

# Customized e-Doc to expedite the Brazilian animal protein export process by sea

Maria L. R. P. Dias, Vidal A. Z. C. Melo, Enio A. M. Pereira, Daniel Rocha, José L. R. Vargas, Clever P. Avila and Eduardo M. Dias

**Abstract** - In Brazil, on 2012, the export by sea was responsible for 96% (525 million of tons) of the cargo shipped abroad. According to data of October of 2013, the animal protein was the second main agribusiness product exported, reaching 16.9% (US\$1,431 million) of the sector's total transactions. The optimization of the export process impacts directly on its cost, therefore, on the competitiveness of the product on the market. This article presents a technological proposal to improve and streamline the Brazilian export process of animal protein by sea. The solution is based on ITS and Secure Supply Chain concepts applied to a management system, with new operational notion. The system underlies on a customized e-Doc, named Canal Azul Eletrônico (CA-e) and technologies (media, equipment and software engineering), like RFID and PKI, which allow the field to embrace the information technology. Its impact was measured over two practical case studies, which demonstrated significant benefits when adopted the proposed technological solution.

**Keywords** - Animal Protein exportation, Intelligent Transport Systems, Near Field Communication, Secure Supply Chain, Tamper Proof, Traceability.

## I. INTRODUCTION

WITH 8,514,876.599 m<sup>2</sup>, Brazil is the fifth largest country in the world (preceded by Russia, Canada, China and USA, in this order) [1]. With a coastline of 7,367 Km [1], is no surprise that, according to 2012 data, 96% of the cargo shipped abroad, which is about 525 million of tons, is transported by sea [2].

Brazil has 33 public ports, 128 Private Use Terminals (TUPs) and 6 Cargo Transshipment Stations (ETCs) [3], however, however the logistic transport of the cargo and the bureaucratic processes interferes with the agility to release the cargo. To have an idea of the impact, on 2012 around 56.5%

This work was developed by the Polytechnic School of the University of The present article is an extended version of the article "Blue Path for exports of animal protein" [6].

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of the total container vessel laytime (for import and export) was inoperative [2], as presents table 1.

Brazilian's ports		
Number of berthing		9,744
Average total time (hours)	Laytime (A) = (B + C)	36.3
	Berthed (B)	20.6
	Berthing waiting time (C)	15.8
	Operation (D)	15.8
	Time without operation (E) = (A-D)	20.5
% of the vessel inoperative time (E/A)		56.5

Figure 1 - Average vessel inoperative time in Brazilian's ports.

Adapted from [2].

As a consequence, there is an increase on the export cost per container unit. According to [4], between 189 countries considered, on June 2013 Brazil was on the 124 position on the Trading Across Borders rank, based on Doing Business - measuring business regulations, which "measures the time and cost (excluding tariffs) associated with exporting and importing a standardized cargo of goods by sea transport. The time and cost necessary to complete every official procedure for exporting and importing the goods are recorded; however, the time and cost for sea transport are not included. All documents needed by the trader to export or import the goods across the border are also recorded" [4].

In order to export from Brazil, it is necessary 6 documents, 13 days and US\$2,215 per container [4], numbers very different from Singapore, leader of the rank. To export from Singapore one will need 3 documents, 6 days and US\$460 [4]. It is clear that the number of documents and days interfere on the cost, thus on the competitiveness of the country.

Considering Brazilian agribusiness products to export, on October of 2013 the second main product was animal protein, reaching 16.9% (US\$1,431 million) of the sector's total transactions in that month [5]. This number is composed by the sum of 3 kinds of animal protein products: cattle, chickens and pigs.

Treated individually on the agribusiness products rank regarding the month of October of 2013, the cattle is on the fourth position (US\$658 millions turnover), the chickens is on the sixth position (US\$631 millions turnover) and the pigs are on fifteen position (US\$142 millions turnover) [5].

The Ministry of the Agriculture, and Provisioning of the Land reform (MAPA) and the Secretaries of Agriculture of the state, where occurs the production, are responsible for the quality control of the production process of animal originated products, as well as for the quality of the product itself.

MAPA has some public agencies, such as the Federal Inspection Service (SIF) and International Agricultural Surveillance (Vigiagro) that intervene in the process. The SIF "evaluates the quality control in the production of animal food, called the Federal Inspection Service (SIF) and composed by fiscals with veterinary formation" [6]. The Vigiagro "is engaged in inspection and supervision of the international transit of plants and animals, working and cooperating with bilateral agreements defined by the specific rules of each importing country" [6].

Brazilian's laws demand that there is a SIF unit in each establishment that has an animal as an input on the production line. Also, there must be a SIF unit in each logistic warehouse that acts along the supply chain of products of that nature.

Each SIF is recognized by a unique number, therefore capable to identify the corresponding productive establishment or logistic warehouse. Thus, by obliging the food package to have a printed label of the SIF number, it is possible to know where that food came from.

"The SIF brand is present in more than 180 countries. Are more than four thousand SIFs across the country, supplying the domestic market and abroad with more than 15.000 registered products" [6].



Figure 2 - Example of a SIF stamp

When the animals are delivered at the industry, SIF inspectors verify the conditions of the animals and vaccination certificates, and if they were properly identified by their origin (farm from where it came) and separated into batches.

The separation of batches in accordance with the animal's characteristics is primordial to verify the markets that the feedstock is allowed to attend.

SIF inspectors are positioned into inspection lines to verify the sanity along the productions lines. If they verify any problem with the product they segregate it and route it for a proper destination, such as incineration.

Also, they "control the process until the processed foods reaches the retail, issuing certificates accompanying merchandise and sealing containers after load. There are two main types of certificates: the CSN is intended for the domestic market and the CSI for the international market" [6].

"The VIGIAGRO is engaged in inspection and supervision of the international transit of plants and animals, working and cooperating with bilateral agreements defined by the specific rules of each importing country.

This entire operation is aimed at a single goal: to ensure food security to the Brazilian people and their trading partners" [6].

Considering the dimensions of Brazil [1], the number of ports along its coastline [2] [3], the role of animal protein in the agribusiness [5], thus, the amount of industries of that nature spread along its territory [6], and the state of Brazilian's logistic network, that is slower and more bureaucratic than desired [4], it is clear that the Brazilian animal protein export process by sea faces serious difficulties to deliver the product to the retailer, which impact on the results and competitiveness of the sector.

Given this reality, the Polytechnic School of the University of São Paulo (POLI) supported by FINEP, a federal governmental financing agency, developed the Secure Supply Chain project, which aimed to improve the logistic of the supply chain of cargos destined to or originated from transport by sea.

International safety standards recommendations established by organizations and governing bodies for trades by sea, such as the International Ship and Port Facility Security Code (ISPS Code) of the International Maritime Organization (IMO), must be respected while developing the solution.

Also, must be taken in account Brazilian's government growing tendency to adopt electronic documents and the benefits perceived by its adoption. For example: Electronic Invoice (NFe), Electronic Bill of landing (CT-e) and Electronic Tax Documents Manifesto (MDF-e) [7], [8], [9].

The objective was to develop a technological solution to improve Brazilian export by sea logistic, respecting international recommendations for trade and transport by sea (made by recognized and respected agencies).

The proposed solution simplifies and speed up the refereed export process by adopting an electronic document, named Electronic Blue Path (CA-e), and others technologies, meaning technology an "equipment, media and software engineering that permit to extend the information technologies to the field, aiming to improve and streamline operations" [6].

While interviewing members of MAPA, some potential areas for improvement were identified along the export process of products of animal origin. The areas involved the documents required and issued by SIF and Vigiagro.

The object of this work is a technological solution to the current paper work process executed by SIF and Vigiagro, based on issuing a document that exists only electronically (the CA-e), and letting the information be available faster to all the actors, as the degree of access previously available to each of them.

This article was divided in 5 chapters. The first is an introduction that puts in context the Brazilian export process, specially the one of products of animal origin. It also explains the object of the research presented and the structure of the article. The second chapter presents the current export process

of products of animal origin in Brazil. The third chapter presents the process proposed and technologies applied. The fourth chapter presents the expected benefits from the solution implementation. The fifth presents two practical case studies. The sixth chapter presents the conclusion.

## II. BRAZILIAN ANIMAL PROTEIN EXPORT PROCESS BY SEA

Presenting in a simplified way, the current Brazilian export process by sea begins with the negotiation between Brazilian seller and an international buyer, which, after reaching a common agreement, generates a purchase order. "In them, and based in international health agreements, are defined the products, the origin of the animals, the type of processing, the storage conditions, the deadlines and business values involved" [6].

The products demanded by the purchase order start to be produced at the industry, in other words, the animal starts to be processed. The input goes through the whole production line (which includes SIF's inspections lines), until results on packaged finished products.

Those products have to be dispatched to their final destination. In order to do that, the logistic department requests "the refrigerated containers to shipowners and their seal that will accompany the load." [6]

The container for shipment must pass through a preliminary inspection, executed by a SIF supervisor. This inspection certifies that the inspected container is able to transport food.

The certified refrigerated container is then brought into the loading area where it will be loaded. "throughout the loading process, the supervisor of the SIF monitors business operations to ensure that all health conditions were obeyed." [6] After finished the cargo load, another seal is applied to the container. This is a numbered seal, which "number is controlled by the SIF. (...) Note that the seal of the SIF is different from the seal of the shipowner mentioned earlier, so after shipment, the container leaves the industry with two seals." [6]

Even though the container is sealed, the cargo documentation might need some complementation, in which case the container goes to a waiting area.

"The authorities in Brazil, requires the seller to issue an electronic invoice called NF-e. The NF-e is a document that exists only in electronic format and can be printed in the form of an extract called DANFE, containing some of its informations. Since 2007, all operations of purchase and sale of goods in Brazil are controlled by NF-e and authorized electronically by the tax authorities before the goods leave the industry.

Depending on the shipping company or logistics process, the producer sends other documents containing information about the cargo, packaging process and other important information for the operation." [6]

The final document to be issued before leaving the producer establishment is the International Health Certificate (CSI), which certifies that the product complies with the demands from the country that will import it.

To generate a CSI the competent employee of the industry

must access the Management Information System of the SIF (SIGSIF), input all the information requested by the system to generate the CSI, print the form, and send it to the SIF unit corresponding to the producer industry to inform the SIF that the CSI is read to be issued.

The SIF agent, after receiving the paper form from a representative of the producer industry, "manually check if all documents were generated correctly and accesses the SIGSIF to perform CSI printing on plain paper or secure paper (depending on the destination country), sign and stamp the documents giving permission to the sealed container leave the industry." [6]

Finally, the container has all the documentation necessary to be transported. "All documentation, including the original copy of CSI, must accompany the cargo during transportation." [6]

In Brazil the vast majority of the transport is executed by road transport [10], and the modal of option on the animal protein supply chain is no different.

In this point is also valid to remind that our focus is export by sea, therefore, even though the export transport can be destiny to the port, airport or boarder crossing, the destination point considered is the port.

The vehicle and the container are subjected to inspection by police officers along all the course of the transportation. "if they suspect something, *[they]* have the authority to break both the seals and check the load.

Once broken the SIF's seal, the container has no more health validity and is necessary to remove back to the industry or to some other place that has SIF operation to restart the whole process of steaming again." [6]

The customs broker "represented by an individual, outsourced company or internal department of the exporter (...) manage all matters relating to the export and release of loads by the authorities." [6]

When the container gets to the terminal, the terminal operator "sends another document, commonly called "cargo presence", and which has the purpose of informing the health and tax authorities that the goods are in a certain place and awaits the export processes." [6]

The customs broker sends an employee to collect, at the terminal, the documents regarding the cargo (the documents the truck driver carried with him along the way and the cargo presence) in order to initiate the load's clearance process.

"The clearance process is extremely complex and involves tax authorities, local authorities, shipowners, police, health authorities and other agents of few importance for the study." [6]

Regarding MAPA's procedure and documentation to export products of animal origin, it will depend if the product is edible and how it was transported [11].

There are four categories [11]:

- 1) Edible products of animal origin (meat, fish, dairy, eggs, honey and its derivatives, natural casings and ready meals - containing as an ingredient, animal products) - Shipment Loose Cargo Load or Conventional.
- 2) Edible products of animal origin (meat, fish, dairy, eggs,

honey and its derivatives, natural casings and ready meals - containing as an ingredient, animal products) - Cargo exported in sealed container or truck.

- 3) Animal by-products and inedible or organo-therapeutic purposes origin - Boarding or Conventional Loose Cargo Load (transshipment of goods to the hold of the ship, aircraft, road and rail transport in the primary zone).
- 4) Animal by-products and inedible or organo-therapeutic purposes origin - Cargo exported in sealed container or truck at the origin.

The mapping hereby presented represents the category "b" (edible product of animal origin and cargo exported in sealed container), for which the documentation requirements are the following [12]:

- 1) Application for Inspection of Agricultural Products;
- 2) CSI (issued by SIF), its annexes and additional statements when required by the importing country;
- 3) Registration of Export (extract from RE);
- 4) Invoice;
- 5) Copy of Bill of Landing or Cargo Manifest (after shipment);
- 6) Authorization of IBAMA, in the case of product controlled species (not necessary in the present case: cattle, poultry and pigs).

Thus, "In relation to health authorities, the customs broker needs to issue two more documents: the export registration and the request for inspection of agricultural products." [6]

As soon as the customs broker has all the necessary documents, and is properly registered and authorized, he subscribes a process demanding the examination of the documents by Vigiagro.

Though the customs broker registers the data at the Management Information System of the International Transit of Goods and Agricultural Input (SIGVIG), a computerized system of the MAPA, as provisions of the Articles 9, caput and sole paragraph, and 10 of the Normative Instruction n° 7/2012, "Agricultural federal supervision may require at its discretion, in the course of the proceedings or thereafter, the original documents which have been filed electronically by the applicant", "Original documents shall be retained by the owner for a minimum of five (5) years", and "The use of electronic means will not relieve the user of docketing the original documents when required on specific legislation" [13]

In view of the demand, Vigiagro will issue a Term of Inspection, that will attest whether the order to export will be granted or denied, or if requirements or regularized recorded occurrences must be met, and, if is the case, a Term of Occurrence. [12]

To sum up Vigiagro can take one of the three actions: approve the exportation without further procedures, request reinspection or deny the exportation.

"The result are registered in the request for inspection of agricultural products and, in case of refusal, is recorded a ticket in (...) SIGVIG.

After approval, the customs broker uses the request approved by VIGIAGRO to give sequence along with the other actors in the process.

The customs broker only knows if the processes are accepted, rejected or not considered when returns to VIGIAGRO and calls back the documents presented." [6]

The Brazilian export process of products of animal origin by sea (in sealed container) involves a series of actors, documents, and processes. It also involves "various problems posed by the lack of technology integration among the few systems used and heavy volume of paper documents existing in the operation" [6].

The presented solution proposes a change of processes, allowed by the adoption of information, communication, and mobility technologies, applied in conformity with standards (such as Public Key Infrastructure - Brazil (ICP-BRAZIL), which ensure electronic information credibility and, in line with Provisional Measure n° 2,200-2, legal validity [6], [14].

It also meets the concept of Business Intelligence (BI), which can be defined as "necessity of enterprises to have better access to information for decision making, through visibility at all times into activities at all levels of business." [15]

### III. NEW PROCESS AND THE TECHNOLOGIES APPLIED

In face of the difficulties observed over the Brazilian export process of products of animal origin by sea, a solution was proposed, one that, due to the adoption of technologies, allows a change on the traditional process.

"The proposed solution uses the concept of issuing a health document, called CA-e, that exists exclusively in the digital format, is stored and delivered through electronic-only means, in order to document an operation of container sealing by SIF, with legal validity guaranteed by the digital signature based on digital certificates issued by ICP-BRAZIL.

ICP-BRAZIL is the official public key infrastructure in Brazil, since 2001, allowing electronic documents to be signed and recognized all over the national territory." [6]

The governmental health inspector responsible for verifying and sealing the container (or any agent or entity authorized by MAPA to execute that function) issues the Electronic Blue Path (CA-e).

For that, the competent agent must have a mobile device with the CA-e application (mSIGCLS). He has to register the demanded information on the CA-e form and then he generates the electronic document within the mobile device by digital signing it.

The digital signature has to follow the ICP-BRAZIL standard in order to have legal validity [14]. This action is enabled by the communication via Bluetooth of the mobile device and the cryptographic card reader.

After the authorized entity generates the CA-e, he records a copy of the CA-e on the seal. This action is enabled by the use of Near Field Communication (NFC) technology.

Given that feature, the numbered seal currently controlled by SIF must be exchanged by a seal with a RFID chip with memory storage capacity adequate to the need of the amount of information to be recorded. The seal should adopt, as well, tamperproof technology. Tamperproof technology permits to electronic identify violations attempts, giving even more

security to the process.

Going back to the process flow, besides the copy recorded on the electronic seal, another copy is automatically sent and recorded at the systems central storage by the adoption of 3G cellular networks, after what the backoffice sent a confirmation of the transmission and other parameters needed [6].

Accordingly, the mobile application is set to [6]:

- 1) Allow the login of the user
- 2) Validate the information, generate the CA-e identification number, digital signature, and time stamp.
- 3) Enable the mobile device to operate via Bluetooth to operate with the integrated cryptographic card reader and, by that, enable the generation of cryptographic digital certificates to the digital signatures in accordance with ICP-BRAZIL.
- 4) Enable communication with RFID chips via NFC.
- 5) Enable communication with the solution's central storage via 3G internet connection.
- 6) Have customizable settings based in parameters files defined by the backoffice.

Figure 3 presents an example of a mobile device for field use. Figure 4 presents an example of a cryptographic card reader compatible with ICP-BRAZIL. Figure 5 presents the generating e transmitting process of a CA-e through mobile device.



Figure 3 - Example of a mobile device for field use.



Figure 4 - Example of cryptographic card reader compatible with ICP-BRAZIL. [16]

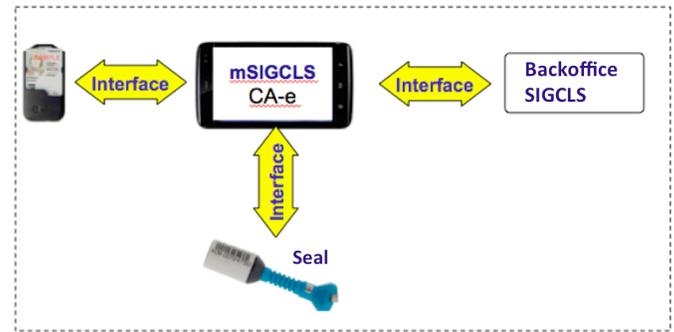


Figure 5 - The process of generating e transmitting a CA-e through mobile device. [6]

The mSIGCLS initiates all communication process with the backoffice. When the CA-e is recorded on the system backoffice, every authorized intervenient can access the CA-e, and, consequently, the information contained in it.

Also, all resulting operations of the CA-e are added to the CA-e and stored in the backoffice, so they are also available to the authorized intervenients through the system.

#### IV. BENEFITS EXPECTED FROM THE ADOPTION OF THE ELECTRONIC PROCESS

The fact that the CA-e has legal validity takes out the need of the original copy of the CSI go along with the cargo. Just for that the proposed system would avoid problems with documentation, such as lost or damage. "One exporter said that the loss of a CSI resulted in an additional cost of U.S. \$ 25,000.00 on the monitoring of container, awaiting the issuance of the new certificate." [6]

Considering the adoption of the solution here proposed, the "the original CSI has value only to the importer and can be sent directly to him" [6].

Besides that, considering that the information is recorded in the seal's chip, by providing the Highway Police mobile devices, it would be possible for their offices to electronic collect and inspect the information linked to the cargo being transported, including attempts of violation of the seal, diminishing the necessity to disrupt the seal to inspect the cargo, and, as a result, the need to take the cargo back to a SIF unit to be resealed.

Also, instead of having to wait for the container to physically get to the terminal, by having direct access to the systems backoffice, hence the information in the CA-e, the customs broker can begin the process with Vigiagro by the time the CA-e gets available in the system.

On the other hand, as soon as all the documents required for Vigiagro to approve, request reinspection or deny the exportation are uploaded on the system, the system communicates Vigiagro, that can initiate the analysis prior to the arrival of the cargo. The analysis can "be carried out as while the container is in transit from the industry to the port, airport, border crossing or special customs." [6]

The process proceeds. A Vigiagro agent uploads the result of his analysis, and, by that, makes the information available to the intervenients, between them the customs terminal, who

"makes use of a mobile device at the gate with an application to query the seal, check the CA-e and inform the cargo presence." [6]

The customs terminal can then analyze the state of the seal (violated/violation attempt or not violated), sum it to Vigiagro's evaluation, and, in consequence of the given combination, take one of the following actions:

- 1) "Seal violated: the terminal automatically moves the container to an area for inspection and the system communicates VIGIAGRO the violation;
- 2) Seal not violated and requested inspection by VIGIAGRO: the terminal now directs the container to the inspection area, avoiding unnecessary movement inside the terminal;
- 3) Seal not violated and cargo granted by VIGIAGRO: the container can now be positioned to export;

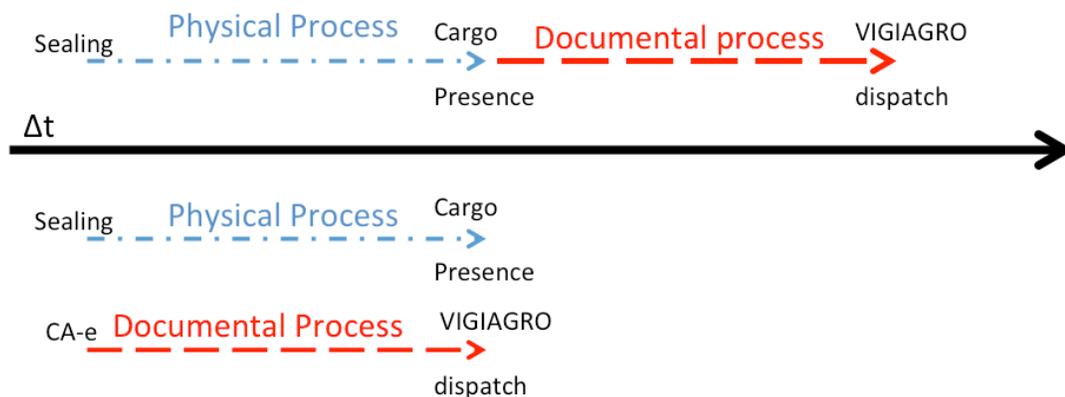
- 4) Seal not violated and cargo refused by VIGIAGRO: the container can be segregated for a specific area or the cargo presence can be rejected at the gate terminal." [6]

If Vigiagro has already evaluated the process by the time the cargo arrives at the terminal, it can be already forwarded to the area where the next step of the process will be executed, avoiding buildup lines in front of the entrance gate, and so preventing the velocity and space losses to movement cargo.

"As can be seen, no information required for the process was suppressed. The technology allowed the changing in the order of the factors and, doing that, all bureaucratic procedures are performed during the shift between industry and the terminal." [6]

Figure 6 presents a graphic comparison between the traditional process and the proposed process (CA-e).

### TRADITIONAL PROCESS



### PROPOSED PROCESS (CA-e)

Figure 6 - Graphic comparison between the traditional process and the proposed process (CA-e)

## V. PRACTICAL CASE STUDIES

The CA-e was presented to members of MAPA, whom, aiming to have concrete data of its benefits, authorized the execution of two pilots, with a total of 400 containers.

One was executed in the state of São Paulo, with one producer, shipping its cargo through the Port of Santos, and the other was executed in the state of Santa Catarina, with a second producer, shipping its cargo through the Port of Navegantes. On both cases the distance between the industry and the port was around 500 Km.

The technologies needed for the implementation of the CA-e were adopted, therefore "The SIFs producers replaced their traditional seals with the RFID seal and his team, the VIGIAGRO team present in ports, the terminal team that controls the gates and the customs brokers team were trained to use the system." [6]

In order to have a proper comparison between the two methods (traditional and CA-e), even though the CA-e was in function, the traditional process was also active, in parallel, permitting to compare times and problems.

The times were measured according to the Issue Date, hereby defined as the time stamp that represents the official start of the process, captured and registered in the system by the electronic sealing.

From the start time were measured the following items:

- 1) "Vehicle travel time between industry and port terminal. This value is obtained by subtracting the value of the date and time of the cargo presence with the value of the issue date;
- 2) Time required after the cargo presence to complete the traditional process. This value is obtained by subtracting the value of the time stamp that the customs broker received the paper request from VIGIAGRO by the time stamp of the cargo presence;

- 3) Time of the electronic process. This value is obtained by subtracting the value of the time stamp of the time VIGIAGRO analyzed the process in the system and the issue date;
- 4) Time required to VIGIAGRO analyze each electronic documentation. This value is obtained by the difference in time stamps between one analysis and another performed by VIGIAGRO." [6]

Both case studies the data pointed out the enormous amount of time to transport the cargo from the sealing point to the port terminal: "about 40% of the traffic between the terminal and the industry is running on a much longer time than necessary. On average, they took 60 hours to travel 315 miles." [6] It demonstrated that the transport of the cargo from the industry to the terminal contributes with to slowdown the export flow, being, in that manner, a logistical bottleneck.

"These data were not measured before because there weren't no system that allowed cross-checking e shows that something is interfering in transit.

The time required to complete the process after the cargo presence in the traditional way were different in the two pilots. At the Port of Santos the process takes on average 57 hours to be released by VIGIAGRO and [at] the Port of Navegantes, the process takes up to 109 hours to be released. (...) these measurements include Saturdays and Sundays." [6] It is important to highlight that in São Paulo Vigiagro do not work on Saturdays, and in Santa Catarina Vigiagro do not work on Saturdays and Sundays.

Summarizing, those 57 hours and 109 hours were the average time to complete all the following procedures:

- 1) Collect the documents that accompanied the cargo by a employee of the customs broker;
- 2) Deliver the collected documents to the customs broker;
- 3) Issue, by the customs broker, of the inspection request;
- 4) Deliver the inspection request to the Vigiagro at a Vigiagro's unit;
- 5) Analysis and dispatch of the inspection request by a Vigiagro agent;
- 6) Withdraw dispatch at Vigiagro

Considering all activities that must be executed so Vigiagro can dispatch the inspection request, it is not hard to conclude the "difficulty of performing all of the above processes in a time less than half the working time (4 hours) or a working day (10 hours), resulting in the completion of only 17.50% of operations during this period.

The data also show that in either case the load can't leave the industry and be released in less than 24 hours, and in less than 48 hours only 10% of the cases can be completed." [6]

The times of the proposed solution were measured "by subtracting the value of the time stamp between one and the sequential analysis made by VIGIAGRO. The electronic process allows the documentation to be considered by VIGIAGRO before the cargo presence at the port terminal." [6]

Based on the verified times of the electronic process, it is save to expect that, as discussed in item IV - Benefits expected from the adoption of the electronic process, by having direct

access to the system backoffice, the terminal agent will be able to forward the cargo in conformance with the analysis of the state of the seal combined with the already available dispatch of the Vigiagro.

Therefore:

- 1) "Processes in which the documentation is correct allow the port terminal to take notice from VIGIAGRO before the cargo presence, stating at the "gate" terminal that the container is "released". The new application for export is issued automatically by the system if the following combination happens: Seal OK + Electronic Grant + Cargo Presence.
- 2) Processes in which the documentation is incorrect results in opening electronic tickets before arrival of the container, allowing the correction without the load sits inside the terminal.
- 3) Procedures in which VIGIAGRO want to perform reinspection, allow the port terminal to has this information in the "gate" entrance, directing the container to a specific area for this operation without needing to move it unnecessarily. Moreover, the "gate" is able to electronically inform the VIGIAGRO how long it need to position the container for the inspection." [6]

Regarding the measured time to Vigiagro anylize one inspection request, the measured average time was about 4 minutes. No analyzis took over 30 minutes.

"This time was mesured comparing the time stamp between the electronic processes, i.e, the time between each differing in the electronic system. Importantly, the analysis performed in the system is identical to that performed on paper, but the data are obtained through the computer screen." [6]

The data revealed an incongruence between the amount of time that takes for the inspection request to get to the Vigiagro agent, and the amount of time that a Vigiagro agent takes to anylize the request. Given technology provides means to facilitate the distribution of pertinent information through the intervinients, in a secure, valid and faster way, it would be unlogical to not adopt it.

## VI. CONCLUSION

As shown through out this work, Brazil has demonstrated a growing adoption of technologies to modernize, improve and optimize the management and the decision-making process [7-9], [17].

Some of the initiatives proved that indeed is possible to replace paper documents by electronic documents, securing its legal validity and therefore public acceptance, and, in some cases, compulsory adhesion [9, 14].

Considering the electronic process based on the CA-e for the Brazilian animal protein export process by sea, the concepts adopted while determining the solution architecture, and the data collected by the case studies, some affirmations can be done:

- 1) The electronic process allows the physical path of the cargo to occur independently of and in parallel with the documental path of the cargo.

- 2) The average time of the electronic process is shorter than the average time of the cargo's physical process.
- 3) The terminal agent, by accessing the CA-e information directly in the system backoffice, and checking the state of the seal, will be able to forward the cargo to the area where will be executed the next step of the export process.
- 4) The average analysis time of the inspection request is 4 minutes, however, the average time for the request to get to the competent fiscal is 57 hours in São Paulo and 109 hours in Santa Catarina.

Considering those affirmations, the logical conclusions are:

- 1) By adopting the electronic process, can be saved, on average, 57 hours (in São Paulo) and 109 hours (in Santa Catarina) over the total time of Brazilian animal protein export process by sea, from the container sealing at the industry to the arrival at the port terminal.
- 2) There is no logical reason to adopt a process that demands a journey of 57 hours (in São Paulo) and 109 hours (in Santa Catarina), for a analysis that on average takes 4 minutes, when there is an alternative that allows immediate access to information when recorded on the backoffice.
- 3) The electronic process allows a faster traceability of the process.
- 4) The electronic process also provides data, and, with the generated indicators, promotes the visibility of whole the process.
- 5) The electronic process allows faster information exchange, allowing the export process to be more up to date with an efficient global business model [18].
- 6) For all facts and conclusions presented, the electronic process would save a lot of time, cargo movement and, in consequence, money. "A quick calculation without the precision of a deep economic analysis, based on an estimated cost of US\$ 100.00 per day for handling and monitoring refrigerated containers and the number of 100,000 containers exported annually by Brazilian producers with beef shows that can be saved around tens of millions of dollars per year, reaching hundreds of millions if other products are considered." [6]
- 7) It is fair to conclude that it would also add value to the product image, because the product would get faster to its destination and the client would be able to follow the product by the system. The system could function as an element to differentiate and to improve the product's strategic marketing ("long-term managerial operations and activities which use the tool of marketing mix as well as specific approaches and methods in all phases of the managerial process" [19]).
- 8)

"The definitive implementation of the solution will require legislation or normative instructions from the Ministry of Agriculture, allowing document analysis through the electronic process, and the development of integration between the Blue Path and other systems of the Ministry, steps that have already been initiated." [6]

The proposed solution do not change the current documents

necessary to export animal protein by sea, it creates another that exists only electronically. In that matter, given the statistics presented by [4], it would be interesting to promote studies to analyze the viability to condense the necessary export and import documents.

The present study, besides being a solution to improve the export process by efficiently distributing information (in a secure manner), diminishing its time, can also be seen as a solution to gather data, to promote traceability, and to promote more conscious and adherent decision-making through out the supply chain.

Considering the concept of the CA-e, it is possible to customize the present solution to others supplies chains and, that way, verify the achievable benefits.

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