

# **Informational Flow Mapping in The Context of Fertilizer Importation Logistic Operations in The Port of Paranaguá, Paraná, Brazil**

**Dra Luciane Scheuer**

Department of Administration –UNESPAR, Paranaguá (Brazil) [luciane.scheuer@hotmail.com](mailto:luciane.scheuer@hotmail.com)

**Dra Elaine Cristina Lopes**

Department of Administration –UNESPAR, Paranaguá (Brazil) [elaine.lopes@unespar.edu.br](mailto:elaine.lopes@unespar.edu.br)

**Giovane Lopes Gonçalves**

Graduate researcher in administration –UNESPAR, Paranaguá (Brazil)  
[gico.lopes20@gmail.com](mailto:gico.lopes20@gmail.com)

**Gustavo Carneiro Alves**

Graduate researcher in administration –UNESPAR, Paranaguá (Brazil)  
[guga42014@gmail.com](mailto:guga42014@gmail.com)

**Jean Castro Policarpo**

Graduate researcher in administration –UNESPAR, Paranaguá (Brazil)  
[jean-castro.pll@live.com](mailto:jean-castro.pll@live.com)

**David Fleck Crystian Matozo**

Graduate researcher in administration –UNESPAR, Paranaguá (Brazil)  
[David.fleck96@gmail.com](mailto:David.fleck96@gmail.com)

## **Abstract**

*Due to the relevant growth of fertilizer importation in Brazil and the great incentive for its use in agribusiness, this study aimed to present the sharing of information from the perspective of the informational flow mapping of fertilizer importation in Brazil using the Port of Paranaguá, as example, seeking to verify the importation chain from the origin to the final destination, using the observation method since it could emphasize the research and thus show the complete mapping of this informational chain. The study was carried out in companies which work in the fertilizer importation and storage sector in the Port of Paranaguá, Paraná (Brazil).*

**Keywords:** Strategic information management; Informational flow; Fertilizer import.

## **1. Introduction**

The world business context has been marked in recent decades by the advancement of management models

supported by new technologies, which consequently leads to an exponential increase in competitiveness. In this sense, it is natural for companies to look for ways to survive and stand out in this scenario.

One of the biggest focuses in this highly competitive environment has been the increasing amount of information that is disseminated all the time, on different areas and with the use of various information and communication technologies (ICTs), making the business world immersed in a very informational context. Many authors corroborate that we are experiencing the “Information Society” or “Knowledge Society” (CASTELLS, 1999; MORIN, 1991; CHOO, 2003; DAVENPORT and PRUSAK, 1998; NONAKA AND TAKEUSHI, 2008; VALENTIM, 2007).

From this perspective, companies are using information as an input more intensely than in other decades, and this can represent both a risk and an important strategic tool. In this last case, it is argued that informational mapping can be an important tool for analyzing the situation of a company related to relevant information, considering that it is able to clearly indicate each step, point out gaps and establish diagnoses. In this sense, the present study aimed to map the information flow in the framework of the logistics operations in a fertilizer importation company that operates at the Port of Paranaguá, Paraná State, Brazil. This study sought to map the existing information flow in all stages of the logistical process in order to understand the steps, offering an informational panorama able to support strategies for the company as well as new studies.

It is understood that the information flow mapping may be able to contribute to the optimization of the logistics operation, considering the intensity of the fertilizer flow in Paranaguá, as well as the competitiveness on a global scale, which promotes an environment where operations need a lot of discretion regarding timing and efficiency in the processes. Thus, this research sought to understand the information flows in this process by mapping and analyzing each point in order to identify which information is actually relevant from the importer to the arrival at the farm, which would be the final stage of the process, and how the port, warehouse and carrier act in this context.

## **2. Theoretical reference**

### ***2.1 Business informational flow***

Considering the organizational perspective, it is argued that information is one of the most important inputs, being present in everything the company does. As it is an important input responsible for both communication and strategic support, it is extremely important that companies pay close attention to the ways in which information is used.

McGee and Prusak (1994) emphasize that in the companies, information can be compared and is becoming an asset as important as others, such as capital, properties, human resources and material goods, considering that all of these need to be managed.

In this sense, many companies already recognize the importance of understanding the information flow as one of the most important resources of the company in order to be able to stay in the competitive environment where they are inserted, because it is through the information flow that the organization is able to efficiently map which are the information that should be used as an aid tool and what information should be used as a strategy tool. From the information flow mapping, the company can have a more

effective overview of its processes and thus build knowledge about the internal and external environments and on its management.

For the organization to achieve its goals, it is essential that the chain elements of the company's process are in line, thus minimizing losses due to the transfer of discordant and inconsistent information during the process, especially in critical interfaces, such as cross-functional ones (Correia and Almeida, 2002).

It is important to mention that the implementation of the information flow analysis approach in the organizations involves the need to know and understand the stages of processes that are often done routinely, and the speed with which such processes are carried out often does not allow an return analysis based on time, implements, people, systems, among others thing involved in the processes.

From this perspective, Correia and Almeida (2002) also add that the information from these flows is often improperly originated, processed, used and destined, which reduces the efficiency of the processes.

The information flows are guided, among other aspects, by the organizational communication, considering that they are understood as a result of the formal and informal interaction process among sectors and individuals in a given organizational context (Valentim and Zwaretch, 2006).

Regarding formal and informal flows, Lopes (2010, p. 30) defines:

Formal flows are resulted from the company's structure, that is, routines and elements applied to the productive activities, being related to the company's organizational chart. In this case, the recorded information runs through the company's formal systems, such as: corporate portals, intranets, reports, records, documents containing rules and codes, among others. And in the form not registered there are formalized meetings, courses and events, but not registered in any type of support. As for informal flows, these can arise spontaneously, during a meeting or even in conversations between employees, being related to the intellectual structure of each individual working in the company. It is noteworthy that informal flows, in general, take the unregistered form, considering they are non-formalized dialogues and interactions among subjects and, therefore, not registered in supports (Lopes, 2010, p.30).

In order to make it possible to manage these informational flows, whether formal or informal, it is essential that the company establishes and conducts integrated actions aiming at prospecting, selecting, filtering, processing and disseminating all information including documents and databases, produced internally and externally to the organization until individual recognition of the different individuals and actions existing in the organization (Valetim, 2002).

In this context, it can be argued that business informational flows are part of the entire business context. It is essential that the company knows and understands this flow and knows how to use it as a strategic tool.

## **2.2 Exportation logistics**

The industrialization process in Brazil took place at the beginning of 1940, and from this decade on, the government encouraged the fertilizer factories. Brazil uses about 6% of all fertilizer commercialized in the world, in addition it can be listed that 70% of all fertilizer in Brazil is imported, being dependent on the world supply, using the means of transportation by road, rail and waterway modals.

### 2.2.1 Logistics solution

The inter-modality of the logistics process is the way to obtain lower costs in cargo transportation. Inter-modality is obtained from a succession of stages, characterized by the use of more than one modal for cargo transportation. The first phase is the movement, characterized only by the use of more than one modal. In the second one, there is an improvement in the efficiency of integration between the modals such as the use of containers and instruments for the transfer of cargo between one modal to another (this is defined as the moment of multimodality, which is the current phase of the Brazilian scenario (Neto, 2014).

### 2.2.2 Port of Paranaguá

The port of Paranaguá last year has been in first place in terms of fertilizers importation, being one of the main products handled in Paranaguá, with 20% of all product handled. The strongest point of Paranaguá is the efficiency and practicality of the discharge, fulfilling goals established by APPA and other regulatory agencies. In a future projection, the Port of Paranaguá intends to handle around 9 million tons in 2030.

### 2.2.3 Importance of information in the context of logistics operations for exportation

The flow of information is very important, not only in logistics operations, but in all segments. Information in logistics has an emphasis on a dynamic environment, with constant changes and in Paranaguá, the flow of information among all those involved is very relevant for the success of the high volume of fertilizers handled. Besides competitiveness, the companies work as stakeholders, partners in handling, always seeking the union in favor of the continuous growth of the Port of Paranaguá. This exchange of information between regulatory agencies and companies, makes port to have greater efficiency in unloading and a better logistics flow.

All information is shared with everyone who is part of the logistics chain operations so that the port has corrections and adjustments that impact on improvement and efficiency. Therefore, what is observed is that this information is more important than the operational capacity of the agents involved. With this information, several alternatives and changes can be applied and maximize attitudes, which positively impacts the logistical success and good final results to the Port of Paranaguá.

## 3. Methodological procedures

This study is presented with an essentially qualitative typology, having been supported by the participant observation research. As for participant observation, May (2001), argues that the great advantage is that the researcher can establish a relationship with the investigated ones, because the observer participates in the process which he is researching, allowing a deeper interpretation of the context.

In order to achieve the objectives, it was also used a case study, which can be understood as:

[...] a method that covers everything - with the planning logic incorporating specific approaches to data collection and data analysis. In that sense, the case study is neither a tactic for data collection nor merely a feature of planning itself, but a comprehensive research strategy (YIN, 2001).

### **3.1 Characterization company**

As this study is about importation, it was not used a specific company, it was chosen the Port of Paranaguá, one of the main fertilizer entrance places in Brazil, being responsible for about 30% of all fertilizer imported and it also distributes the fertilizer to other regions of Brazil such as Southeast and Midwest. In this way, the Port of Paranaguá has great relevance for the flow of this product importation, which has enabled the researchers to analyze some points such as: the ships arrival management, the spaces for mooring management, whether there is space for the products landing and whether they already have the means to deliver them to the final consumer, all of these points are very relevant in structuring the mapping.

## **4. Results presentation and discussion**

This paper sought to map, from the perspective of informational flow management, which are the main points inherent to logistical processes in the context of the fertilizer importation sector, considering the beginning of the process, that is the importer, until the arrival at the final customer, pointing out the main strategic information related to each stage of the logistics process. In this sense, the presentation was categorized according to the structure of the observation script that sought to identify each logistical step and the relevant information generated, the following categories and subcategories bellow:

### **Category 1: Purchase specification**

Subcategories 1: as for the producer, as for the product, as for the mean of transportation, as for the terms, as for climatic issues, as for the price.

### **Category 2: Importation monitoring**

Subcategories 2: as for the time of ship departure, as for the route, as for the quality control of the product in the course, as for the arrival at the destination.

### **Category 3: Arrival at the Port terminal**

Subcategories 3: as for the choice of the terminal, as for the ships programming, as for the control of the Port internal logistics, as for storage.

### **Category 4: Transportation and the choice of modal for shipment to the buyer**

Subcategories 4: as for the railway modal, as for the road modal, as for the costs.

It is also noteworthy that both registered information (documents) and unregistered information (based on observation) were considered, so this way it was also possible to identify the document flow of the processes. Next, the categories, subcategories and the respective information that make up the information mapping are presented.

### **4.1 Category 1: Purchase specification**

#### **4.1.1 As for the producer**

The countries from which Brazil imports the most vary according to each type of fertilizer, and in most cases, in order to be able to import fertilizers, it is necessary to have an authorization document for importing fertilizers, inoculants and correctives, which can be done by individuals or companies, and it is need to require for an authorization with import license, invoice, analysis certificate and cargo knowledge.

Between January and June 2019, Urea was most imported from Algeria (21%), Russia (16%) and Qatar (12%), Ammonium Nitrate come in a greater quantity from Russia (72%), Ammonium Sulphate came mainly from China (64%) and Belgium (18%), MAP had a great demand from Morocco (22%), Russia (20%), and USA (17%), whereas the main DAP countries were the USA (71 %) and Saudi Arabia (15%), while Potassium Chloride was most imported from Canada (32%) and Russia (26%).

#### 4.1.2 As for the product

There is a large amount of fertilizers that are imported into Brazil, such as Urea (used to replace this nutrient in fertilizers), Single Superphosphate (SSP, is widely used in soybean crops), Triple Super Phosphate (TSP, has a high concentration of phosphorus), Ammonium Sulfate (widely used in several crops and can be used for its replacement), Potassium Chloride (KCl, main supplier of potassium, widely found in NPK in Brazil), Diammonium Phosphate (DAP, widely used for concentrated fertilizers and is a great fertilizer for wheat and corn), Monoammonium Phosphate (MAP, widely used by the industries for fertilizer mixtures but can also be used in its pure form) and Ammonium Nitrate (it is an efficient and fast nitrogen fertilizer but has some restrictions).

#### 4.1.3 As for the mean of transportation

The imported fertilizers are generally sourced from countries in Europe, Asia and North America, so the method usually used is waterway one, the ships bring to Brazilian ports and after the arrival at the port, the products are delivered to the factories by trucks or trains.

#### 4.1.4 As for the terms

The time for the arrival of the fertilizer at the port varies in several aspects, such as if the product is already ready, if it was packaged correctly, in which container it will be placed, which will be your ship, in which port it will be loaded, which will be the modal to be delivered to the destination, how it will be placed in the truck or train, how the fertilizer will be removed from the container or if it will arrive at the destination inside the container. Therefore, everything must be defined in advance so that it is possible to safely predict the arrival of the product.

#### 4.1.5 As for climatic issues

The climatic conditions are a very important factor to be considered because the product must be well packed and the container must not have any damage, as in case of rain the product can be wet and damaged. The climate is not something that directly affects fertilizer, because if the harvest is not in a good season, as lack of rain it can directly affect agriculture and reduce the demand for the product, thus reducing the desire to import (Thomazella, 2019).

#### 4.1.6 As for the price

Brazil is a big consumer of fertilizers and as there are no taxes on fertilizer importation, it is more convenient to buy from countries on other continents than to buy from the states in Brazil, due to high taxes on Brazilian logistics. Thus, according to Fontanari and Pereira (2019) in February 2019, the fertilizers

with the highest price are MAP (425.8 USD), potassium chloride (355.0 USD) and TSP (332.5 USD).

## **4.2 Category 2: Importation monitoring**

### **4.2.1 As for the time of ship departure**

In Paranaguá Bay – PR it was observed that the average size of the ships varies between 199 and 214m, with an average of 60 thousand tons per ship and the time for unloading and loading is done under agreements between suppliers and importers, varying from 3 to 10 days on average. The entire process between arrival, mooring and departure is measured according to the lineup that each port makes available, thus the daily average regarding the time of ship departure can be visible to make the data effective. Weather conditions must also be taken into account during the period in which the ship is operated.

### **4.2.2 As for the route**

The average time of the route is measured considering the route on which the ship will sail. This route is carried out under the orders of the captain therefore, the route is pre-established by the course of the route before the ship leaves until its final destination. However, the ship's route can be altered by external factors defined by the captain, such as weather or supply factors.

### **4.2.3 As for the quality control of the product in the course**

The quality control of the product is carried out during the ship loading procedure at the origin, and during the unloading of the ship at the destination, that is, during the journey, quality control is not carried out, however the control is carried out before the ship is loaded and during the unloading process. For such verification, professionals and companies specialized in quality control of the loaded products are designated, this investigation aims to have products with excellence, as there are products that cannot be influenced by other agents, such as humidity, for example.

In order to avoid this kind of problem, some data about the ship is carried out, such as age, material, flag and which were the last loads carried.

For products loaded in the Port of Paranaguá, for example, the quality control is carried out right after the arrival of a loaded truck in the city, so that there is no contamination of the product in the storage, this means that the cargo of a contaminated truck is not mixed with the other cargoes that will be loaded in the ship.

### **4.2.4 As for the arrival at the destination**

After the entire loading process and choosing the route, the unloading process is carried out, being coordinated by the ship's captain. Reports are generated with notifications related to the ship's conditions, its positioning and arrival forecasts so that then the average time of the journey can be predicted and if the ship will be able to reach its destination on the scheduled date.

Upon arrival at the destination, the captain sends a communication called NOR (Notice of readiness) that complements the NOA (Notice of Arrival) which basically includes the notification that the captain is informing that the ship has arrived at the port anchorage and that it is already ready and willingness to carry out the stipulated operation. This document is very importance for all parties involved, as it is based on it

that premiums or fines will be stipulated for the delay or not in the operation.

### **4.3 Category 3: Arrival at the Port terminal**

#### 4.3.1 As for the choice of the terminal

The ports of Paraná totaled an amount equivalent to US\$ 1.4 billion in landings until the middle of 2019, representing 34% more than the previous year. With these data it is noted that the Port of Paranaguá receives the amount that represents 30% of all fertilizer imported by Brazil, characterizing this port as the main importer port of Brazil.

It can be evidenced that there is a total of 299 tons landed per hour, and for that purpose the Port of Paranaguá has great efficiency and a structure, highly prepared to receive this enormous amount of cargo. The landings present the types of direct landings (by trucks) and landings by dalas (carriers) that are directly connected to warehouses, improving the flow and speed of the products transportation. The warehouses that receive fertilizers are close to the port, thus avoiding major bottlenecks.

It was possible to verify during the observation, based on daily documents and analyzes, that over the years Paranaguá has expanded in the territorial context, with the Port of Paranaguá becoming more modern, however the city did not follow the tendency of the port growth regarding the structure, which has generated some bottlenecks in the landings due to the proximity of the warehouses. It happens because with the exponential growth of the port, the flow of landings increased considerably and, consequently, the flow of trucks also, which generates huge queues in periods of great peaks, causing disturbances in the region and complications in the landings.

#### 4.3.2 As for the ships programming

The programming of fertilizer ships is done with data provided by dispatchers, shipping agencies and port operators that daily enter data using the Paranaguá and Antonina Ports Association (APPA) system. Dispatchers make the documents clearance, such as the Bill of Lading, called BL's, at the APPA and IRS (Internal Revenue Service).

These documents make up the ships' documentation, they are managed by a maritime agency that does all the processing, such as: the negotiation with the importer, selling the option of fast landing in Paranaguá after every deal that occurs in the Fertilizer Meeting that takes place at APPA. However, when ships go to the meeting, they must be duly cleared by APPA and IRS (Internal Revenue Service), documentation that is the responsibility of the Port Operator which does the operational management, landing and logistics to the warehouses of the importer's choice. Thereafter, the port operator daily inserts in the APPAWEB system the distribution of the ship, specifying the product, the importer and where the product will be landed. The control of this distribution is supervised by APPA. After 100% released by the agencies, the maritime agents participate in weekly meetings at APPA in order to know which ships will be "next". It was possible to observe all the criteria used in the meetings, such as which ships are preferred and which are not. The moorings are elaborated by APPA using a daily LINE UP.

#### 4.3.3 As for the control of the Port internal logistics

It was possible to follow in real time everything that happens in the internal logistics of the port, knowing



which ships are moored, their arrival and departure times, which agencies and operators were working on the ships, the way of all products (if it is importation or exportation), all of this was possible using the Graphic Map that is made available on the official APPA website. It is a good option for future importers that are looking to analyze the times and deadlines for landing their products. It is also possible to access data about the number of trucks that can enter the port range.

#### 4.3.4 As for storage

The Port of Paranaguá, in relation to fertilizers specifically, does not work with internal storage in the port area. All landings are carried out by direct unloading or carriers, due to the fact that the port does not have an extensive physical area, in addition to the fact that all warehouses are located around the port, which facilitates the logistics of the importer since it will be easier to move this cargo to the producers. All fertilizers that are landed in Paranaguá serve producers in Paraná, in addition to the states of Mato Grosso, Mato Grosso do Sul, Goiás, São Paulo and Minas Gerais.

### **4.4 Category 4: Transportation and the choice of modal for shipment to the buyer**

#### 4.4.1 As for the railway modal

According to the Brazilian National Land Transportation Agency (ANTT), the railway modal is characterized by the ability to transport large volumes efficiently, especially when traveling medium and long distances. The railway modal is the most secure, with the lowest accident rate and the lowest incidence of theft and robbery. Among the typical loads of the railway modal are fertilizers, which are the object of this study. Brazil has the largest railway system in Latin America in terms of transported cargo, reaching 162.2 billion tons per usable kilometer.

Paraná has 2,400 km of railroads and ANTT is the regulatory agency and being divided into two concessions:

- 2,039 km concessioned to América Latina Logística (ALL).
- 248.5 km concessioned to the Government of Paraná State, being managed and operated by Estrada de Ferro Paraná Oeste S.A. - FERROESTE.

#### 4.4.2 As for the road modal

The road transportation is responsible for transporting 58% of all the country's cargo on federal highways. According to Rodrigues (2003), federal highways are divided into five types of "BR's" that cross the country:

- BR Radial - start in Brasília, numbered from 1 to 100;
- BR Longitudinal - North-South direction, numbered 101 to 200;
- BR Transversal - East-West direction, numbered 201 to 300;
- BR Diagonal - diagonal direction, numbered 301 to 400;
- BR Connection - join the previous ones, numbered 401 to 500.

Transportation by road, despite being the main modal in the country, has insufficient legislation and several problems linked to it, such as theft and deviation of cargo that generate losses of US\$ 32 million per year on average.

#### 4.4.3 As for the costs

The road modal, although being responsible for carrying more than half of the cargo transported in the country, has relatively higher costs when compared to the railway modal.

According to the Department of Research and Economic Studies of Bradesco (DEPEC, 2011), the railway modal cost from R\$ 15.00 to R\$ 26.00 per 1000 ton/km, while the road modal cost from R\$ 35.00 to R\$ 45.00 per ton/km.

## 5. Final Considerations

The aim of this paper was to describe and analyze the informational flow of the logistical operations management of fertilizers importation, with the perspective of the criteria used to carry out the stages of importation from the origin to the arrival at the final destination. For such analysis, a mapping of the information flow was carried out regarding the stages that permeate and that are important to these processes, using participatory observation based on a previously established script as a method.

The chosen environment for the research and case study was the Port of Paranaguá, which has great importance in the fertilizer importation logistics sector in Brazil, being considered the port that handles the largest volume of fertilizers in the country.

In relation to the logistical process, the central axis of this paper, it includes characteristic elements of a structured information flow, that is, the flow of information is highly efficient in supporting the processes carried out. The informational flow when it is well structured provides good communication, a fundamental item when it happens in an environment with a diversity of agents acting.

It could also be observed that there are improvements in the Port of Paranaguá, these improvements brought greater efficiency in the logistical processes of fertilizers importation, as well as in the generation of relevant information and document management. Such improvements are related to technological advances, especially in relation to updates to the port informational flow management system, thus obtaining better process results.

The sharing of information in the fertilizer importation process was considered as one of the main agents in the quality management of the Port informational flow, which makes it possible to identify problems in a timely manner, as well as to create solutions.

Therefore, the dissemination of information within the port logistics process is one of the main contributing agents for the improvement and efficiency of the processes. In this regard, it could be seen that the adequate dissemination of information among agents makes the optimized informational flow one of the main organizational tools in the search for excellence in this context.

In view of the observed aspects, it is concluded that the informational flow mapping can be considered as one of the main organizational tools related to the diagnosis of processes. It is noted that due to its numerous possibilities in relation to the broad visualization of the stages, it is possible to collect information, analyze documents, access data and build holistic knowledge in order to diagnose and create solutions and improvements.

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