that in this phase, the absence of existing data (benchmarks) makes the product development achieved through on going analysis of the characteristics of joint towards the optimization of the aircraft in terms of loading cargo, stable flight, take flight with less run way length as possible, structuralnalysis and optimum yields of the team score.

4.3 PLANNING ORGANIZATION

Defined as the need for organizational logic weekly meetings:
- Of the leaders of each sector with their respective controlled;
- Of the leaders of each sector with the team captain.

At the end of each weekly meeting, it is for industry leaders to draw up an Action Plan for next week, and a general report of activities performed.

The logics as follows: each sector leader will be responsible for completing its share in the minutes after the completion of the weekly meeting with his command of the sector.

After duly organized such data, these will be taken at the weekly meeting of the captain with the industry leaders, and gathered all points in a single file, available later in the Discussion Group for all, being supplemented by other approaches that are raised the meeting leaders and the observations contained in the "Remarks and Administrative Matters."

This is an interesting procedure that positively influences subsequent construction of action plans for each leader, keeping a better control of the main activities.

Besides these, will be held at the end of each month a general meeting, attended by all team members, that cover the major events and issues in the period that passed, the activities to be implemented in the next period of so as to design at

the routine procedures performed in scale sector, besides the main comments and suggestions for continuous process improvement. Thus, the end of each General Meeting, we undertake a PDCA cycle of each sector, realizing the optimization of procedures that will be developed sequentially.

4.4ADMINISTRATIVE ROUTINES

The administrative routines will be required as the implementation of weekly and monthly meetings stipulated in the team.

It is defined as the end of each weekly meeting and sector leaders, we must generate a report based on where you will find the activities, the outstanding and those to be completed next week. From this periodic documentation, has control of the overall progress of activities, and promote a state of constant improvement project, which will apply the PDCA cycle - assessing the quality of the activities resulting in pointing stable factors of the process and those capable of optimization. From this, we propose an Action Plan, which will be verified next week if it was properly discharged.

Through this proposed action, it is possible to perform the mapping of existing processes in the development of activities - routine - and those who are subject to continuous enhancements - improvements to standard procedures.

There is, therefore, greater security about what is developed, making possible an efficient process management in the organizational scope.

Moreover, it remains the stated set of objectives, targets and deadlines, and resources available for such a team, so that all bounds are respected and the project are met, proceed to project management as a whole .

4.5 KNOWLEDGE MANAGEMENT

Given the high turnover of members in this type of project, documentation of sequential processes and activities it is indispensable in order that progress be maintained regardless of the composition which is the team, leaving the system of management organization and division of tasks and activities applicable to each sector so there is a new competitive design in terms of basic requirements established and measured insights, influencing on the technological innovation.

FINAL CONSIDERATIONS

The process of implementation of management tools, in any sphere considerably, leading to a guideline of organized action. For the team of Skywards Aerodesign-UFV was no different; prioritization methodology for this system channeled their ventures and became recognized aspects and studies, which until then were under common sense, devoid of a technical apparatus. Organized by procedures well defined and perfectly followed, chained themselves to the perpetuation of information between the team (both are said to know about the future, given the ongoing renovations of limbs), standardized procedures that were previously determined differently by sub-teams work and systematized the work schedule.

In this sense, it can be stated without doubt that competitive advantages are achieved when it chooses, to introduce a focus of action among all who are involved in the work before the potentials and constraints that are present on the system as a whole, they are under types of environments or scenarios analyzed, identified routines and reasonable improvements to the process as a whole.

REFERENCES

BORCHARDT, *O perfil do engenheiro de produção: a visão de empresas da região metropolitana de Porto Alegre*, Produção, v. 19, n. 2, maio/ago. 2009, p. 230-248.

BARROS, C. P. Uma metodologia para o desenvolvimento de aeronaves leves subsônicas. Centro de Estudos Aeronáuticos – EEUFMG: Belo Horizonte –MG, 2000.

CAMPOS, V.F. TQC - Controle de Qualidade Total. Belo Horizonte: Fundação Christiano Ottoni, 1992.

CORDEIRO, J. S. ALMEIDA, N. N. BORGES, M. N. DUTRA, S. C. VALINOTE, O. L. PRAVIA, Z. M. C. *Um futuro para a educação no Brasil: desafios e oportunidades.* Revista de Ensino de Engenharia, v. 27, n. 3, p. 69-82, Edição especial 2008.

DEMING, W. EDWARDS – Qualidade: A Revolução da Administração. Rio de Janeiro: Marques Saraiva, 1982.

GIL, ANTONIO CARLOS. Métodos e técnicas de pesquisa social. São Paulo: Atlas, 1999.

O'DELL, C.; GRAYSON JUNIOR, C. J. Ah... Se soubéssemos Antes o que Sabemos Agora!. São Paulo: Futura, 2000.

PAHL, Gerhard et al. *Projeto na engenharia*: fundamentos do desenvolvimento eficaz de produtos, métodos e aplicações. São Paulo: Edgard Blücher, 2005.

SISK, T. History of Project Management. 1998. Disponível em http://office.microsoft.com/dowloads/9798/projhistory.aspx. Acesso em: 10 de mar. 2011.

SLACK, Nigel & CHAMBERS, Stuart & HARLAND, Christine & HARRISON, Alan & JOHNSTON, Robert. Administração da Produção. São Paulo: Atlas, 1999.

STEVENSON W. J., (2001) Administração das Operações de Produção. Rio de Janeiro: Editora LTC.

VON KROGH, George. Facilitando a criação do conhecimento: reinventando a empresa com o poder da inovação contínua. Rio de Janeiro: Campus 2001.