Improve Your Knowledge (IYK)

Reflections on Systems Engineering (ES) - Study or Feasibility Analysis of an Aeronautical System

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In these times of international competition, in the commercial aviation market, the companies that develop the main product of this market, that is, aircraft, seek to develop processes that can put them at an advantage, in relation to the competitors, either by the technical characteristics, or by the economics of their products, considering the entire life cycle of these aircraft. These processes make up the so-called Feasibility Analysis of bringing these aircraft to light. Does it make up or not? This is the question. The purpose of this IYK is to give a view of such an analysis, respecting the short space of an IYK.

First, let us remember that the life cycle of an aeronautical system (LC), which has the aircraft as the main component, comprises the following phases:

1. *Identification of the Need for a Particular Aircraft (interaction with potential customers);*
2. *Conceptual Design;*
3. *Preliminary Design;*
4. *Detailed or Advanced Design;*
5. *Construction or Production;*
6. *Operations or Use;*
7. *Modification or Disposal.*

Phases 2, 3 and 4 constitute the development phase per se.

We note from the outset that it is highly recommended that any aircraft development and production company only bring out a new aircraft after conducting a thorough study or feasibility analysis to launch it competitively. The following paragraphs will make this assertion clearer.

*A parenthesis: Just to establish a parallel, such an analysis, **by the way**, at the level of a person's daily life, is also prudent before deciding to do anything in life. This is a behavior that should be taught in schools at the appropriate level of the education cycle (secondary and higher education).*

The feasibility analysis may consider topics such as:

1) Political Feasibility;
2) Feasibility of Technology;
3) Technical Feasibility;
4) Management Feasibility; and
5) Economic Feasibility.

A ministry or secretariat of a government (federal, state, or municipal) may include all of these topics, and Political Feasibility may often be crucial. In our case, however, in the case of a commercial aeronautical system, we consider only the topics from (2) to (5).

The technology and technical feasibility strictly only proves verifiable after establishing the performance requirements resulting from customer requirements or "wishes" and functional analysis of the aircraft. However, unless it is an aircraft with a very different configuration from the usual ones, as was the case with the Concorde aircraft, the companies already have a good knowledge of the existing technology and have technical staff to act on the project; but, if it is the case, goes to the market in search of an eventual need to complete its technical staff.

It seems clear then that the genesis of the feasibility study is actually in the first phase of the life cycle, that is, in the Phase or Conceptual Project with the survey of the requirements of the potential clients, as we have already had the opportunity to see in the IYK 66, when dealing with QFD (Quality Function Deployment).

However, the main point of such an analysis is economic viability, characterized by cost constraints in the several phases of the live cycle

*(Life-Cycle Costs - LCC); and, **again in passing**, at the level of a person's daily life, this knot always exists for making decisions regarding everything we want to accomplish in our life.*

We can have technical capacity, know the state of the art of technology, good managerial competence, but cost constraints may simply make the program unfeasible. Therefore, it is important to develop the feasibility analysis to demonstrate that our aircraft has competitive technical and competitive LCC in relation to competitors' aircraft. It is, no doubt, a goal that must be pursued, otherwise we can lose the competition.

At this point, let's make it clear that we do not intend here to say exactly what a company should do to conduct a cost analysis. Our aim is to give a north of such analysis, bringing suggestions from renowned authors (see Ref. 1 and 2), for who may be asked to participate in this kind of analysis.

Well, we are going to present the types of costs that are dealt with in the life cycle of an aeronautical system. Are they:

- *Non-Recurring Costs CNR (i.e., occurring only once);*
- *Recurrent Costs (CR) (ie, recurring over the life cycle);*
- *Direct Operating Cost (DOC); and*
- *Indirect Operating Cost (IOC).*

Non-recurring costs (CNR) are those that occur only once. They are, in general:

*(1) **Development** - Costs with market analysis, requirements development, feasibility studies or analyzes, engineering design, configuration control, software, testing / tools and evaluation of engineering models (such as p management. Development of the technical support of the aircraft (Maintenance training, special tools and ground support equipment (GSE)), prototypes and rigs and associated management. Development of the technical support of the aircraft (Maintenance training, special tools and ground support equipment (GSE)).*

***(2) Production and Construction** - Process engineering, raw material, manufacturing, assembly, testing, operations, quality control, parts, test equipment, etc.*

Recurrent costs are those that occur repeatedly in the operational phase.

***(3) Recurrent costs to aircraft** - Preventive and corrective maintenance, parts replacement and storage, transportation, system modifications, etc.*

***(4) Direct recurrent operating costs (DOC)** - Shipping fees, landing fees, ground handling, crew (cockpit, cockpit), depreciation, possible organic maintenance, fuel, oil.*

***(5) Indirect recurring operating costs (IOC)** - Dispatch reliability, operational reliability, etc.*

The fact is that the cost to be worth even is in the operational phase, far surpassing the costs of development and production. In order to have an overview of the magnitude of these, it is only to imagine an iceberg, where the emerging part (visible) represents the costs of development and production, and the submerged part constitute the operating costs, throughout the life cycle, much larger than the former.

We were sometimes thinking: this would not be more or less what happens with our automobile, acquired new, after about eight years, considering fuel, oil, maintenance, replacement of components (buffers, for example), tires, expensive maintenance after the warranty period has expired, etc. ?

Well, my friends, we're here. We hope we have awakened a theme that is hardly discussed. Consult the references. Thank you for the patience.

Thank you..

References:

1. *Blanchard, B. S.; Fabrick, W. J. Systems Engineering and Analysis. 5th. Ed. Prentice Hall. Upper Saddle River, NJ, USA. 2006.*
2. *Blanchard, B. S.; Fabrick, W. J. Life-Cicle Cost and Economic Analysis. Prentice Hall. Englewood Cliffs, NJ, USA. 1991.*