

URBAN LOGISTICS

Unmanned aircraft systems an exploratory model for application in freight shipping – case study in Lisbon pharmacies

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Abstract

In the last decades, the pharmaceutical sector has run through a deep change, where the profit margins are getting lower and lower and due to the ageing of the population, so drug distribution problem to pharmacies has become much more important in large metropolitan areas.

Customers' demands are turning more serious and need even more attention. By other hand, pharmacies demand for shorter delivery times: it becomes harder for distributors to routing and scheduling their resources of logistics and shipping. It is known that the traditional organization based on conventional freight transport vehicles does not satisfy the expectations of customers and may in some instances be quite inefficient for the providers.

The aim of the present work is to create an explanatory study for improvement of the freight transport on urban logistics by integrating an innovating system on the pharmaceutical distribution that could bring a complementary solution for freight urban transport.

The subject is presented by demonstrating the complexity of urban living in the context of transportation matters with special care for the freight transport, and characterizing the pharmaceutical distribution in Portugal regarding the last legal changes occurred in the recent years, what kind of implications happened to the sector and the problems that were noticed by the population.

By analysing this activity and their issues it was evident the actors' massive concern and their interest to release the pressure induced by the regulation that drop down the profit margins, which will imply a requirement to come up with a new solution on the supply chain.

By this context, it comes the idea to submit an innovation and disruptive way of transport – unmanned aircraft system – that could solve part of the problem.

Keywords: Urban Logistics, Pharmaceutical Supply Chain, Unmanned Aircraft Systems, Business Models

1. Introduction

Transport theme and mobility are fundamental societal and economic factors and they demand to be easily directed to bring better outstanding for living patterns to the city dwellers.

In economic terms, the transport is a matter of growth and job creation, however it suits to promote his sustainability due of the new challenges that are constantly put to the societies.

Today half of the inhabitants of the planet live in the cities, and in 2030 about 60 % or more of the worldwide population will be living there – in the European countries this percentage already represents 70 % of the population. The establishment of cities must take in consideration this quick growth since that will be of critical importance to their citizens. (Comissão Europeia COM 144 Final, 2011)

1.1 URBAN LOGISTICS

The urban centres are the mainspring of the economic growth and global productivity (the European cities produce more than 80 % of the GDP of the European Union) (Comissão Europeia COM 913 final, 2013) and as that they represent the biggest consumption of resources and the main cause of greenhouse emissions. The urban development in his economic, social, cultural side is very important for the well-being of the population and for the sustainability of the planet. (OCED, 2003), (UN-Habitat, 2012 - 2013)

Urban centres and quality of life are influenced by several causes in which some activities are inseparable – to live, to work to circulate and leisure (Athens Letter, 1993 in (Antunes Ferreira, J., 2013). So the exchanges of

products and services and their appropriate organization are essential parts that must run in harmony.

The interventions of urban planning and the studies and investigations on that matter have been constantly in the direction of turning over for social welfare of his inhabitants. Yet, there always have been little attention to the problems given by the growing increase of the transport of goods in urban zones – in the central regions or urban centres. (OCED, 2003), (Anderson, S., Allen, J., Browne, M., 2005), (LOGURB, 2007), (Allen, J., Thorne, G., Browne, M., 2007) and (Macário, R. et al, 2006)

The present and the future success of the urban centres – especially on city business district depend on the efficiency of the organization and the solutions of transport freight. Therefore, there is at the present an incessant search in the systems, production or urban logistics for the demands of commercial activities and for consumers in a way of an appropriate, profitable and sustainable path. Maintaining living quality standards for urban environment is vital to attract guests, tourists and activities (economic, societal and cultural), and must be a way to persuade the population to live in this central urban area. (European Commission SWD (2013) 524 final, 2013), (UN-Habitat, 2012 - 2013)

There is a generalized belief that transport of goods is damaging the environment and could contribute clearly to problems like the negative externalities (as the traffic jam or pollution and safety and noise). (Taylor, 2005), (LOGURB, 2007), (Allen, J., Thorne, G., Browne, M., 2007), (Rodrigue, J-P., Dablanc, L., 2013), (Dablanc, L., Giuliano, G., Holliday, K., O'Brien, T., 2013), (UN-Habitat, 2013)

So, these dilemmas demand a reflection on measures and solutions appropriate for their resolution, which the objective is to guarantee that the urban centres will be attractive and that activities will unfold without conflicts, or, at least, these negative impacts are minimized.

An urban logistics concept with its complex interactions are fitted at 3 decision levels: strategic, tactical and operational. These levels wrap several agents with different projects. When one intends to function at the level of operational measures, it must have acknowledged that only a global and integrated strategic policy has the strength to reach efficiency on economic, environmental and social objectives to go forward. As well as putting resources and instruments to insure that these measures will go on.

Besides the agents on these different degrees, there is also to be considered the product complexity, the physical factors and their flows, and they share the same infrastructures with other authors (passenger transports – private or public – and also other users) of the urban space.

By definition urban logistics is the integration of information, transportation, inventory, warehousing, material handling and packing and recently added security on urban environment, so transport is the major component of most logistics services. (Rodrigue, J-P., Dablanc, L., 2013)

1.2 PHARMACIES SUPPLY CHAIN AND FREIGHT DISTRIBUTION

Activity with strong connections on urban environment and its contribution is essential for the quality of life of the population and simultaneously very affected by factors as the high standards of technical requirements and request the

optimization of transport to insure the necessities of his users. (Pita Barros, P., Martins, B., Moura, A., 2012)

This organization is based on the traditional model of a supply chain and their actors have their roles quite defined and even guided by own legislation, which prevents that some functions cannot be developed by those who are not authorized.

Its evaluation standard is measured by own indicators and with international standards, since production centres and consumption places could be localized worldwide. In national terms the regulations are effectuated by a national entity that depends directly from the Ministry of Health, following European and International directives as the World Health Organization. (INFARMED, 2014)

The focus of the problem of the distribution of medicines in the urban environment relies on the difficulties in getting an elevated level of service of supply, due to the physical restrictions (space for storage of the pharmacies) and firms' limitation of financial resources. Moreover, the complexity of planning and allocating the vehicle for distribution, due to the delivery demands (scarce products and essential to the population) and the physical demands (time window of deliveries, orders of low quantities and several daily deliveries). (Pita Barros, P., Catela Nunes, L., 2011)

Recently this sector suffered strong legislative changes with its liberalization and it provoked high tensions on market, agents and users. (Deloitte, 2013)

1.3 TRANSPORT SYSTEMS INNOVATION

As said before, transport activity is the engine of any economic activity and represents a

dynamic system in constant evolution. The technological advancements in the modes of transport have been marking different stages of humanity's evolution and progress was generally preceded by the situations of technologies saturation. (European Commission SWD (2013) 524 final, 2013)

The current investigation of transportation looks for the efficient application of the new ways of use of the technical and scientific knowledge to improve the existing ones and it goes besides that, creating complex and sophisticated systems that are commanded and orientated autonomously to remove or reduce human risks. (OCED, 2003)

Unmanned aircraft systems (UAS) are an obvious example of that, and they are in line with the objectives drawn by the modern societies as European Union suggestions to reach an intelligent, inclusive and sustainable strategy in the transport systems. (Comissão Europeia COM 913 final, 2013)

The term of unmanned aircraft systems (UAS) is by definition is a pilotless aircraft which is flown without a pilot-in-command-on-board and also a system with all the components (ground control with a communication link) necessities to accomplish the mission objectives. It could be remotely and fully controlled from another place or programmed and fully autonomous. (Shaw, Ian G.R., 2013)

Regarding the necessities of reducing the emissions of CO₂, urban transports (as responsible for a heavy slice of these emissions) have to stick to a new path, changing the type of fuels used, and relieving the urban space for other activities on behalf of the social welfare. (Comissão Europeia COM 144 Final, 2011)

Unmanned aircraft systems are well-known by their potential, but also pursued by the associated risk. Consequently, some obstacles are being lifted that obstruct his full development. As soon as the system overcomes these barriers, there will be a diversity of applications that suggest a new era in the autonomous transports. (U.S. Department of Transportation - Federal Aviation Administration, 2013), (VOLPE - National Transportation Systems Center, 2013)

1.4 BUSINESS MODELS

The term Business Model had its appearance on the literature later on 90's and it was associated with technological firms. Today, however, this is a transversal issue for any organization according to some authors. Nevertheless, there are a lot of interpretations and definitions employed around this concept. (Osterwalder, A. Pigneur, Y., 2010)

It is with well design business models that enterprises with new ideas and technologies enter in the markets and its importance is as significant as the same presented idea of different styles can produce quite distant economical results. (Magretta, 2002)

Some confusions produced in the terminology oblige to a deep examination on the subject to check that in fact different definitions are used to explain the same concept.

The development of the model by Osterwalder et al. is perceptible to the general understanding and clarifying the business model definition became a reference for the topic. They used a simple and systematic methodology aggregated in nine main blocks: value proposition, customer segments, customer relations, distribution channels, key actions, key resources,

key partners, cost structure and revenue flows. They also highlight the model with a good graphic design to present their idea and demonstrate how the business model canvas could be applied to any organization or idea. (Osterwalder, A. Pigneur, Y., 2010)

2. Problem definition

Analysing the traditional distribution model it was confirmed that there are determined tasks that can be executed by vehicles using an alternative way of road transport in a way of optimizing the distribution.

Some assumptions need to be made to improve significantly the quality of service and to satisfy the tight delivery times and, if possible, to dropdown the costs associated of delivery (transport), contributing in the general way to a better service for the consumer and in simultaneous to compete with a friendly solution to the environment.

Using the unmanned aircraft system (UAS) could be an alternative to the distribution process if thinking of small packages since it could be more reliable due to their enormous flexibility and range of autonomy and it could contribute to a decrease of operational costs. (DHL Microdrones, 2014)

1.5 OBJECTIVE

This study intends to develop a base for future research on innovating system that could be an alternative in the urban goods distribution with the introduction of a technological system that operate autonomous in the air space.

The thought is creating a support model for future trends contributing to a relief traffic inefficiency and resource waste, being able to

minimize environmental impacts, using less pollutant energy and reducing considerably the social impacts, without exposing the human factor to the dangers of the road accidents.

Thus the generic objective is to establish lines of a distribution model using a UAS in an urban environment, in a way to serve' as a complement to the conventional system of medicines distribution to pharmacies. This would promote a combination between the necessities of transport and innovatory solutions, contributing to a higher efficiency, adaptability, diversity and sustainability of the urban mobility.

The persecution of this objective is not a detailed study, but an exercise for future investigations in the context of the urban logistics, in which data will serve as inputs to be used in modelling transport tools to optimize the potentiality of this technology.

1.6 METHODOLOGY

The methodology was gathering an exhaustive literature regarding the issues involved. It was made an exploratory approach to get the knowledge of the distribution process and sale of medicines on urban context.

A few interviews were done in pharmacies around Lisbon area, with a distributor that act as pharmacies supplier, and also to some organizations that are already working and developing autonomous aircraft systems. These local observations allow a big picture of the relationships between several wrapped agents and how the innovation could fit.

Through these natural processes of understanding and interpretation, some data were obtained to build a process of diagnosis and also

definitions for parameterizing the type of equipment (vehicle and system) to be used in the model of calculation of shipping costs and to define new trends.

It is known that several difficulties should come up, namely the information relative to the performance of these vehicles. The problem is always figured out using estimated data or values used on conventional vehicles. (DECOPE, 2014)

Some scenarios were made regarding different types and quantities of medicines with fixed prices to test its applicability to real possible situations considering the previous calculations made for the cost of the transport by *DroneFreight* and working with profit margins for each agent.

3. State-of-Art

1.7 URBAN LOGISTICS CONCEPT AND COMPLEXITY

In urban centres the goods distribution is a very current subject in the modern societies. This subject is a growing preoccupation as a result of the society and technological modifications that exasperate significant changes in the standards and intensity of freight transport in urban areas with also the services that are included (Taylor, 2005), and they also interfere with the other city users. (Dablanc, L., 2007)

Regarding all the matter that contains urban logistics issues, it was important to gather a comprehensive literature to explain the concept and its definition.

It is an activity that is vital for the social and economic development of a society, since it could guarantee the different connotations between the agents involved (producers, distributors, retailers,

transport companies and consumers), and they are organized by public entities that insure the policies and sector regulations, and also the management of the infrastructures.

Focus on **Urban Freight Transport** organize the issues involving an extreme complexity of measures and actions with the target to promote consumer satisfaction and also looking forward for an efficient distribution system, since that is determinant for the economic success of one region or an individual area. (UN-Habitat, 2013)

There is a dilemma for the urban freight transport that is struggling with the needs of efficiency to promote city developments – making them better places to live in order to improve economical activities as working, shopping, and leisure, regarding the fact they need to compete with peripheral places, and it is known that freight transport has a great negative contribution to the environment by creating congestion, pollution and noise. (Allen, J., Thorne, G., Browne, M., 2007), (Dablanc, L., Giuliano, G., Holliday, K., O'Brien, T., 2013)

Find solutions for **Urban Freight Transport** has been a commitment for all the urban planners once the transport services and logistics have a significant cost and a very strong impact in the cost of the goods and services consumed in a region or urban zone. As an example, in average one job produces a delivery (or a pickup) in a week (Dablanc, L., 2007). This is also aggravated by the growing pressure created on sector to present high levels of efficiency at a low cost, promoting a raised of small freight vehicles on the field. However, this solution has been producing more problems of traffic jam that affect the growth of the remaining urbane activities. (Macário, R. et al, 2006)

To solve the logistic problems many measures have been applied to find solution and they could be separated (Macário, R. et al, 2006) according to:

- Legislative and Operational – cooperative systems, night deliveries, intermediate centres of deliveries; accesses conditioning (restrictions on weight or dimension), time window restrictions;
- Territorial Management – establish zones for loading and unloading, small logistic centres;
- Technological – the use of GPS and tracking, software of route planning, adoption of no pollutant vehicles;
- Intervention on Infrastructures – creating urban distribution centres, use of railroad transport and also underground transport and underground zones for storage.

Another solution would be the use of consolidation centres to load and unload located at different levels in peripheral and central zones, which allows transferring load with light vehicles (bicycles or electric cars) and avoiding hard vehicles in the interior of the urban zones. (OCED, 2003), (Allen, J., Thorne, G., Browne, M., 2007), (Browne, M., Allen, J., Leonardi, J., 2011), (UN-Habitat, 2013)

1.8 PHARMACY SUPPLY CHAIN AND TRANSPORT DISTRIBUTION

It is a very relevant subject related to urban activity since it is basic and essential in a city, organized according to very rigid criteria that has

very regularized technical requisites and faces follows to the demands of a consumer for one level of elevated service, and it requires a number of movements of the load in a very considerable urban space. (Legislação Diversos, 2007)

The distribution of the medicines is organized in two main levels – warehouse activity and the direct sale of medicines to the patients. We find also three categories of intervention in this system: the pharmaceutical laboratories – that develop products (following regulation processes) or obtain the production license to commercialize their sale, and eventually they also supply direct to pharmacies; the distributors – that insures medicines distribution to the pharmacies; and on the bottom line, the pharmacies – whose activity is to supply the medicine or other services the patients. (Pita Barros, P., Catela Nunes, L., 2011)

A research was made about legislation of this sector to understand the last measures that were applied. These actions had an extraordinary impact on the pharmacy business and also affected the access of the medicine to the population: liberalization of the activity and ownership, price reduction and the establishment of a maximum in the sale price – which result in a reduction in the profit margins, more used of “generic” medicines (lower margins) and savings on distribution costs.

Regarding a study made for the sector is was shown that pharmacies are trying to survive on the market and to deal with their fixed costs. (Pita Barros, P., Martins, B., Moura, A., 2012). This study also shows the difficulty that the consumer has to find products on the market. Another study allows to comprehend the supply faults in the national pharmaceutical market and the enormous waiting times to acquire the products. (Deloitte, 2013)

1.9 INNOVATION IN TRANSPORT SYSTEMS

An important research was made on this subject to realize what has been going nowadays regarding the autonomous systems.

The reason of following this issue is to be aligned with the most recent European and global policies concerning the environmental problems.

Unmanned aircraft systems have been developed and improved in the military field and recently to help public entities so all the research that is being done on these systems could be very useful, it is possible to apply them to the transport freight sector since they operate in an environment that doesn't suffer from congestion and constraints. Also, they could relieve the urban space and infrastructure for other activities.

By definition this system is made to work and operate in an autonomous way and they have a lot of potentialities for working in the urban areas. Logically, there are also a few concerns that need to be solved if we want these systems integrated in the air space. However, some technological barriers need to be run out and that will happen in the near future (if they are not yet, but not divulged) so what is missing now is a political decision that express confidence to the community. (U.S. Department of Transportation - Federal Aviation Administration, 2013)

1.10 BUSINESS MODELS

Another significant issue in this study is the necessity to put a system like this operating on the market.

However, there is a lot of confusion on these themes with this concern – it was made an

extensive research on literature to compile all the recent investigation about it.

It is consensual that Osterwalder and his team had found a fantastic work to illustrate a model (canvas) that is able to define the design of a business with all the main components-

Also it is important to construct an environmental map as a “zoom out” to show everything that relates to the business revision and finish with a “zoom in” created by a value proposition canvas to evaluate all the single important topics that need to be fit between customer necessities and the proposing value.

This model is used to exemplify how a business of a new mode of transport could be organized and how to show the value proposition to the customer or to the market.

4. Case Study

A brief information about the market with statistical references was made just to indicate what kind of information is needed to pursue a study connected with the subject.

Some information were obtained at pharmacies to help to create a template concerning retail margins (prices are determined by own legislation) which were important to construct later some scenarios.

It was important to give a detail information about the traditional process of distribution and to reinforce where the system is inefficient and how is possible to introduce a new transport system.

Also, some technical information was detailed to explain some limitations of both systems and how the new system is supposed to be working on.

The model used for the calculation is then defined, and it is also important to give a framework for the scenarios. To develop these scenarios, several information's were collected, a few were obtained on the manufacturer's websites and also a lot were founded on the Web. However, regarding the difficulty to obtain real data some estimations were made.

The scenarios were built to demonstrate that it could be possible to use this new system to solve the problem of small and unexpected orders. Collecting an extra fee to the consumer and deducing a percentage of the profit margins to the agents (distributors and pharmacies) it is possible to run this solution and offer a better quality service to customers without penalizing them so much.

5. Conclusion

This study had the intention to establish a framework for future developments regarding a new solution to urban logistics problems.

To persecute the objective it was made a wide investigation of literature and a field work to cover and understand the freight distribution of the pharmaceutical business.

Difficulties were already understood by its agents, and there is an enormous necessity of finding solutions that become appropriate for a resolution. (Deloitte, 2013)

Looking over the whole supply chain, it's been clear that the traditional freight transport used is not sufficient to solve the requirements of the consumers.

Working on new transport mode solution could be proved that for delivering small packages or even just one product the *DroneFreight* has

presented the better service – fast and reliably and even less expensive than conventional vehicles.

Since this is not yet operational on the market all these assumptions need a solid investigation. However a lot of studies have been published showing all the details needed to go forward on this innovation so the main issue nowadays is to change the public opinion by doing some lobby on the political side. (U.S. Department of Transportation - Federal Aviation Administration, 2013), (VOLPE - National Transportation Systems Center, 2013)

1.11 FUTURE CONSIDERATIONS

To prepare a work that corresponds effectively to the process of distribution of medicines it is necessary a lifting still more detailed of the whole activity of the distributor and of the pharmacies, so only in this way one can check the concrete values of the requests effectuated (orders), and analyse a deep statistic on the way like the units of load that are filled out, what its average and medicines' weights.

Pickup situations were not considerate on this study, even knowing that they are very important in this supply chain, but just to simplify the model it was decided not to use it.

An important part to be developed in future investigations is in the systems creation: when several applications were integrated between software, what are wrapped – programs of management of stocks, routing and planning models and navigation systems for satellite – GPS, obtaining in this way an almost autonomous system of requests and its allocation to the not manned air vehicles, lifting for the operators the mission of controlling and analysing the current operation

One should recall that all these subjects are being already debated in depth a few years ago to this part, allowing to say that there were already exceeded many technological barriers and therefore, it is only when the public and political will is lacking in putting in functioning these systems.

Following the advice on gathering more detailed, these data will allow a quite substantiated preparation of a model and a business plan necessary for getting financing and subsequently to put in the market this transport type of goods.

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