

Montreal Port Authority CargO2ai 2021 AAPA Information Technology Awards





CargO₂ai

1) Summary of the project

CargO₂ai was developed in the spring of 2020 through a partnership between the Port of Montreal, CargoM, Termont, MGTP, Scale AI and Ivado Labs to tackle the COVID-19 pandemic. The purpose is to deliver medications, medical equipment and food products as quickly as possible to avoid supply delays and stock shortages during precarious economic and public health situations.

Based on an algorithm that quickly identifies targeted goods as soon as they leave their port of origin, CargO₂aimakes it possible for supply chain partners to prioritize these goods and accelerate their processing and delivery. It is a humanitarian logistics tool whose primary mission is to contribute to the collective effort in the fight against the pandemic.

2) Description of the Port

The Port of Montreal is the second largest port in Canada and a diversified transshipment centre that handles all types of goods: containerized and non-containerized cargo, liquid bulk and dry bulk. The only container port in Quebec, it is a destination port served by the largest shipping lines in the world. With transshipment ports in Europe, the Mediterranean and the Caribbean, the Port of Montreal is connected to more than 140 countries around the world and offers the most direct route between Northern Europe and the industrial heartland of North America. It is also an intermodal hub with a service offering that is unique in North America, featuring its own dockside rail network connected to Canada's two national rail networks.

Driven by values of sustainable development and social responsibility, the Montreal Port Authority is committed to the community and takes solid action to reduce its GHG emissions, integrate harmoniously into the urban landscape and ensure responsible management of its infrastructures. Placing innovation at the heart of its vision, the MPA is developing numerous innovative initiatives with a view to efficiency, safety, transparency and improving its competitiveness, and is positioning itself advantageously in the new technological era of logistics.

3) Goals and objectives/Business problem

In the spring of 2020, during the COVID-19 pandemic, the Port of Montreal was concerned about the risk of outages of medical equipment due to the upswing in demand and the resulting supply problems. It was also made aware of the importance of rapid delivery of priority goods and the potential danger of delays in delivery.

That is why the MPA and its partners began developing a system that would make it possible to move critical materials in record time. The goal was to be able to identify containers with priority goods, such as masks, protective equipment and sanitizers, thereby significantly reducing the time required to process the containers.

One of the main challenges in carrying out the project was to successfully navigate the complexity of the logistics chain. Many logistics partners operate at the Port and are involved at different levels of the supply chain, making it difficult to coordinate information: two terminal operators, six shipping lines, two railroads and numerous trucking companies. In addition, there are a multitude of variables to consider when estimating transit times, including traffic conditions, weather and other external factors.

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After several months of honing the project's technical details, the Port of Montreal and its partners deployed the CargO₂ai system throughout the city's industrial port facilities. A call went out to all stakeholders in the supply chain - trucking companies, logistics forwarders, shipping lines, shippers and operators - to join the initiative in large numbers. This was to ensure maximum efficiency and to use it to its full potential.

While taking all of these factors into consideration, another key question was raised. As a key entry point to Quebec, Ontario, Western Canada and the U.S. Northeast and Midwest regions, how could the Port of Montreal enable fast identification and prioritization of critical cargo and essential goods that Canada will need, such as medications, medical equipment and PPE, moved by containers during the COVID-19 crisis, and still maintain uninterrupted operations and make fast decisions in the best interests of all its clients?

The main business objectives were to:

- Accelerate the delivery of critical medical cargo to patients in need; in turn, enable Canadian and
 American populations' well-being and potentially save lives ("fast lane" creation)
- Reduce dwell time (unloading and distribution) of medical and other critical supplies
- Readjust priority level for critical cargo for strategic and operational planning
- Ensure supply chain continuity and resilience in scenarios of potential terminal operation closure due to labour issues

4) Discussion

Background

The Cargo₂ai project was launched in the context of the COVID-19 pandemic. As the economic engine of Quebec, the Port of Montreal and its partners wanted to help fight the pandemic. As stockouts were feared, particularly for medical supplies in high demand, such as gloves, masks and sanitizers, the

CargO₂ai project was designed to optimize the efficiency of the supply chain for these items in particular, so that they could be removed from containers as quickly as possible and delivered to the people who needed them. The initiative is not for profit, but rather to encourage supply chain stakeholders to work together to help frontline responders in the fight against COVID-19.

With the help of Ivado Labs, a leading AI solution provider, the Montreal Port Authority (MPA) aimed to develop an AI-enabled solution with a dashboard to exhibit views on incoming critical cargo and predict the estimated time of arrival (ETA) of vessels to optimize coordination and enable fast cargo movement in and out the Port of Montreal.

The AI module is based on Natural Language Processing (NLP) techniques for cargo identification at the container level. This solution is now used as a single source of information by the MPA operations team, at both tactical and operational levels for coordination with its stakeholders (rail and terminal operators). Additionally, the data facilitates the sharing of critical information for workers moving cargo when it is unloaded. The solution also provides tracking of the cargo until it departs from the Port. In the first phase that ended December 2020, a fully deployed POC (proof of concept) of the solution was released. In January 2021, an MVP (minimum viable product phase) was started to enhance visibility and allow flexibility within the solution. This second phase to the project enables features such as a mass upload of official critical lists from various governments and organizations, such as the World Health Organization (WHO), Canada Border Services Agency (CBSA) and the Government of Quebec, and critical keywords management.

Objectives and methodology

Objectives

The objective of the CargO₂ai project was to be able to identify certain goods at their port of origin in order to track those that were deemed to have priority. This gave the supply chain partners, namely the trucking companies the railways that had to pick up the cargo at the dock, an accurate time of arrival at the dock and its exact location on the terminal. This information made it possible to accelerate the processing of the goods, their transit by truck or train and, as a result, their delivery.

The algorithms behind CargO₂ai are based on official Canadian government lists to identify what needs to be shipped quickly or not. The federal government requires importers to add the term "URGENT—COVID-19" as a description of the goods in the release information submitted to CBSA for all medical devices being imported into Canada for this purpose. Also, a very clear description of the goods makes it possible to determine whether or not the contents of the imported cargo are critical.

Technical objectives:

- Create a dashboard user interface fed with advance data, Natural Language Processing models (NLP) for extraction of key container-level data, and data engineering techniques to combine critical cargo information, physical location of vessels and terminal operations data for optimal unloading and distribution of goods
- Have a single source of information from MPA operations at both the strategic and operational levels for coordination with stakeholders
- Enable easy share and export of information to coordinate activities with the government, terminals, railway operators, etc.

Methodology

Main work packages:

- Back-end (data pipelines, algorithms, analysis and infrastructure)
- Front-end (dashboarding solution and reporting options for operational and strategic decisionmaking)

Data used to identify and track critical containers:

- A source of HS codes and descriptions (both live and 5-year historical)
- Canada Customs Information (EDI311), which contains information needed to report information to Canada Customs
- Terminal operators data
- Vessel AIS data, which indicates where the vessels are located
- Terminal Operations and Intermodal Ramp Activity data (EDI322), a source that provides upcoming and updated information at the container level on its status and movement in the port
- Rail Advance Interchange Consist (EDI418), which transmits advance information related to equipment that is to be interchanged to a connecting rail carrier
- Other: Manual data, such as the list of keywords and priority HS Codes provided by external sources, e.g. the WHO, CBSA and the Quebec government

AI Models:

The artificial intelligence component is the natural language processing (NLP) module which infers missing HS Codes. The artificial intelligence module will receive container content details. If the HS Code is present, it is presented directly. If it is absent, it is predicted using the NLP module. For the information retrieval approach, descriptions are broken down into tokens, which are then coded into a vector representation (bag of words [1] or bag of Ngrams [1]). The same procedure is applied to a reference description of the HS Code, built from the five-year historical data and from a reference description of HS Code. The descriptions are then compared to the reference descriptions. The solution is similar to a search engine where descriptions are queries, and the reference HS code descriptions are the documents. The solution has the feature that multiple HS Codes are presented to the user.

• Hardware/software used

The solution runs entirely on the Montreal Port Authority's servers. No additional hardware was necessary for the project besides dedicating parts of servers for development and production purposes. Due to the pandemic, all the work was done remotely on virtual machines. Software such as Jira and GitHub was used to manage the project and for coding the solution. The solution is a web-based interface that enables the MPA to manage critical cargo and generate files to be sent to terminal operators and shipping lines. The files generated by the solution are sent via an ftp server directly to the partners in a .csv format for them to save in their respective operating systems.

• Project cost

The first phase was costed at CAD \$470,000 and the second phase is costed at CAD \$500,000, for a total of CAD \$970,000.

• Performance measures

To date, as of the time this entry is being submitted, more than 4,500 container units (8,600 TEUs) have been identified by CargO₂aiand expedited to consumers. The impact is clear for the Port of Montreal, its terminal operators and other stakeholders. The solution supports planning and coordination of operations at the strategic and tactical levels alike. Decision making on critical cargo is based on data and quantitative information to accelerate operations and reduce dwell time for imported goods. Dwell time for critical containers can be cut by up to 50% between their unloading and their departure from the terminal compared to the average dwell times for all containers.

A key benefit of this solution is that it enables additional MPA capabilities to manage the COVID-19 crisis and any future crises because it improves the understanding of crisis management needs, it ensures business continuity, and it avoids the disruption of essential port activities.

Furthermore, the CargO₂ai solution enables better understanding of the data flowing through the port, introduces AI-driven innovative solutions into processes that are traditionally conservative, and creates a tool that acts as a single source of truth (SSOT) for the entire supply chain linked to the Port of Montreal, increasing the technical level of maturity of all organizations involved.

• How the project fulfills the Award Criteria

A humanitarian project:

The benefits of the CargO₂ai project are humanitarian in nature. Thanks to the collaboration of all the partners in the supply chain, the Port of Montreal is playing its role as a public utility service at the service of society, with the well-being and health of the population at heart. Through this project, we are returning to the core mission of a port infrastructure, which is all the more important in a crisis context: to deliver and distribute the goods that people need in the most efficient way possible.

A revolutionary tool:

The CargO₂aitool represents a major innovation from a logistics solutions perspective. First, AI processes are not common within enterprises, and even less across the supply chain. The solution provides a single source of truth for the shipping lines, the terminal operators, the railway carriers and the trucking companies, allowing them to rally and fight the pandemic.

Second, the solution is a perfect example of the augmented human concept, which aims to assist the worker in improving decision-making processes and accelerate the understanding of the massive flow of data that a port receives on a daily basis. The solution is truly hybrid, allowing partial automation by machine learning and incrementation.

Last, the solution leverages already existing data and IT infrastructure to create a powerful visibility and decision-making tool for the stakeholders of the supply chain. The solution is very cost-effective and independent from external applications or software, which gives flexibility in developing for future purposes.

Immediate results

The results of the CargO₂ai tool are being felt throughout the supply chain. Launched on a large scale in the port territory as of September 2020, the outputs of the solution are used by most of the stakeholders of the Greater Montreal port community. The outputs of the solution are discussed on the daily operational calls between CN, CP, the terminal operators and the MPA to ensure coordination and prioritization, especially on the rail side. On the trucking side, CargoM, a cluster that brings together all Greater Montreal freight transport and logistics stakeholders, promotes the initiative and provides incentives to trucking companies that accelerate their last mile delivery processes when handling cargo flagged as critical by the solution.

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Transferability to the port industry:

The solution was also developed for re-use as a business tool in a post-pandemic context. The solution will allow uploading of every possible HS Code or keyword, enabling the user to customize a business or customer need.

Beyond the context in which it was born, the CargO₂ai system could see its use extended to other regions and other types of products. Based on the same artificial intelligence and automatic language processing system, CargO₂ai can be used to quickly identify other types of cargo based on current priorities, such as in-demand agri-foods, specialized components and hazardous materials.

It can be adapted to the reality of any port in the world to improve the efficiency and management of freight transport and help various supply chains serve people and businesses in a smart and visionary way.



www.port-montreal.com/cargo2ai

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