# Procurement and Importing in New Product Projects of Brazilian Aerospace Program

Sanderson Barbalho[a,1], Eduardo Richter[b], Mário Stefani[c]

[a]PhD, Senior Engineer, Opto Eletrônica S.A., São Carlos, BR.
[b]Undergraduate student, University of São Paulo, São Carlos, BR.
[c]PhD, Senior Manager, Opto Eletrônica S.A., São Carlos, BR.

**Abstract.** New product development is a business process with many functional interactions in a company. The concurrency of these interactions must be managed in order to meet the preestablished schedule, budget and scope. The issue of procurement is central to a succesful project. When a new project belongs to an aerospace program this issue is even more crucial. And when the aerospace program belongs to a developing country such as Brazil, the core issue involves its budget and schedule planning. This article addresses the question of procurement in a small company designing a new satellite camera for the Brazilian Government. The procurement process was mapped, a monitoring structure was created and performance indicators were developed. The performance indicators are discussed to understand the leverage of each kind of purchased item and each process step on costs and schedule.

**Keywords.** New product development, aerospace projects, procurement, performance indicators

## 1 Introduction

In developing countries, new product development (NPD) is still an obstacle rather than a common practice. The same holds true for aerospace projects. What happens when a small Brazilian company attempts to develop a new product for the aerospace industry?

The purpose of this article is to address that question. However, an examination of the entire picture would require the analysis of too many aspects. Therefore, this article analyzes solely the question of procurement, since a new product in the aerospace sector requires the importation of numerous and miscelanous items.

The company under study has been engaged in the development of a new aerospace product since December 2004, to which end it set up a project

[1] PhD, Senior Engineer, OPTO ELETRÔNICA S.A., Joaquim R. de Souza, Jardim Sta. Felícia, São Carlos, BR; Tel: +55 (16) 2106 7000; Fax: +55 (16) 3373 7001; Email: sanderson@opto.com.br; http://www.opto.com.br/mrm

management office to manage procurement. This article makes comparisons between purchases carried out in Brazil and in foreign countries. It compares lead-times for the acquisition of mechanical and electronic items, equipment and software. It discusses import costs and their impact on project overruns and delays.

## 2 Procurement and Importing in New Product Development

Procurement management is a knowledge area of the project management body of knowledge [5]. It includes the processes involved in purchasing products and services, or the results required from outside the company to execute a project.

In product development literature, procurement is analyzed more as a co-development strategy in which the company builds partnerships to design a product jointly. This kind of discussion was presented by [1], who described four types of supplier involvement in product development: proprietary parts, black box parts, detail-controlled functional parts, and detail-controlled body parts, and discussed the pros and cons of each approach.

Some discussions about procurement in new product projects relate this process with prototype generation. In [1] there is an argument that in-house “specialists” in prototyping tend to focus on asset utilization at the expense of fast feedback on prototypes. When subcontracting, design engineers have the flexibility to decide how much the company is willing to pay for fast cycles. Some authors as [7] considered the “black box” approach the most interesting one when the company’s purpose is to relieve the internal engineering teams from additional responsibilities.

According to [2], capability maturity model integration (CMMI) locates procurement in two process areas called “integrated supplier management” and “supplier agreement management”. The former is based on the aforementioned co-development philosophy and the latter is used for on-the-shelf and off-the-shelf items that are generally available and are not modified in any way. The basic work product prescribed by CMMI to perform these processes is a formal agreement, i.e., any legal agreement between the organization and its supplier

A few studies deal with procurement management in developing countries. In a study of procurement delays in highway projects in Nepal, [5] identified a possible correlation between the cost impact of an item and the schedule delay in both materials and equipment, and found that supplier defaults such as monopolies and importation difficulties are responsible for 79% of procurement delays. In Ghana, [4] interviewed owners, consultants and contractors of Ghana’s groundwater drilling projects and found that the main factors affecting project delays and cost overruns are related to procurement management: absence of effective procurement management, late delivery of items and difficulties in importing.

## 3 Project requirements of the brazilian aerospace program

The Brazilian Aerospace Program utilizes the European Aerospace Standards as a reference. These standards are divided into three types: managerial, engineering,

and quality assurance. Managerial standards are based on project management theories, such as those of the [3]. Therefore, when a new project is initiated by the Brazilian Aerospace Agency (BAA), it prescribes a milestone timetable and a detailed description of the deliverable scopes.

The company analyzed here is engaged in two aerospace projects, both of which involve the development of optical cameras and their processing electronics. In addition, a complex piece of optoelectronic equipment is necessary for camera verification. **Table 1** lists the deliverables to be produced for the BAA, showing their composition in terms of imported items.

**Table 1.** Deliverable typologies in the aerospace project

| Deliverable | Quantity | Imported items level |
|---|---|---|
| Bread-board model | 1 | Low |
| Engineering model | 2 | intermediate |
| Qualification model | 1 | High |
| Flying model | 3 | High |
| Ground support equipment (GSE) | 3 | High |

All the projects for the BAA follow the phasing structure prescribed by the European Aerospace Committees. Therefore, there is a bread-board model, two engineering models – one for environmental and another for functional tests –, a qualification model, and flying models. Although qualification and flying models contain a large portion of imported items, their purchase is the responsibility of the BAA, according to the project contract. These items involve microelectronic components, whose trade is constrained by US anti-terror legislation. The purchase of the engineering models and GSEs are the supplier's responsibility.

The BAA's supplier selection criteria include penalty clauses. The amount of money foreseen in these clauses makes it less costly to invest in project management than to pay the fines. This article discusses the delivery of engineering models and GSEs.

## 4 Mapping and monitoring the procurement process

The first action to monitor purchased items was to map the company's procurement process. This was done by talking to buyers, engineers and operation managers. The process is described in the flowchart presented in **Figure 1**.

Engineers are allocated to an engineering unit where they develop item specifications, make an initial supplier selection, and send it to the company's buyers. If the item is on-the-shelf, it is recorded in the configuration control system and its acquisition begins. If not, the engineers negotiate its price, specifications and timetable with suppliers before the formal purchase process is initiated.

Depending on whether the item will be purchased from a national or foreign company, there are two different flows. If it is an American item, it is purchased from the US subsidiary. If it is a European, Japanese or Australian item, it is purchased directly through the import department. In the latter case, the engineers draw up a procurement plan for senior management approval. If it is an on-the-

shelf item and is purchased on the domestic market, a quotation is requested and submitted to senior management for approval. Senior management decisions are made after price and timetable negotiations have been completed.

After the negotiation, a supplier contract is signed, after which the item goes through the normal process of manufacturing, intercontinental transportation and customs release. The steps outlined in **Figure 1** are related to parts, materials and processes (PMP) and configuration management processes. However, a discussion about these steps is outside the scope of this article.

Because of the large number of steps in the mapped process, they have been summarized and their number reduced to allow for monitoring of the process, especially for imported items. **Figure 2** presents the major milestones identified. The plan was that a date would be set for each milestone and its lead-times monitored. The process illustrated in **Figure 1** was mapped in August 2006 and a weekly monitoring began in September 2006. A person was appointed to purchase every item required for the aerospace projects, and to monitor the status of each item. This employee was allocated to the project office shown in **Figure 1**.

One person was appointed to head each milestone and the monitoring process was discussed with him. These head people make weekly reports to the project management group about the schedule and status of each purchased item.

The last step to structure the monitoring process was to create performance indicators and a procedure for periodically monitoring and informing the status of the indicators. The indicators are monitored weekly and fixed on a monthly basis.

## 5 Findings

Figure 3 depicts the number of acquired items monitored, showing the imported and domestic items purchased per month. The data were systematized on February 15, 2007. This figure reveals that every domestic purchase process was concluded while the import processes were not. In fact, there are import processes dating back to July 2006 whose status is still open. Taking into account only purchases initiated after September 2006, one can see that almost 43% are from other countries. In the company's traditional projects, this number is less than 5%.

This analysis is complemented by Figure 4, which compares item lead-times. The materials are typologized according to their technological background, while equipments are classified as imobilized assets and software programs are listed explicitly. Note that the lead-time of imported mechanical and electronic items are 11 and 8 times longer than national lead-times.

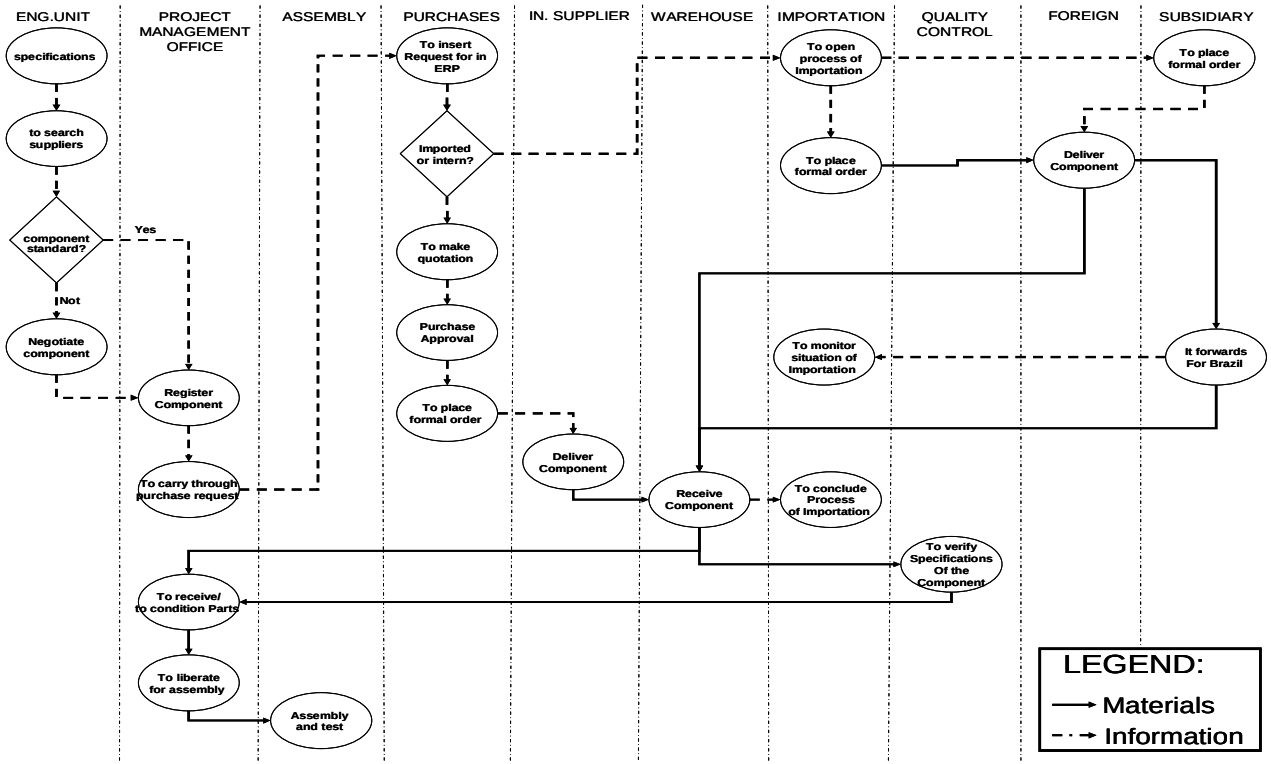


**Figure 1.** Flowchart of procurement process for prototype items

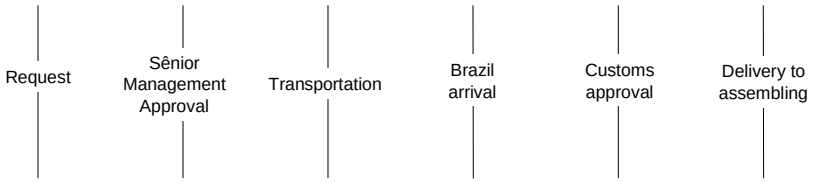


**Figure 2.** Main milestones of the procurement process of imported items

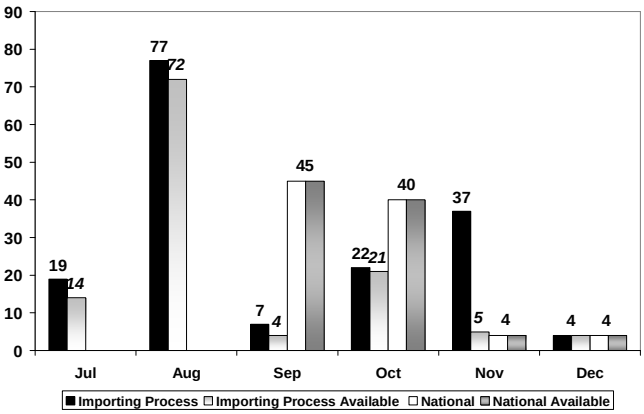


**Figure 3.** Purchase Process: Importing versus National Items

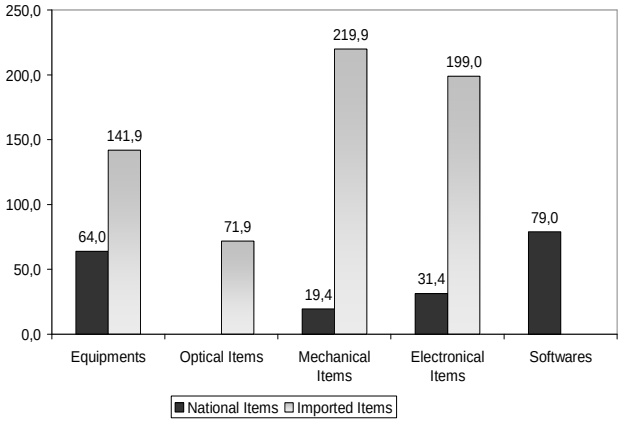


**Figure 4.** Lead-time by Item typologies

Figure 5 shows the percentage of the price of each item in the overall purchase cost of both national and imported items, revealing a very substantial difference. The price of imported items represents only 25% of the overall import process. National items rate up to 98% of total cost. This demonstrates how expensive the importation process in Brazil is.

From the number of national and imported items delivered, an average time can be established between the beginning (the order) and the end (the component's transfer to assembly) of the purchase process, or simply the lead-time of the process of acquiring new items. Figure 6 presents the lead-times of both national and imported items according to the month when they were ordered. A mean lead-time for each monthly average was calculated for national and imported items to analyze the trends.

The line of averages representing the import procedure is higher than the national one on scale of six (on average). The importation lead-time was reduced after the monitoring process started. The difference between national and imported item lead-times also decreased.

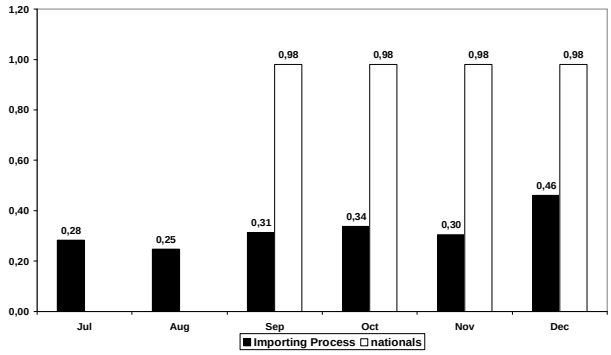


**Figure 5.** Average of item prices over the total cost of purchasing them.

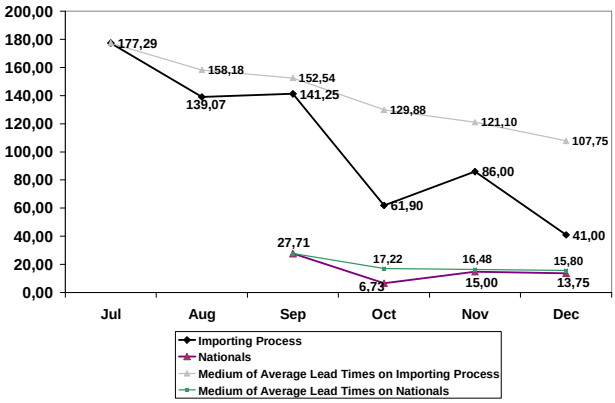


**Figure 6.** Lead Time for Month and Averages

Figure 7 illustrates the average time between the consecutive milestones illustrated in Figure 2. The graph serves to identify the critical steps in the lead-time of the procurement process. As can be seen, two months elapse between the commercial agreement represented by senior management approval and the beginning of the shipping process. This can be explained by the fact that almost all imported items are made-to-order. Moreover, the data indicate that the time elapsed between an item's arrival in Brazil and its release from customs is longer than the intercontinental transportation itself. It takes Brazilian customs agents more than a month to analyze an item and release it to the importer.

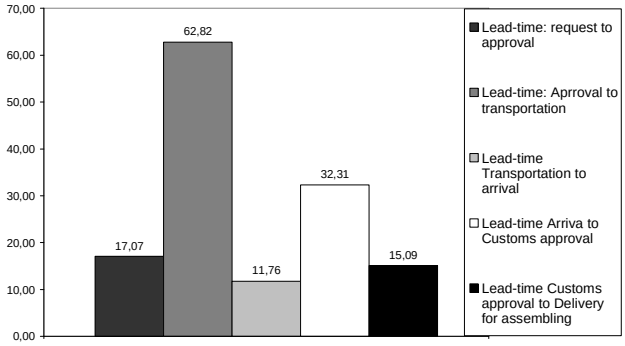


**Figure 7.** mean time between each procurement process milestone

## 6 Final considerations

The goal of the data presented in this paper is to help managers make decisions about purchasing and design strategies.

As reported in the literature, there are considerable delays and cost overruns involved in procurement. In November 2006, the three GSE models were to be delivered to the BAA. However, due to importation lead-times and costs, this delivery was postponed.

The company's management has opted to strictly monitor imported items, especially mechanical and electronic items, and attempts have been made to nationalize them. A team has been set up to study the composition of the period elapsed between an item's arrival in Brazil and its release from customs. This period represents one month of the total lead-time and almost all the cost overruns. The team is trying to apply a lean office program to the overall procurement process to decrease the other partial lead-times.

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