

# E-Truck Net

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Future logistics need to solve a lot of efficiency problems that exist today.

## PROBLEMS OF NOWADAYS LOGISTICS

Vehicles and containers often return empty when back from a shipping. In numbers, that is approximately 20% of the fuel wasted in going to the next point with the truck completely empty [1]. Moreover, the containers are not always fully loaded and empty space is left in the trucks. This inefficiency means an increase in CO<sub>2</sub> emissions aggravating climate change, unnecessary road degradation and traffic congestion.

Due to the fluctuating demand of online products, for example the increasing demand during the holiday season, distribution centers struggle to update the amount of inventory in time. This results in products that do not reach their market in time are remain unsold or unused, causing an approximately 25% of unnecessary expenses [2].

In other words, trucking could be cheaper, faster and more respectful with the environment if we solve these problems. Furthermore it could help to solve warehousing problems mentioned in the last paragraph.

Truck industry is still very important in logistics. For example the US spent \$600 billion in truck industry just in a year, 85% of the total \$700 billion dedicated to logistics [3]. Furthermore, in the future, self-driving trucks give more possibilities for larger shipments, independently from the distance of the delivery points and in a reliable way. For this reason trucking will still be used in the future, however it has to be more efficient for staying sustainable, prevent unnecessary road degradation and reduce traffic congestion.

## AUTOMATION DOES NOT NECESSARILY IMPLY EFFICIENCY

In the near future, let say 10 years, logistics will be technologically improved extensively. Technologies such as drones for packet handling [4] and self-driving vehicles [5] will have been developed to a point that could be used. Although these technologies will contribute to faster and low-cost deliveries, it does not automatically imply that the inefficient use of truck transportation nowadays, as described in the previous section, is solved.

Therefore, I am introducing the E-truck network. A solution that is using the technological developments of today to create a more efficient, low-cost and reliable truck transportation network.

### E-TRUCK NETWORK

My idea is to create a new company that will offer software solutions for efficient truck distribution over Europe. This company will offer services in managing floats of self-driving long distance trucks in **the most efficient way and solving the problems of today's logistics** to shipping companies that are using self-driving technology.

The following points summarize how the E-Truck network solves today's logistics problems:

#### **1. Shared space inside trucks:**

Shipping companies do not always take advantage of all the space available in the trucks [1]. This is not efficient. If there were a network which managed all the self-driving long distance trucks, and had information of the size of each truck and size of the packets, then this network would compute the best way of doing the shipment and this problem would be solved.

This network is the **E-Truck Network**.

This way if a customer buys something on different webpages the E-Truck network would compute the best way of delivering the different products. This would result in more efficient long distance deliveries, saving money and time for the shipping companies, and a customer that could receive those different orders faster and cheaper.

The E-Truck network would substitute today's logistics for long distance deliveries, but person-to-person treatment will still have an important task taking the goods from the warehouse and delivering them to the final customer.

#### **2. Efficient route computing:**

A float of self-driving vehicles needs to know how they are going to do the deliveries in the most cost efficient and time efficient way. Here is where E-Truck network will be necessary.

First of all, every task will be performed inside the network. This network will have several servers available for responding all the routing requests.

Then all the available data of the self-driving trucks (position, size, state etc.), warehouses, highways (traffic, weather issues etc.), delivery orders (size, destination, fragility etc.) will be used to calculate the routes that achieve cheaper and shorter delivery times. The calculations will be performed using cloud computing. Finally the route will be sent to the self-driving truck which will store and process it for carrying out the shipment.

For this aim, the mapping and cloud computing services will be externalized, using these services from a more specialized location company (for example: ArcGIS or Here Technologies). This way the company will only spend money in paying for these services and for the hosting of the application. This will result in more robust servers and reliable communications.

### **3. Warehouse flexible stock:**

The network will have a lot of real time data of the needs in a certain area, and the stock in each warehouse, because of the management of the trucks. Processing this data would lead into a new service: moving the products to the area that will need them. In addition privacy will be taken into account. Customer's data won't be stored for advertising purposes, only the information about product tendencies in each region will be processed.

As the trucks will be constantly moving between warehouses, they could move the products to the area that they will be needed, giving more flexibility to the customer's products to reach the right market on time. This would solve nowadays problem of wasting fresh products, and other products that if they are not delivered on time would not be sold and neither used. This applies, for example, to clothes and food.

### **4. Easy trucks float managing:**

One of the issues that need to be taken into account is the flexibility of the self-driving truck float. It must be easy to add new trucks to the float, but also eliminate them if they need to be repaired.

This issue is solved with a database which will collect the information of the available trucks, their position and state. If for example a truck needs to be repaired, its state in the database would be changed into "damaged" and will not appear for the route computing until it is repaired. If a new truck enters the float, then a new entry would be added to the database.

Every self-driving truck will have a lot of sensors such as vibration sensors, pressure sensors or temperature. These mechanisms will detect if the truck will need to be repaired or revised, and could send a request to the server to

change the route for leaving the packages in a nearby warehouse and change the destination to a repair shop. A contract with different repair shops could be made so if a shop is needed there will always be one nearby.

## **5. International Communication:**

This idea could be developed just for Europe at the beginning, but the vehicles must be well communicated when they are in different countries, so a good telecommunications system will be needed.

Each truck will have an embedded system in it; this system is the one that will receive the orders from the server to perform the routes and must be connected to internet.

For this purpose, 5G connection would be necessary. 5G nets have a fast data transmission rate and a very low latency; these characteristics are very useful for self-driving vehicles in general, but even more when it comes to logistics. This permits self-driving trucks to not being sending and receiving data all the time, but send it when they are able and in very short time. This is useful when they are in rural areas or in areas with little mobile coverage.

## **6. Robustness of the net:**

Taking into account that a float of self-driving trucks is going to be interconnected in a network, security must be taken into account very seriously.

First of all, there must be an authentication method for assuring that all the commands that are received from the server are truly from the server. For achieving authentication, a public key Standard must be used.

Also the communications must be encrypted with the most robust standard, which nowadays is the symmetric key standard "AES". This will cost more time in computation, but it will increase a lot the security in the communications. Some technologies around AES Standard where developed, for example Intel developed security solutions using AES, and could be implemented in this project. As the project is thought to be developed in a couple of years, other encryption standards could be used, for example elliptic curves encryption.

Once we have encrypted the communications, we have to add extra security measures. If someone breaks the encryption and have the control of the truck, then on-board measures should ensure that the vehicle will not be stolen and in the worst case scenario will not be used for terrorism. These measures will be also useful for security in general and not only for bad actions.

There will be several solutions for preventing bad behaviours:

- First of all, **authentication**: The truck will only be opened if it detects an authentication card. This card will be given to the people in charge of opening the trucks in a warehouse, and it will have the information from those people.
- Secondly, there is **position tracking**: This means that the truck will use a GPS system to detect its position, so if it is outside a warehouse it will not open.

Position tracking also have more possibilities for security, for example if the truck detects that is off the road, then it could stop. Also as this idea is being designed for long term deliveries, the trucks will avoid entering the cities, which are the places with more people.

- In the third place, **surrounding processing**: so if the truck detects an obstacle on the road it stops or it avoids the obstacle. Instructions from on-board mechanisms will have more privileges commanding the truck than the instructions sent from the server. This will prevent from receiving wrong commands and it will secure the truck from damages.

### BENEFITS OF THE E-TRUCK NETWORK

The E-Truck network will solve many of today's trucking and warehouse logistics problems. Fuel will not be wasted carrying empty or partly empty containers. Warehouses will have more flexibility in consumer's products stock.

The E-Truck network will add ease in the management of the truck float. Deliveries will be cheaper, faster and more reliable, resulting in a happier customer and smaller shipping expenses for the companies.

### REFERENCES

- [1] <https://www.transportenvironment.org/newsroom/blog/running-empty-how-optimize-logistics-and-slash-emissions>
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- [4] <https://www.amazon.com/Amazon-Prime-Air/b?ie=UTF8&node=8037720011>
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