

Hyperconnected City Logistics and Last Mile Delivery in Casablanca City

Ahmed CHAKROUN¹, Hassan ABBAR², Mounir TANTAOUI ELARAKI³

1. Ecole Nationale de commerce et de gestion, settat, Morocco

2. Ecole Nationale de commerce et de gestion, settat, Morocco

3. Université Internationale de Casablanca, Casablanca, Morocco

Corresponding author: chakroun.phd@gmail.com

Abstract

City logistics provides the final and last segments of the physical internet logistics and transportation networks. In this paper, we will present a new scheme for big cities where we imagine the use of existing infrastructures and non-pollutant means of transportation to deliver encapsulated goods rapidly and safely from origin to destination. In order to clarify the idea, we will use the map of rail network of Casablanca city (the biggest city, chief port, and economic capital of Morocco) to minimize the maximum travel time (or distance) and ensure a better interconnectivity between nodes. We will also propose the use of nearby agencies as a Distribution Centers (DCs) to improve the last Mile Deliveries.

Using existing means of transportation and platforms intelligently, encapsulated goods will be delivered more efficiently.

Keywords: DC, Relay Point, Physical Internet, HCL, CDC, π -container

1 Introduction

The world's urban population is 54% in 2014 and projected to 66% in 2050. In the developed countries already largely urbanized - around 80% - The process also continues. This urban population is also more and more connected, where an increased use of the e-commerce.

In the developed countries, the annual growth of the sector is generally, and again this year, to two digits (b2pr Report, 2016).

Under such trends urban freights transport issues have become more important for supporting a better life for people as well as a better environment in urban areas. Urban freights transport is not only essential for economic growth and cleaner; quitter and safer communities are needed. In addition, as we face higher risks of disasters due to global climate change and aging societies, urban freights transport should incorporate these risks for creating more sustainable and livable cities. (Taniguchi et al 2014).

The physical internet is an open global logistics system founded on physical, digital and operational interconnectivity through encapsulation, interfaces and protocols aiming to improve the economic ,environmental and societal efficiency and sustainability of the

way physical objects are moved ,stored,realized,supplied and used all across the world (Crainic and Montreuil ,2016).

Taniguchi et al (2001) defined city logistics as “the process for totally optimizing the logistics and transport activities by private companies with support of advanced information systems in urban areas considering the traffic environment, the traffic congestion, the traffic safety and energy savings within the framework of market economy”. The aim of city logistics is to globally optimize logistics systems within an urban area by considering the costs and benefits of schemes to the public as well as the private sector, Private shippers and freights carriers aim to reduce their freights costs while the public sector tries to alleviate traffic congestion and environmental problems.

Last Mile delivery: Last mile deliveries are one of the major effectors of heavy traffic of commercial vehicles in the whole city area. Their essential features, significantly lowering the rational functioning of the transport system, include high degree of fragmentation and low range of use of the cargo load compartment of vehicles. The importance of this type of deliveries grows with the increasing interest in remote shopping. Currently, its biggest inducer on B2C market is e-commerce (Iwan S and Kijwska K ;2015).

The remainder of the paper is structured as follows: section 2 is dedicated to related works and articles which were written about this topic. In section 3 we will formulate the problems of the last Mile delivery where the case of the city of Casablanca is considered to illustrate the framework, the issues and challenges of our work. In section 4, we present our solution methodology for the design and efficient exploitation of current infrastructure and transportation network. The conclusions and avenues for future research are discussed in section 5.

2 Related Work

In their article “physical Internet enabled hyperconnected city logistics” Mr Montreuil and Crainic introduced the notion of hyperconnected city logistics (HCL) and its nine fundamental concepts which are complementary and offering a rich framework for designing efficient and sustainable urban logistics and transportation systems.

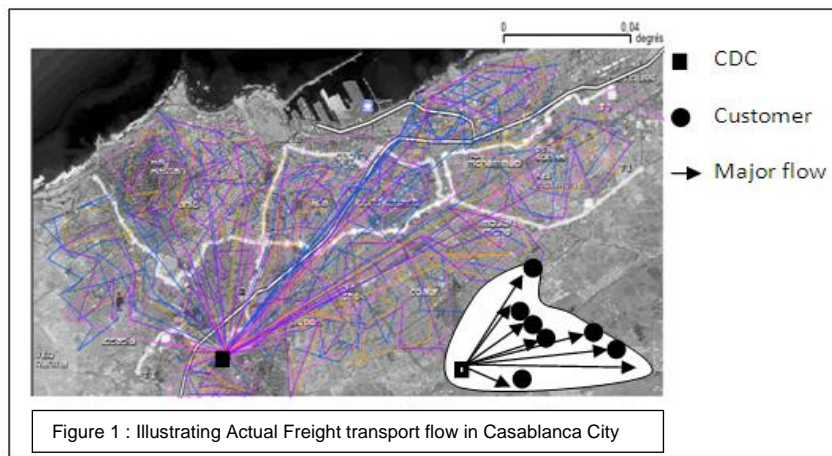
Taniguchi in his article “concept for sustainable and liveable cities” introduced the concept of city logistics for sustainable and liveable cities and discussed the three essential elements for promoting city logistics, (a) application of innovative technologies of ICT (Information and Communication Technology) and ITS (Intelligent Transport Systems), (b) change in mind-sets of logistics managers, and (c) public-private partnerships.

Maro Dell Amico and Selini Hadjidimitriou in their article “innovative logistics model and containers solution for the last Mile delivery” discussed their solutions for the last Mile delivery and their impact on the reduction of CO2 emission and congestion.

In this paper we will discuss how the physical internet and the hyperconnected city logistics can improve the last Mile delivery and make of our cities liveable and sustainable ones by introducing the idea of using the current existing non-pollutant means of transport (e.g. Tramway, train,) to make the goods as near as possible to the delivery zone and then using some already existing network of nearby agencies to execute the last mile delivery.

3 Problem formulations

This stage involves the formulation of the problem, as we know the urban freight distribution is today performed by several vans that deliver shipments directly to the customers. The transport operator usually organizes deliveries by partitioning the delivery points in urban areas. City distribution centers (CDC) are usually located at the proximity, but outside the city center (figure-1). In case of unsuccessful delivery, in general, the customer needs to go to warehouse to pick his parcel up. Unsuccessful deliveries are costly and time consuming. As shown in figure-1 we have illustrated the flow of many freight transport operators who are delivering the same areas with multiple resources.



Edwards et al.,2009 modeled CO₂ emissions for failed deliveries ,for a failure rate of 10% the results show an increase of 15% of CO₂ emissions, for 30% failure rate there is an increase of 45% while for 50% failure deliveries an increase of 75% of CO₂ emissions can be expected.

Freight transportation is also a major disturbing factor to urban life, however, freight vehicles compete for the street and parking space capacity and contribute significantly to congestion and contribute significantly to congestion and environmental nuisances, such as emissions and noise .The nuisances impact the life of people living or working in cities, and the productivity of the firms located in urban zones and of the associated supply chains. They also contribute to the belief that «cities not safe” that pushes numerous citizens to move out of the city limits. And the problem is not going to disappear any time soon.

However, logistics activities sometimes generate traffic congestion, air pollution, noise and crashes in urban areas.

Therefore, balancing smart economic growth and cleaner, quitter, and safer communities are needed. In addition, as we face higher risks of disasters due to global climate change and aging societies, urban freight transport should incorporate these risks for creating more sustainable and liveable cities (Taniguchi et al, 2013).

Casablanca is Morocco's chief port and one of the largest financial centers on the African continent. The 2014 census, adjusted with recent numbers, recorded a population of about 4 million in the prefecture of Casablanca. Casablanca is considered the economic and business center of Morocco.

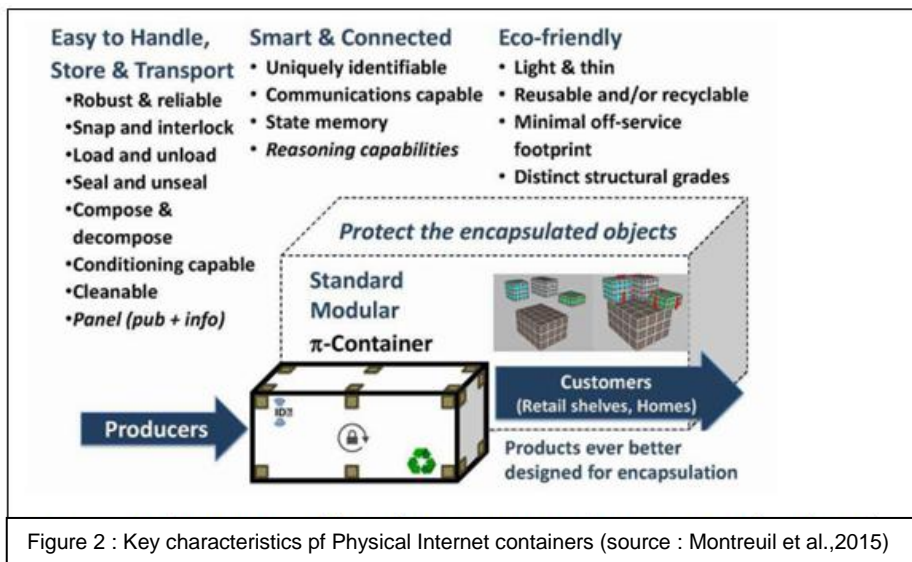
The transport sector in Morocco is a significant contributor to national carbon emissions. About one quarter of energy consumption in Morocco is attributed to the transport sector alone (El-Oalja, 2010). Furthermore, with regards to local air pollutants, air pollution from vehicle emissions are especially of significance in urban areas in Morocco, especially in the zone of Rabat-Casablanca where about 50% of vehicles are concentrated in this city alone (Van Breusegem et al. 2011).

The private and public infrastructure and rail networks are less or not used in transport sector especially inside the city.

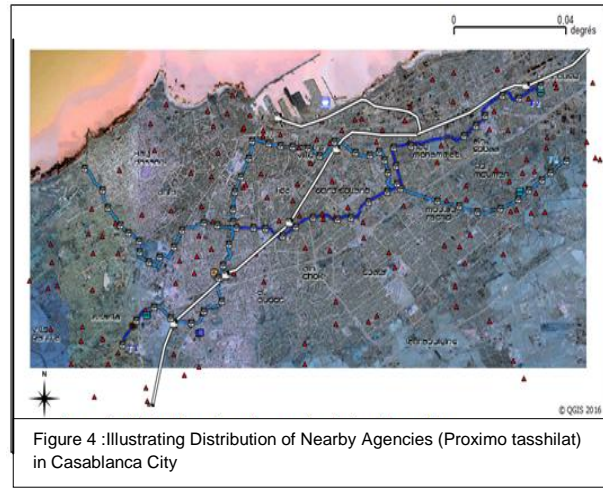
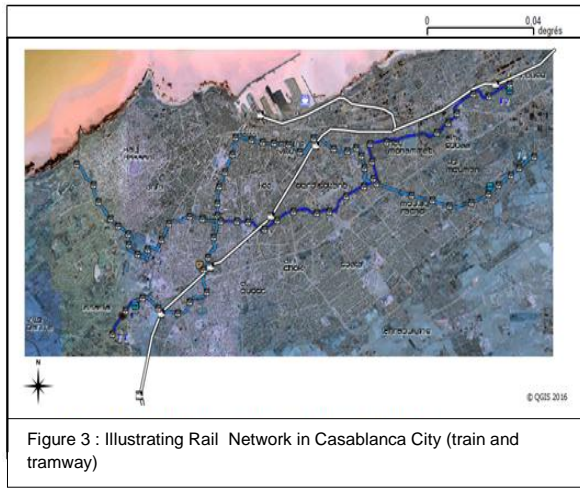
3 Solutions

Our solution is to reduce or eliminate the number of vehicles moving within the city based on the high usage of the existing rail transportation networks and infrastructure (train, tramway) that is less used by the city logistics operators on the city. Casablanca city has some nearby agencies named (Proximo Tasshilat) their role is to facilitate the payment of electricity invoices, water and telephone bills etc.... these agencies relay all the areas of the city, our proposal based on the use of these agencies as a distribution centers (DCs) which can be used by CL operators to deliver and pick-up goods.

To facilitate the flow and movement of goods we suggest the use of modular containers (π -containers) as illustrated in figure-2 these π -containers are easy to handle, store and transport, they are smartly connected and eco-friendly.



As shown in the figure-3 the rail network goes through Casablanca city and connects the main and critical areas of this large city, they are about 200 nearby agencies widespread and covering the entire city (figure-4).



The scenario of our proposal involves the following steps:

Step 1: Goods arrive in a π -container to the port/airport through international logistics and transportation systems, then a related IT system (software) will sort them by geographical zones and calculate the optimal path that they may take.

And to be able to identify and orient each π -container to its next correct destination, we will use a header/label that will contain all the required information and the meta-data like the delivery address (prefecture, zip-code ...etc)

The π -containers are loaded into trains and routed to the mid-town area where we expect to locate a City distribution center that link train and tramway networks. The π -containers are then loaded into an adapted and non-pollutant kind of transportation depends on the dimensions (high/weight) of the transported goods (eg: electrical engines, scooter, electrical truck...) brought them to the closest tramway station.

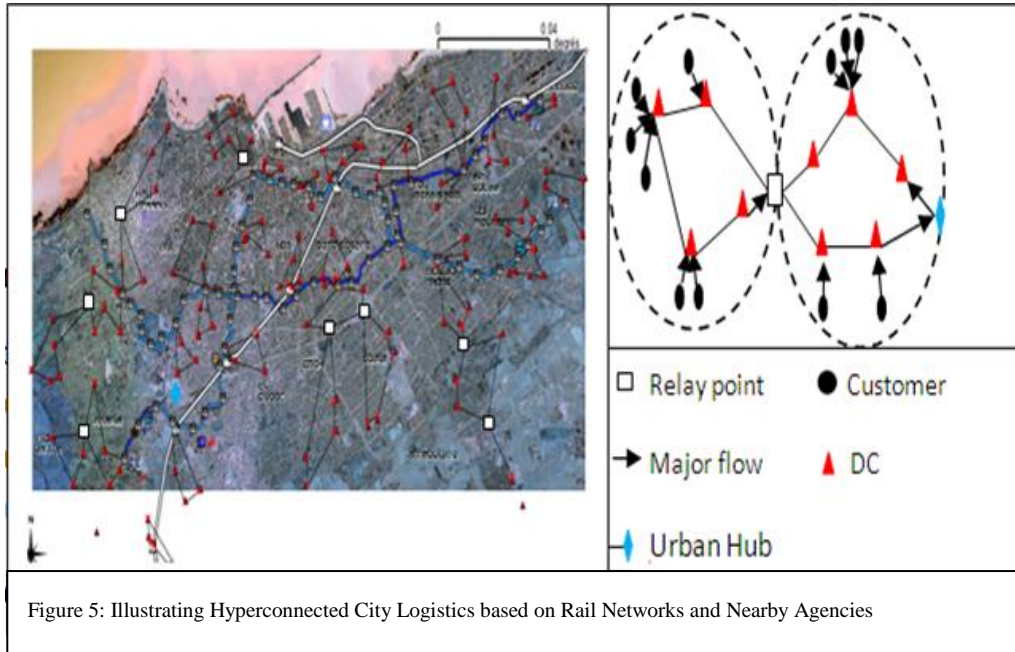
Step 2: the π -containers will be transported by tramway to the next closest tramway station and to the nearby agency where the customer is located, and that it is due π -container labels that facilitate its movements. The frequency between trams is around 30 minutes that thing will increase the number of visits to the distribution center and subsequently to customers.

Step 3: the π -container will be picked up from the tramway station based on the meta-data printed on the labels and routed by the adaptable transportation form that will be used (we recommend any kind of electrical engines) to different nearby agencies which are already exist and cover almost the city (figure-4) then the delivery agent can begin its delivery tour through the different agencies belong his geographical zone.

To optimize the use of the transport delivery form, the delivery agent can take also the π -containers from the agencies which have no direct connection with the tramway station used as urban hubs..These agencies as shown in figure-5 will be called Relay Points (RPs). As many Delivery Agents are needed to satisfy growing freight demand, there is a need to evaluate alternative dispatching methods as an interface to reduce the delivery agent tour lengths and improve its efficiency. One alternative dispatching method considers the use of the network configuration of Relay Points (RPs) which are a set of physical locations (in our case distribution centers DCs) where the delivery agents exchange π -containers of between the two adjacent zones, that allow delivery agent to return to the urban hubs and make their tour of delivery zones more frequently while the other π -containers continue their movement to the final destination.

Step 4: When the π -container arrives to the nearby agency, the client will be notified with an sms or an E-mail based on his preferences and the available information about him.

The nearby agencies must be equipped with tools such as scanners and IT system to confirm the delivery and the pick-up and also to share information between customers/freight transport operators while the tracking of their parcels.



5 Conclusions

Our aim in this article is to initiate a research by studying the case of the Casablanca city, we introduced the idea of using the existing infrastructure and transportation networks and exploiting the network of nearby agencies widespread in the large city to improve the last mile deliveries and make from Casablanca a sustainable city and a great place to live in.

We have chosen the Casablanca city as the starting point due of its representativeness to design and create a scalable, easy to use model that could be generalized on other cities in the world.

The design of this idea represents a set of benefits and also some limitations as:

- The confidentiality of customers information
- The customer will not be delivered at home
- Rail and tramway stations today are incapable to manage the π -containers

The next step of this research will cover some questions that we consider crucial; where urban hubs and relay points should be more optimally located? How to optimize the delivery tours ? Our solution will come up with some optimization algorithms. And to prove the direct effects and benefits of adopting this new design on our economy, society (quality of life) and environment, we recommend launching a quantitative study and some kinds of surveys by City Logistics operators.

This new design will be presented to Casablanca smart city committee by the end of this year and the limits discussed in this article could be analyzed and some private-public partnership projects will be realized.

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