

APPLICATION OF THE ROOT CAUSE TREE TO THE CARGO TERMINALS OF VIRACOPOS INTERNATIONAL AIRPORT

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Abstract

This paper presents an application of the root cause tree to the cargo terminals of Viracopos International Airport in Campinas, São Paulo State, Brazil. This technique aims to make it easier to understand the main causes of a problem or event so that proper corrective measures can be proposed. Some problems related to road transport were identified and a root cause tree was built for each of them. The results show that the terminals are not suitably prepared to meet the needs of this transport mode. The systematic analysis of the problems and their root causes can contribute to enhancing the efficiency of the operations in the airport cargo terminals.

Keywords: Viracopos International Airport; Cargo terminal; Root cause tree; Road transport; Air transport

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1. INTRODUCTION

The region of Campinas, a city located in São Paulo State, is regarded as a center of the national transportation network, for being a crossway of important railway and highway systems, as well as having one of the most important airports in the country, Viracopos International Airport, with import and export cargo terminals.

Because this airport has intermodal terminal features and close connection to the highway complex, analysis of its operational system, aiming at identifying problems would allow significant gains in efficiency in the activities developed. These activities occur especially in the vehicle maneuver areas and in the terminal platforms, with the use of cargo vehicles with different loading capacity. In order to help to identify the problems and the corresponding causes, this paper presents an application of the technique known as root cause tree, which is presented in section 2. The cargo terminals are described in section 3 and the application of the root cause tree to the terminals is discussed in section 4. Concluding remarks are presented in the last section.

2. ROOT CAUSE TREE

The root cause tree, also known as the ‘five-why analysis,’ aims at identifying the fundamental causes of a problem or event. A deeper knowledge of the causes of the problem makes it possible to adopt certain adequate corrective measures. This technique was first proposed by Masaaki Imai in the 1970s to improve the production system of a Japanese car assembly plant (Calabrezi, 2005).

Having a problem to be analyzed, one can get to its core by asking the question “Why?” in succession. The first answer will correspond to a possible cause. For each cause, the question is asked again, thus obtaining other causes. By asking “Why?” up to five times, one can usually feel as though the essence of the problem is understood and the root cause should also be readily apparent (Goldsby and Martichenko, 2005, p. 220). Figure 1 represents a generic example of root cause tree.

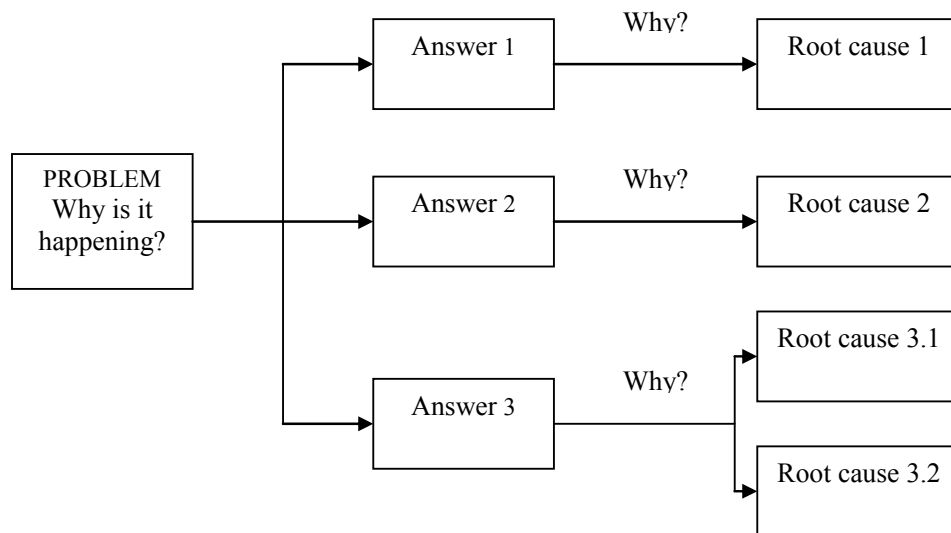


Figure 1 - Root Cause Tree.

The main advantages of this technique are the simplicity of application, which contributes to facilitate the identification of the root causes, and the possibility of graphically representing the structure of the elements that caused the problem (Wells, 2003).

3. CARGO TERMINALS OF VIRACOPOS INTERNATIONAL AIRPORT

Viracopos International Airport is located 14 km away from the city of Campinas, in the region of an important technological pole. This airport was inaugurated in the 30's, and it reached such a level of development that, in 1960, international operations were allowed. Administrated by a Brazilian public company (INFRAERO) since 1981, this airport is number two in air cargo traffic in the country (INFRAERO, 2004). Since 1995, INFRAERO has been providing investments for the implementation of the airport Master Plan,

with improvements in both passenger and cargo terminals.

There are two cargo terminals at the airport – one is for the import, and the other for the export traffic. The terminals have independent physical structures and there is no sharing of either human resources or equipments.

The import terminal, with an area of 53,698 m², has a warehouse and a platform for seventy parked vehicles. This warehouse is divided into two separate parts by a fence, with no communication between them. The vehicles enter the place through independent gates with sentry boxes.

One of the areas is destined to the import process itself, where the goods await their release by the Internal Revenue Service (Receita Federal). This area of the warehouse has thirty-three places for loading. The other one is destined to the in transit import, that is,

the goods are released, transferred and inspected in a different place, which can be a port or airport (primary zone), or a warehouse of an Inland Customs Control (Estação Aduaneira Interior – EADI) (secondary zone). This area has thirty-seven places for loading. The export terminal has an area of 13,760 m², and a platform for nineteen parked vehicles. Its entrance is independent and the control of vehicles is done at the sentry boxes.

The import and export terminals have support infrastructure for different types of cargo: area for live cargo, refrigerated areas, vaults, X-ray detectors, area for special cargo (infectious, radioactive or explosive) and a parking area for cargo vehicles.

The handling of cargo at Viracopos International Airport is nonstop. However, some activities depend on other governmental departments, such as the Internal Revenue Service, which restricts the release of cargoes at specific hours, as follows:

- Export – 24 hour operations: cargo receiving, storing, cargo expedition and release of perishable cargo, live and in transit cargo;
- Export – operations according to the Internal Revenue Service working hours: release of dry cargo;
- Import – 24 hour operations: reception and expedition of cargo, storing,

meeting the requirements of cargo agents and airline companies, and release of priority cargo;

- Import – operations according to the Internal Revenue Service working hours: transit and verification of documents and cargo.

The goods which pass through the import terminal are especially composed of high value pieces, used by high technology, telecommunication, computer and automotive companies which are utilized to make products which will be exported. In the export terminal, the most embarked products are the mechanical, automotive and electronic ones.

4. APPLICATION OF THE ROOT CAUSE TREE

4.1. Identification of Problems

The first step for the construction of the root cause tree is the identification of the problems to be studied. So as to do so, a research in documents was initially made (INFRAERO 1997, 1998, 2001), with the purpose of obtaining information about Viracopos International Airport and a better understanding of its structure.

After that, the cargo terminals were visited. Because the terminal premises are controlled by the Internal Revenue Service, an authorization for the visit was made necessary, though some areas were restricted.

The period of the visit was of five days, with two days in the export terminal and three days in the import terminal, which has a more complex operational structure.

The access to the warehouse and the outdoor areas was limited, for it was not possible to visit the area destined to the loading and unloading of the airplanes. The registering of the images was not allowed, either. The people in charge of each warehouse accompanied the visit, which made the obtaining of additional technical data and clearing of doubts possible.

In this way, four problems in the terminals were identified, related to the loading and unloading system of the road transport. This system is composed of a sole built platform and mobile ramps which compensate for the difference in height between the vehicle and the platform, thus aiding loading and unloading. The system is appropriate for the operation with medium and big sized vehicles, the height of which is compatible with the platform.

The first problem was identified in the export terminal, where it was observed that the platform system is not adequate for vehicles which are equipped with cargo trailer or traditional semi-trailer (dry cargo), and small vehicles.

The second problem also occurs in the export terminal and it refers to the accumulation of goods on the platform. According to the INFRAERO adopted procedures, the goods can not be checked inside the vehicle. Thus, the employees must wait for the total unloading of the vehicles and the placement of the cargo on the platform to initiate the checking.

The third problem was identified in the import terminal, where a restraint for the traffic of large dimension cargo was observed. The last problem happens in this same terminal and it refers to the concentration of vehicles for the loading of in transit cargo on Fridays.

4.2. Construction of the Root Cause Trees

For each problem, a root cause tree was constructed by the procedure described in section 2. The problems studied are: difficulty in unloading certain types of vehicles (Figure 2), accumulation of goods on the platform (Figure 3), difficulty in moving large dimension goods (Figure 4) and high flow of vehicles to claim in transit goods (Figure 5).

4.3. Root Cause Analysis

4.3.1. Difficulty in Unloading Certain Types of Vehicles

The following root causes for this problem were identified: inadequate platform and inexistence of appropriate area; terminal user lack of information about the unloading

system and the need of the lateral unloading of the vehicle due to the type of cargo (Figure 2).

For the unloading, the vehicle is transversally positioned on the platform and the cargo is removed by the rear part side by a fork-lift.

During the visit to the export terminal, it was

observed that the loading of large volume and irregular dimension goods is common. In the case of a traditional semi-trailer vehicle and this kind of cargo, it is very difficult for the fork-lift to make the unloading through the rear part.

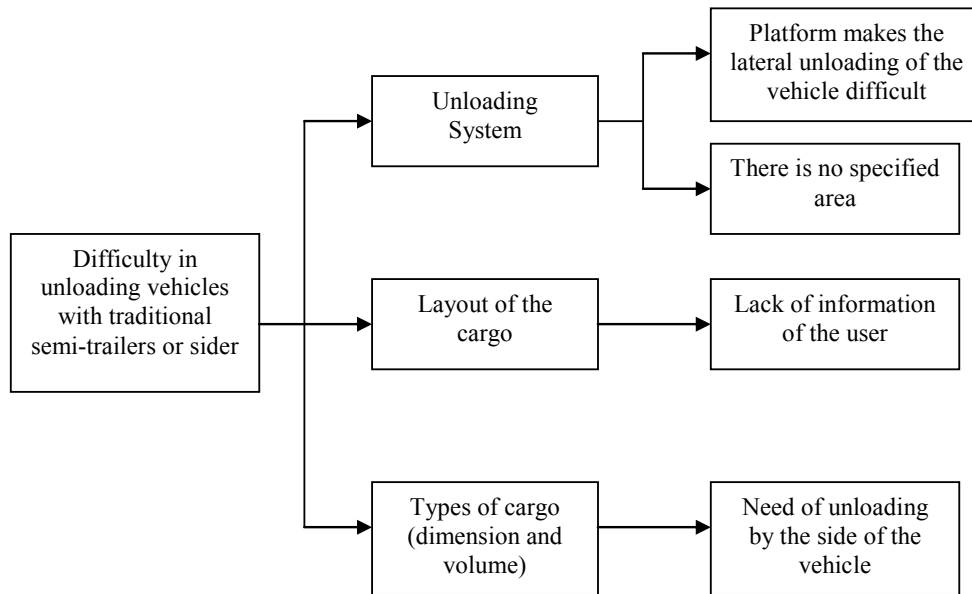


Figure 2 – Difficulty in unloading certain types of vehicles

For the platform to be used, the vehicle has to be positioned on its side, thus allowing the fork-lift to easily reach the cargo. However, considering the total length of the vehicle (19.78 m), and the available length for unloading in the platform (3.80 m), five places would be used in order to prevent other vehicles from unloading. Also, maneuvers would be necessary to unload from the other side of the vehicle, and this would increase its permanence time in the terminal.

Besides, there is no appropriate area for receiving goods with specific characteristics.

As the terminal user very often is not aware of such difficulties, there is no concern in adopting other kinds of vehicles or laying out the cargo in a more appropriate way.

For these reasons, the unloading in the export terminal is made in the vehicle maneuver area instead of on the platform. This implies that the goods are unloaded outdoors and moved

by the fork-lift in the area, which has inadequate floor for this function.

4.3.2. Accumulation of Goods on the Platform
The root causes of the accumulation of goods on the export terminal platform are: flying

schedules, INFRAERO procedures, and inadequate use of the warehouse and the platform (Figure 3).

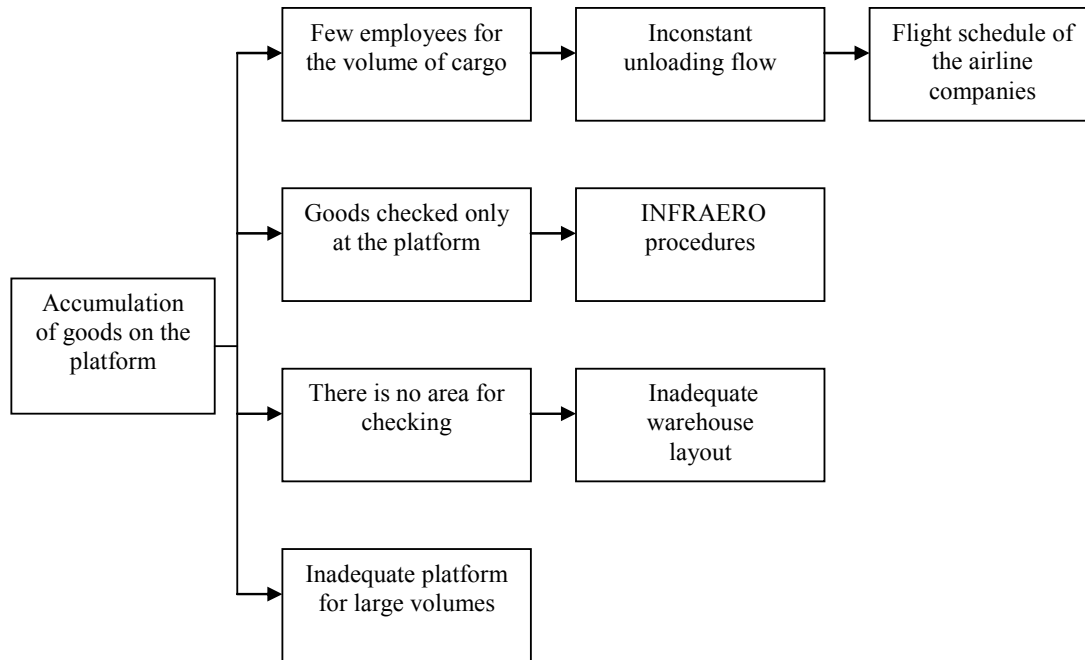


Figure 3 – Accumulation of goods on the platform.

According to INFRAERO procedures, the cargo can only be checked after being removed from the vehicle. The moving of the goods, while in the vehicle, holds the carrier responsible, except when a fork-lift is necessary.

Moreover, the airline companies have their flights scheduled for certain days of the week, so as to reconcile the unloading at the import terminal with the loading at the export one. This way, the occupation rate of the aircraft is

kept high and decreases its permanence time at the airport.

The consequences of the accumulation of goods on the platform include the exposure of the cargo to damages, possibility of loss, risk of accidents, and increase in permanence time of the vehicle at the terminal.

4.3.3. Difficulty in Moving Large Dimension Goods

This problem happens at the import terminal, and the following root causes were identified: inadequate loading devices, subdivision and

sharing of the warehouse, and warehouse area located away from the loading (Figure 4).

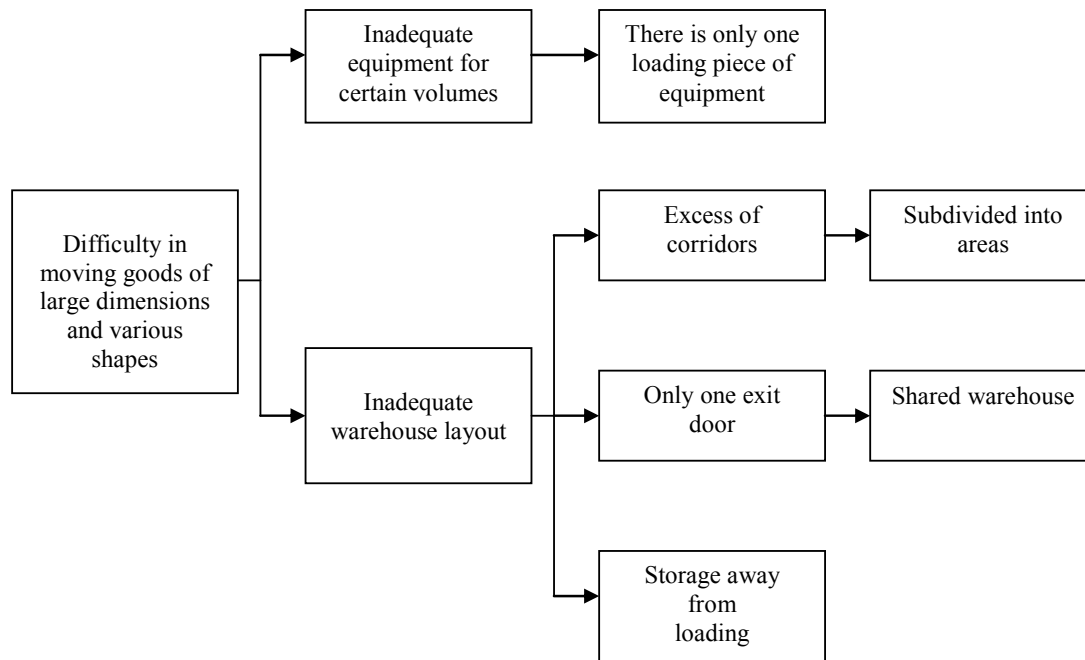


Figure 4 – Difficulty in moving large dimension goods.

The warehouse of the import terminal is divided into two areas: one for the import, and the other for the in transit cargo. Because the project of the warehouse had not considered the need for distinct areas, some subdivisions were made which created some corridors, and they, in turn, make it difficult to move large dimension cargo. There is one exit door in each area.

The large dimension cargo is stored in a place close to the unloading, which makes the traffic through the corridors to the loading platform difficult.

The equipment used in the terminal has a frontal device with two iron blades, on which the cargo is transported. If the cargo has small

dimensions, there will not be difficulty in transporting it. On the other hand, if the cargo has large dimensions, this equipment will not be suitable.

The inadequate characteristics of both the warehouse and the equipment may cause accidents and increase the loading time.

4.3.4. High Flow of Vehicles to Claim in Transit Goods

For the high flow of vehicles, the following root causes were identified: the storing fees and Internal Revenue Service working hours (Figure 5).

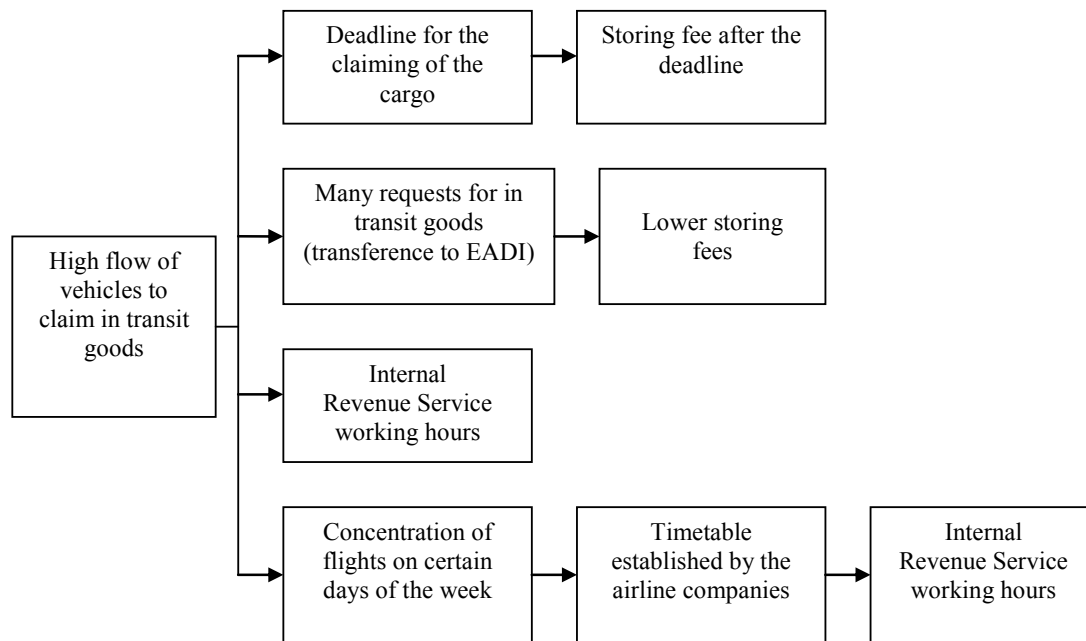


Figure 5 – High flow of vehicles to claim in transit goods.

Due to the fees charged by INFRAERO, the importer usually chooses the in transit alternative, because fees are cheaper. The in transit cargo must be released and loaded within 24 hours after the aircraft has landed. The release of the cargo by the Internal Revenue Service is done from Monday thru Friday, from 8 am to 5 pm.

The airline companies and the carriers defined specific timetables for the unloading and releasing of cargo. The international flights arrivals are concentrated on Fridays, having the cargo released on Mondays for the loading at the import terminal. Nevertheless, the importers who have chosen the in transit alternative are forced to retrieve their cargo by

5 pm, so that they do not need to pay for the storing fees.

Owing to this situation, the flow of vehicles at the import terminal increases very much on this day, leading to the following consequences: risk of accidents, increase in the permanence time of vehicles, overwork for the loading operators, and difficulty in the control of people and vehicles in the outdoor area.

5. CONCLUDING REMARKS

This paper presented an application of the technique known as root cause tree to the cargo terminals of Viracopos International Airport, in Campinas. By means of document survey and visits to the warehouses and outdoor areas of the import and export

terminals, some problems in the loading and unloading of cargo vehicles were identified.

In order to understand the reasons for the occurrence of each problem, root cause trees were constructed. Results indicate that the cargo terminals are not prepared to meet the needs of the road transport. This jeopardizes the performance of this transport mode and may also interfere in the operations related to air transport.

It is important to mention that the participation of the employees in charge of the terminals for the identification of the problems and their respective root causes would have contributed to obtain more complete and representative results. However, their participation was not possible due to time restraints for the visits.

The application of the root cause tree helps the development of adequate corrective measures. Calabrezi (2005) presents some examples of measures that could improve the operations of the road transport:

- Increasing the width, and eventually changing the layout of the export terminal platform, in order to allow the unloading of open vehicles;
- Creating an area for cargo inspection at the export warehouse, so as to avoid

the accumulation of cargo on the platform;

- Improving the division of the import warehouse and buying adequate equipment to facilitate the movement of large cargo;
- Evaluating the possibility of changing the Internal Revenue Service working hours, in order to avoid the accumulation of vehicles that claim in transit cargo.

It is considered that the systematic study of the problems related to the road transport, and also the ones related to air transport, as well as their root causes, might contribute to increase the efficiency of the operations at the cargo terminals of Viracopos International Airport.

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