Warehouse Automation: Enhancing companies' performance by meeting customers' expectations [1]

How can a structured warehouse automation project enhance a company's supply chain flow and meet its customers' expectations? [2]

By Valentin CHAILLOT, Maïssa MADI, Milouda CHAHED, Anne GONDOU

The Graduate School of Industrial Logistics – ESLI
(l'École supérieure de logistique industrielle - ESLI)
Paris, France

ABSTRACT

With the big and quick development that the industries have known for the last three decades and the changing in the way customers changed their practice via e-commerce, industries were challenged to keep up with the rapid changes in the demand. With the new dawn of the rising e-commerce, warehouses automation makes sense as it can respond and enhance the efficiency of the supply chain. In this paper we will be seeing the evolution of the warehouses and how can automation increase the client satisfaction.

INTRODUCTION

With the spread of online sales – e-commerce is emerging as one of the new modes of consumption. Nowadays, tacitly of purchase from our connected devices is accessible to all at any time. In 2017, more than 85% of French online shoppers order items from all over the world, of different sizes and require a short delivery time. In order to meet the demands of consumers, logistics plays an essential role in responding to the changing needs of the conventional dynamics due to a structural change. This is explained by the principle of massitication of the flows tends in order to increase the conventional warehouse tenfold in order to better respond to the new customer expectations.

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1. The changing typologies of warehouses following the rise of e-business

The pre-conflict dynamic was synonymous with traditional logistics where all functions were managed manually in the same and only entity (that of logistics) to dissociate the buildings by activity.
The old warehouses were small, often poorly lit areas in which worked warehousemen and where products were stored in an undefined manner.

Traditional logistics-related storing processes can be considered as old and archaic storage methods – hence, more or less obsolete. Indeed, the presence of shelving did not exist, the products were stored directly on the ground and on pallets that could contain several different references. These storage behaviors would lead to poor management of the deliverables and time being wasted instead of concentrating on preparation and delivery.

After this, there was a strong increase in consumption, prompting warehouses to rebuild in order to best serve buyers. As a result of the Trente Glorieuses (1945-1975), customers are more and more demanding which indeed drives Supply Chain players to rethink their storage, distribution and delivery in order to keep-up with the competition and the need to aerate the costs. It is to be noted that Warehouses have become unrecognizable; they are higher, bigger and have a large storage area, they reach 30,000 m2. They are composed of illuminated shelving with location allocation rules according to the typology of products. Indeed, warehouses are now divided by activities in order to streamline logistics flows.

The storage part is often attached to warehouses with a large surface area and are divided into 3 parts themselves:

- A part dedicated to the reception and the storage of goods
- A section dedicated for preparations
- A part dedicated to expeditions

The storage part is increasingly optimized. Some manufacturers and distributors choose to subcontract storage by using local platforms. The advantage of this subcontracting is to eliminate point-of-sale (POS) storage while increasing the service rate and reducing the risk of breakup.

2. The Mechanization of warehouses

In the 1980s, the emergence of the Warehouse Management System marked the start of mechanized warehouses. Indeed, these tools make it possible to streamline storage operations; e.g. LaRedoute and the Evry Euromarket are among the first companies to use bar codes. The XXIst century is synonymous with the digital age as Warehouses are now robotic in response to the growing demands of goods' volumes. E-commerce warehouses manage a large number of references, so it is necessary for them to mechanize their stocks in order to optimize the storage space and boost it. Stocks' mechanization plays a crucial role when it comes to reducing the company's additional costs:

- Reduction of the need in surface/ massification of the storage / Optimization of inventory space
- Deletion of non-essential / low added-value operations (handling), Automation/ Optimization of stock classification
- Reliability of stocks and inventories.

3. Automated storage example: Mecalux France solution

The mini-load is an automated storage system for crates or trays that includes in a single package the racks, the transporter, the conveyors and the warehouse management software. The mini-load is the ideal solution for companies that carry out many picking operations.

This is the case of the storage machine, which carries out the deposition and extraction of the load on the shelves. This storage method is directly linked to the order picking tables. Indeed, once the order is made, the case is returned to its storage address. Storage is managed by the WMS which maintains a permanent inventory – thus allowing the implicated warehouse staff to know the exact quantity in stock at any time.

The mini-load is capable of multiplying by ten the storage capacity of a pallet warehouse. It optimizes the storage space due to its high storage density – both in length and in height. The transtocker is responsible for transporting the product to the picking station in order to prepare the control. It promotes the principle of "the product towards man" and saves time given that the operator does not have to move. This type of automated store increases the company's performance at entry by reducing personnel costs. The movements of loads and operators are completely secure and this storage also allows to reduce travel times and therefore increases the productivity of the company.

4. Amazon empire building history

The industry giant known today as Amazon, was merely at the beginning a sketch drawn on a paper towel by a certain Jeff Bezos in the 1990's.

Prior to setting up his own business, Jeff Bezos was working at DESCO which stands D.E. Shaw & Co, a global investment and technology development firm, who exploited computers and complex mathematical formulas in the large-scale finance market.

As a company V.P., Bezos was tasked with researching new business opportunities on the rapidly growing Internet, which held tremendous potential in the early 1990s.

One particular opportunity came to him thanks to this job, as he received a business plan for an online retail activity, in addition to how Internet would have major benefits on commerce activity.

Willing to start his activity in the best conditions, Jeff Bezos was seeking products that could be sold easily in large quantities.

Digging a little deeper into his idea, books seemed to be ideal considering the important demand on the global market at that time. Therefore, Amazon became the first online library which encountered an important success, with the products stored in Jeff Bezos' garage.

It should be noted that the company was first named Cadabra at the beginning, but Todd Tarbet, the company's first attorney, convinced Jeff Bezos through a phone call of its similarity with the word « cadaver ». Bezos was also in favor of the name « Relentless ». Have a guess on which website you'll go by searching « relentless.com ». In the end, the name « Amazon » has been his final choice, as he loved the idea of its company compared to the largest river on Earth.

A) AMAZON ACTIVITY EVOLUTION

Since its launching, Amazon never ceased to diversify its online retail activity, with a wider range of products proposed to its clients, mainly due to its « FBA » (Fulffiled by Amazon) method.

This method allows small retailers to sell their products on Amazon's website, which for sure are not only books anymore. As a matter of fact, one might find on Amazon's platform a huge variety of products, with goods such as clothes to household products for instance.

How does this method work? Retailers can either store their products in Amazon's warehouses or keep them in their own stock, while Amazon displays these products on their website. In the end, when an FBA product is bought, Amazon gets a commission on the sale.

Amazon's activity is not only based on its initial online retail activity. It's also a subscription-based streaming service with Amazon Prime Video, that allows its members to watch TV shows and movies without commercials, such as Netflix, with some exclusivities.

The company also supplies a musical streaming service, audio books (Audible), an intelligent personal assistant (Alexa) and an interactive livestreaming service as Amazon bought Twitch in 2014.

In September 2021, 950.000 employees were working for the company worldwide.

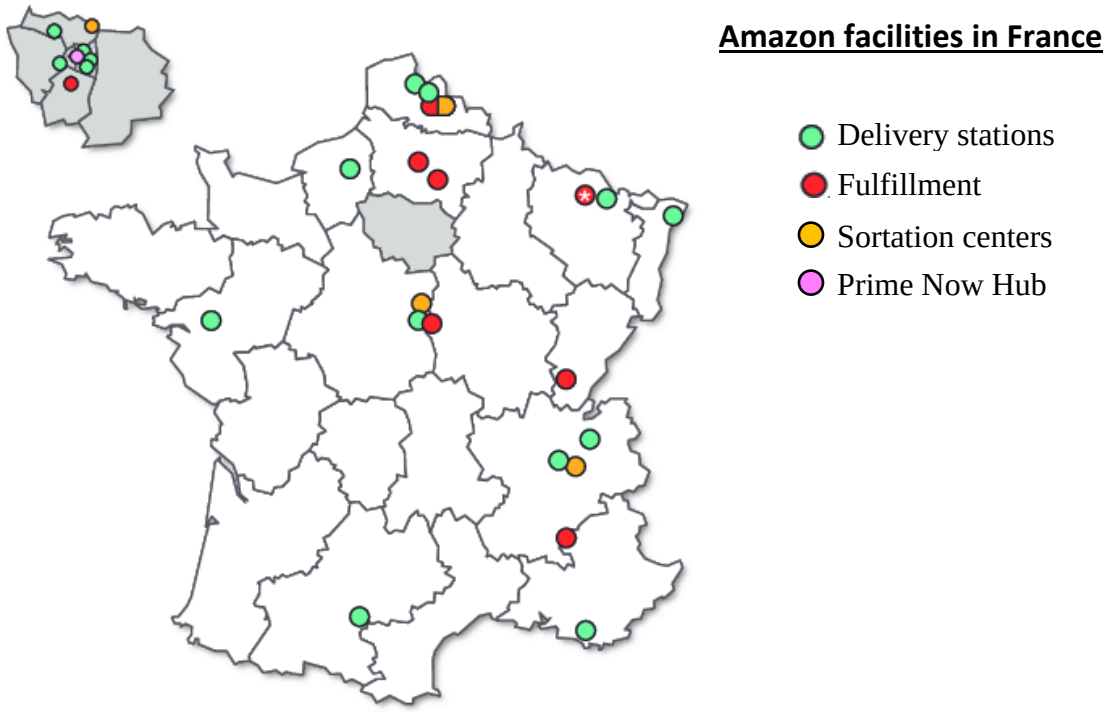
Amazon is also one of the five GAFAM companies, which stands for Google, Apple, Facebook, Amazon and Microsoft, seen as the five companies leading the global financial market.

B) AMAZON FACILITIES

In 2021, Amazon's global activity was spread across 800 facilities, representing 20 million square kilometers worldwide. These facilities have various purposes:

- Fulfillment centers (distribution center – around 300 in the world)
- Delivery stations (delivery agency – around 300 in the world)
- Prime Now Hubs (small-sized warehouses, closer to downtowns, allowing deliveries in less than 2 hours which embodies Amazon's future plans – around 80 in the world)
- Sortation Centers (distribution centers that sort parcels or pallets, usually located close to fulfillment centers – around 80 in the world)
- Amazon Fresh (fresh produce distribution center– around 20 in the world, mainly in the U.S.)
- Amazon Whole Foods (12 warehouses recovered thanks to Whole Food Group takeover)
- Amazon Airport Hub (In 2019, Amazon broke ground on the Amazon Air Hub, an 800,000-square-foot facility in Cincinnati (Ohio, USA) to support its growing air cargo network)

C) AMAZON FRENCH NETWORK



D) AMAZON'S LOGISTIC STRATEGY

Companies such as Pure Players[1] like Amazon have their own means of transportation at their disposal, on a larger or smaller scale, mainly based on their activity level.

There is nothing surprising in it as e-commerce companies are more and more perceived as distribution logistics market players.

Their competitiveness is not only based on their trading activity anymore. From now on, it extends on their ability to always deliver bigger range of products and services to their customers as quickly as possible.

Therefore, web merchants have their reliability reputation on the line regarding set deadline compliance, and so far Amazon have answered that criteria in an effective way.

Actually, to build loyalty among the prospects, the company committed itself to reduce its delivery times through groundbreaking offers that were perceived impossible at that time:

- Normal delivery for free (3 to 5 days)
- Prime Delivery: Delivery in less than 48 hours (subject to subscription– 40€/year in France)
- Prime Now: Delivery in less than 2 hours, under certain geographical conditions. Besides, the Prime now delivery is reduced to 30.000 items, with mainly "emergency" products (beauty, health, etc.).

Therefore, its strategy quickly appeared as the maximization of its customers' satisfaction, according to the e-commerce market standards, through the management and the optimization of their distribution system.

The American company is also aware that improvements on its transportation activity would be tough. Despite all their goodwill, there is too much external factors that can embody irreducible restraints as speed limits and traffic jams can't be avoided.

Thus, it's on the « click-to-ship » part, which means the period between the customer placing an order to the order's shipment, that Amazon has engaged most of its resources.

Thanks to a 775 million dollars investment in 2012, Amazon succeeded in finding an agreement to purchase a logistic robotics purposes specialist systems (LRPSS), Kiva Systems.

Founded in 2003 by Mick Mountz, this company holds patents due to its innovations in terms of robotics applied to logistics. Big names such as *Gap*, *Staples* or *Saks* are listed among its customers. Its robotics knowledge goes beyond the logistics domain as in 2007 an uploaded clip of its logistics robots performing a Tchaikowsky ballet caused such a sensation.

Finally, the company was officially bought in May 2012 by Amazon and is now introduced as Amazon Robotics. Starting from this moment, Kiva System's technology is wholly committed to Amazon's logistic activity.

E) AMAZON'S INNOVATIONS

This partnership has given birth to major innovations in the logistic activity automation field. Most of the time, the main example that comes to the logistic field uninitiated's mind is autonomous robots, moving by their own way within warehouses and bringing products to the order pickers.

As a matter of fact, those Amazon's robots are considered as ones of the firsts **Goods-to-man** systems never deployed. Actually, Kiva robots are making their way until being beneath shelves,

lift them up and bring them towards the picker whose job is now reduced to remove items listed in the order.

Those robots are moving in a coordinated way, interacting with each other, by reading QR codes placed on the operating area floor. As pickers don't have to leave their workplace anymore, the order picking time has been drastically reduced, as it is now of 15 minutes rather than the previous 60 minutes, and pickers efficiency has been improved.

Today, Kiva Robots are implanted in 26 state-of-art centers among the 175 that counts Amazon and allow the company to store more and more products with a decreased storage area in the meantime.

Indeed, as Kiva robots remove aisles and non-used areas, Amazon is now able to store 50% more products per square meters, while its area's needs have been reduced by 35%.

Moreover, the lower the area's needs are, the closer Amazon would be able to set up its warehouses from downtowns. Therefore, such a position would allow Amazon to get closer to its customers.

Order picking activity has been further improved thanks to a well-known method, the **Pick by Light** system.

Pick by Light system simplicity is what makes it so effective. It's ideal for any situation where speed is important and where productivity can be improved by pickers being more accurate. Pick by Light is set up so that there are lights above the containers that will be picked from.

But how does this method work at Amazon? It actually depends on if the warehouse is using Kiva Robots or not.

If this is not the case, the picker scans a barcode that will contain information about the customer order. This could be on a bag or picking container. Then, the picker will be directed to the right location by a light that comes on above the correct bin. The light will also show the quantity of items that are required from that bin.

Once the items have been collected from the right place the picker presses the light above the bin to indicate to the system that the pick has been done. If the system does not illuminate any other containers to pick from, the picker knows that the order is complete.

If the warehouse has Kiva Robots at its disposal, the process is a bit different but is indeed much more faster and easier due to the Goods-to-man method as shelves come towards the picker.

Once the shelves are in front the picker, the picker will be directed to the right compartment by a light that comes above it.

This method is as easy to implement as it is effective, in comparison to other existing alternatives.

For instance, there is no language barrier, and alternatives such as voice-guided systems are effective until a different language is required for workers.

Therefore, Pick by Light is an universally understood way to indicate what to pick, and how many items are necessary. So, there are no restrictions on the diversity of warehouse staff for those businesses using this technology.

Even though improvements regarding the transportation part seem very complicated, Amazon managed to find a solution, linked to the parcels assignment, that would allow the company to optimize its transportation activity.

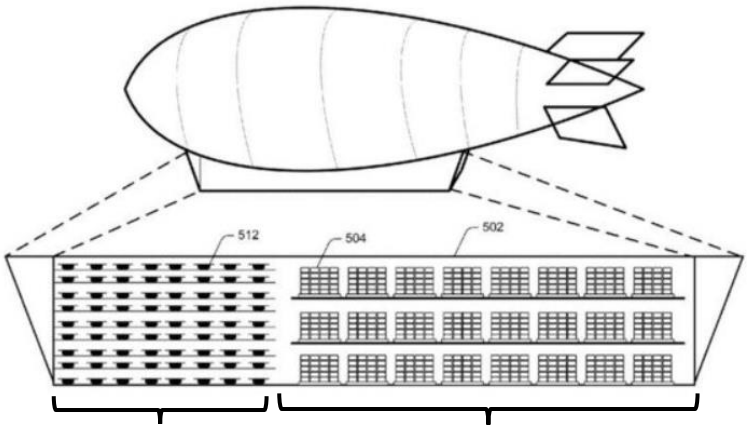
Indeed, once a parcel is ready to be shipped, algorithms help to determine which carrier offers the best tariff offer, according to the delivery place, the type of product and the emergency level.

On the long run, Amazon's wish is to revolutionize its distribution system, thanks to a groundbreaking method, based on a goods' transportation ensured by drone until the delivery point, named as **Amazon Prime Air**.

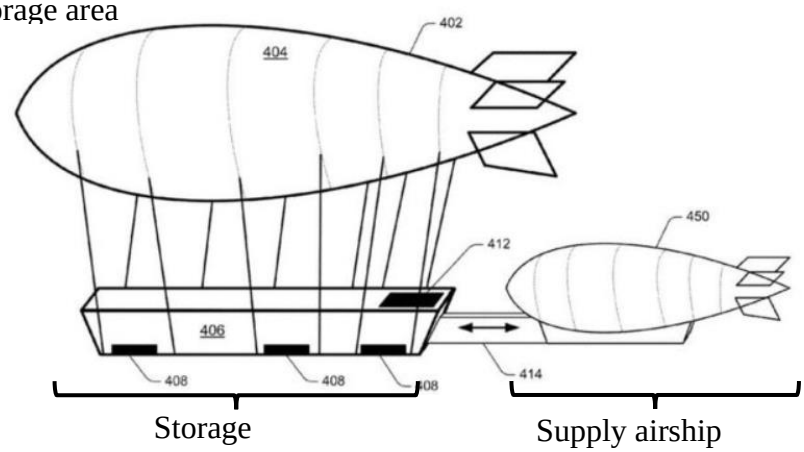
Speaking of activity by air, Amazon has also filed a patent in March 2016 of a **flying warehouse** installed inside airships, described as the ***e-commerce Death Star***, based on Star Wars reference.

Its principle is simple: as drones have both limited range and autonomy, these flying warehouses would fly over a specific delivery area, with parcels prepared to be delivered there by drones, coming to pick them up gradually.

The airship itself would be supplied with parcels, energy and employee through a shuttle system, which are for now, drawn as smaller airships.



First blueprints on Amazon flying warehouses included in its patent



One of Amazon's last innovations is the **Amazon Key** system based on connected locks. The main purpose of the company through this innovation would be to allow the delivery man to drop off a package even when the client is not home. As a result, the company would reduce its last mile costs.

To implement this system, Amazon suggests customers replace one's lock with one of its connected locks, which includes a surveillance camera named « Cloud Cam », that would record a video of the delivery man during the parcel's delivery.

When the delivery man comes to the client's front door with no one at home, he scans the parcel and Amazon runs a check ensuring that the delivery matches the one expected: the correct parcel, the correct delivery man, the right place, the good time as planned, etc.

As soon as everything matches the delivery, the front door would unlock itself, allowing Amazon's delivery man to drop off your parcel inside.

From the customer's side, a notice would be sent on its phone once the delivery man is in front of his / her front door. He would be able to keep an eye on its parcel's delivery, thanks to the « Cloud Cam », either in live or later with a recorded video.

F) AUTOMATION, ONE AMAZON'S FEATURE

Previous robotics examples only represent the most famous's developed ones, used by Amazon. The company has managed to develop its logistic activity's automation, making it one of its main trademarks. For a lot of people, the first image that comes to mind about Amazon is a strongly automated warehouse that always provides / delivers state-of-the-art robotic innovations.

Speaking of logistics automation by including Amazon is now a common thing, either in a non-initiated people conversation or in an exchange between professional logisticians.

We can define automation as part of Amazon's culture and logisticians systems.

Items moving on an automated

A crane lifting a pallet to a higher

To demonstrate the results in a nutshell, Amazon warehouses' automation has brought down its operating costs by 20%, while a productivity gain of 20 to 40% can be noted on storage operations and order preparation. Besides, the parcel processing time within Amazon's warehouses has been divided by 4, from 60 minutes to 15 minutes.

As reported in May 2019 by Scott Anderson, Amazon Robotics CEO at this time, through its interview to Reuters Agency, the Amazon's automation goal is simple, to replace as much as possible human labor by robots by 2030.

A necessary time for the society in order to develop wholly-automated robots, capable of completely managing the tasks currently entrusted to humans.

G) AMAZON'S INNOVATIONS DRAWBACKS

Automation brings job cuts

Even if automation is relevant for companies on an economic scale, it also raises societal issues, as one of the main drawbacks which goes hand in hand to warehouses' automation, is the increasing disappearance of logistic jobs.

Amazon is not shy about it. Indeed, through its strategy which claims to optimize and completely manage its distribution system, the company also have a purpose of reducing its operating costs, which include labor costs.

There is no guarantee on whether this strategy would be accepted or not by all the parties involved, and more precisely by the urban areas' representatives that would welcome an Amazon's warehouse on their soil.

Furthermore, one of the key points often highlighted by the representatives and Amazon, towards the population during the establishment of such logistic facilities in their neighborhood, is how important the quantity of jobs created will be, thanks to their activity.

To defend itself, Amazon is emphasizing on how maintenance activity will be important with an increasing automation of its warehouse activities.

Unfortunately, that kind of argument is not always as convincing as companies with a project like Amazon would like it to be.

The matter is that these jobs in that domain require very specific knowledge and skills, in contrary to the previous logistic jobs that could be seen as menial ones, but which were also paramount to ensure the company's smooth running and more accessible to a more important local labor.

Significant implementation costs

The development of a strategy combined with such state-of-art innovations requires, most of the time, a major financial investment beforehand. Unfortunately, this investment is often seen

as the most important hindrance, as not all the companies have enough financial resources, to develop and implement that kind of organization

CONCLUSION

Warehouse automation is the new way of working effectively, and Amazon has proved that with its global expansion and customer satisfaction. They found a way to always be there for the client and respond to all his demands by shortening delivery time and being more flexible with returns.

All of this wouldn't have been possible without a solid supply chain structure to support all of it and make it possible. The answer for Amazon was warehouses automation by using robots that can replace humans in the warehouse which makes the risk of mistakes nearly 0. This also means cutting off the extra budget of all the employees' payroll and making extra profit.

Using robots also means no break time and no rest which signify more working hours and achieving goals easier. All of these benefits will increase the global efficiency and make the company major profits. But the first step in all of this is to invest. The investment is major and any company that wants to go automated must think of this in the first step. The return on the investment will be within a period and the company must know how to handle it without losing too much.

Also, another very important point which is that not all warehouses can be automated. There are some types of preparation that require a human presence to be done properly. In this case we can use robots to help the workers with their work but not replace them definitively.

To conclude, warehouse automation makes up a big part of the future of supply chain. In the years to come we will witness the disappearance of classical methods and replacing them with robots that work more efficiently and with fewer mistakes.

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About the Authors

Valentin CHAILLOT

Paris, France

Valentin Chaillot holds degrees in both Logistics and Transport Management as well as in Purchasing Management. Such two fields of expertise allowed him to have acquire his experience in both Logistics and Purchasing fields, especially during his tenure at CARMAT, a French medtech, developing and marketing artificial heart prosthesis in the EU, and more recently in the US. Willing to enhance his industrial knowledge and to work in a multicultural domain, Valentin is currently a student at ESLI Paris, pursuing his MSc Industrial Logistics and Purchasing Management (MLAI) with an apprenticeship at B. BRAUN Medical. He can be contacted at vchaillot@etu.campus-redon-industries.com

Maïssa MADI

Paris, France

Maïssa Madi is a student at ESLI Paris, MSc Industrial Logistics and Purchasing Management (MLAI). She began her academic work in engineering where she obtained an engineer degree after 5 years of studies. Today she crisscrossed her competence with career interest and changed the course of her studies' disciplinary orientation to join the MLAI class while working in the agri-food business with Carrefour Supplychain. She can be contacted at mmadi@etu.campus-redon-industries.com

Milouda CHAHED

Paris, France

Milouda Chahed has been an apprentice in the aeronautical field for 4 years now. Her various apprenticeship contracts allowed her to develop her logistics skills. She has previously set up item sheets and replenishment thresholds in a WMS (Warehouse Management System). She participated in a reimplementation project of 1000 products using an ABC analysis. Currently she is working on a production site on a line of exhaust casings. Her missions include the implementation of indicators and to follow the industrialization of aeronautical parts. She can be contacted at : mchahed@etu.campus-redon-industries.com

Anne GONDOU

Paris, France

Anne Gondou holds a Bachelor's degree in Business Administration and Management with focus on marketing. She is currently completing an MSc Industrial Logistics and Purchasing Management with a focus on Secured and Intelligent Logistics while pursuing an apprenticeship at Carrefour. She can be contacted at igondouebouba@etu.campus-redon-industries.com