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Residents' acceptance for night deliveries policy in the city of Thessaloniki, Greece

Marios A. Zelidis^a, Efstathios Bouhouras^{a*}, Socrates Basbas^a, Tiziana Campisi^b, Stamatia
Ftergioti^c

^a*School of Rural and Surveying Engineering, Faculty of Engineering, Aristotle University of Thessaloniki, 541 24, Thessaloniki, Greece*

^b*University of Enna Kore, Faculty of Engineering and Architecture, Cittadella Universitaria, Enna 94100, Italy*

^c*Department of Economics, University of Ioannina, P.O. Box 1186, 451 10 Ioannina, Greece*

Abstract

As humanity struggles to absorb the effects of the Covid-19 pandemic, city logistics is one of the transport sectors that has been affected. The restriction measures applied, and the regional lockdowns had put significant pressure on the supply chain but also on the last mile delivery. City logistics stand before a crossroad with important challenges lying ahead and difficult decisions to be made. The transformation of the city logistics sector is inevitable as more and more countries join an alliance against climate change. In this framework, the present paper presents an enquiry concerning the residents' acceptance at the city of Thessaloniki, Greece on the possible implementation of night deliveries. A questionnaire-based survey was conducted and the analysis of the collected data is presented revealing that the residents are aware of night deliveries' occurring problems as well as their willingness to accept the implementation of such policy if all necessary precautions and measures are applied.

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* Corresponding author.

E-mail address: stbouh@auth.gr

1. Introduction

The concept of Night Deliveries is based on a simple, yet important, principle: to reduce freight transport during peak hours daily (Ljubicic & Pavlovic, 2015) by applying traffic restrictions for commercial vehicles in a specific area. Goods' deliveries are carried out during nighttime and most commonly from 10:00 p.m. to 07:00 a.m. The specific policy could be considered as a controversial one, since it is implemented during nighttime and at the same time, it concerns the delivery of goods, which can be considered as a rather disturbing activity (e.g., noise, vibrations). This happens because most of the people believe that loading and unloading activities during the night are performed in the same way as during the day. This is a common misunderstanding, among not only the citizens in urban areas but also (to some extent) among the carriers, forwarders and even policy decision makers (Bouhouras & Basbas, 2018).

Night deliveries can be a subtotal for off-peak hour delivery strategy as the second one aims to segregate commercial vehicles' traffic from the rest of the traffic and utilize any time window allowed for loading/ unloading activities. Night deliveries are constrained to achieve the exact same goal but only during night-time. Most of the research has been implemented the last twenty years following different approaches. Noel (1983) and Noel et al. (1980) presented a review and an analysis of night deliver as a tool for managing vehicle traffic in high-density central business districts of urban areas and explored the feasibility of implementing a system of off-jour pickup and deliveries in the central business districts of U.S. cities.

Browne et al. (2006) presented the issue of night deliveries restrictions placed on retail stores in the UK and specifically the benefits and impacts of a reduction in night-time delivery restrictions. In 1998, the Dutch Government set out standards for noise emission during loading and unloading in retail trade and craft businesses and as a result, a project was developed under the name PIEK (2020). In 2006, the Municipality of Barcelona developed a system for quiet night deliveries in collaboration with two supermarkets operators, identifying the benefits and recognizing that night deliveries can be an innovative approach (NICHES, 2006). Similar projects were implemented in other cities as well (Paris, Dublin, Rome as presented by Marcucci & Gatta (2017), Paris as presented by Dablanc (2017), Sao Paulo as presented by Bertazzo et al. (2015), Toronto as presented by McPhee et al. (2015) emphasizing to the very promising results while Verlinde et al. (2010) noted the necessity of public support for night-time delivery to be successful. In 2000 the European Co-ordination Action on "BEST Urban Freight Solutions" (BESTUFS) was funded by the European Commission (DG Transport and Energy) which was active until 2008. BESTUFS was one of the most important European research projects aiming to address key urban freight transport problems and identify potential solutions as mentioned by Allen et al. (2007). The Good Practice Guide published in 2007 extendedly presented Night Deliveries examples, specifications and key points for successful implementation. The key issues regarding Night Deliveries that under investigation by the researchers are the following:

- How local supply chain will address cost's changes (increased labour cost by Cunha and Yoshizaki (2017), transportation cost and emission savings by Estrada et al. (2018), economic impacts of off-hour deliveries by Holguin-Veras et al. (2012) as well as Mommens et al. (2018);
- Level of acceptance by the stakeholders by Stathopoulos et al. (2012), de Oliveira & de Oliveira (2017), Polimeni et al. (2005), Dias et al. (2019), Kotlji (2019) and the local societies by Macharis & Melo (2011), Nathanail & Karakikes (2019), Verlinde & Macharis (2016), Bjerkan et al. (2014), LaBelle et al. (2015). Ljubicic & Pavlovic (2015), highlight that in order to achieve efficiency in urban areas, all participants must join forces.
- Technical specifications regarding the required equipment and the design for unloading/ loading bay related to noise problems by Rodrihue et al. (2013) as well as Slavik & Gnap (2019). The technological evolutions regarding commercial vehicles construction, the materials used for the equipment needed for loading/ unloading activities combined with the experience from the implementation of Night Deliveries in several cases, can perform as safety net ensuring low or at least tolerable levels of produced noise by the residents of urban areas as analysed by Wang et al. (2013).
- Identify/ quantify the benefits by the implementation of Night Deliveries at small-medium cities by Morfoulaki et al. (2015), at large cities by Holguin-Veras et al. (2011) and Fu & Jenelius (2018) as well as in national level by Taefi (2016). An extensive literature review on this issue is presents by Sanchez-Diaz et al. (2016). Van Duin et al. (2020) acknowledge Night Deliveries to be one of the '*most beneficial alternatives for a sustainable last mile in all different cases*'.

Several European projects (PIEK, SILENCE, STRAIGHTSOL) (URBAN FREIGHT, 2015) have tested through pilot actions the implementation of Night Deliveries with promising results. However, the implementation of Night Deliveries in an urban area is not an easy task, as the specific policy requires not only the cooperation of all stakeholders of URFT sector but also significant investments on equipment and infrastructure. If Night Deliveries are implemented in an urban area without the required preparations in all levels, most likely will be unsuccessful, although in general researchers agree that the effectiveness of restricting policies concerning urban road freight transport depend on the time periods for which they will be applied (Yannis et al., 2006) and that could potentially perform better at night.

Although as mentioned on the above, Night Deliveries were implemented in several cases, it has not become very popular among logisticians. It is well known that each case is unique and thus the successful implementation of a policy in one case does not automatically mean that it will be successful in another, despite any existing similarities. The success of Night Deliveries is directly linked on how the policy makers and the stakeholders will cooperate concerning addressing and eventually overcoming the identified problems that Night Deliveries create (produced noise, human demand for serving the goods distribution during nighttime, investment on equipment and infrastructures) as mentioned by den Bossche et al. (2017). Regarding produced noise, the researchers through pilot actions concluded that: **i)** there are materials that could decrease the levels of produced noise according to Finaly (2008) and **ii)** that average values of produced noise during nighttime did not significantly exceed the legislation permitted level according to Slavik & Gnap (2019) and Ainge et al. (2007). Taking into consideration all the above mentioned, it is rather obvious that the process to be followed in order the implementation of Night Deliveries in an urban area to be successful is more or less the same as the one for the Sustainable Urban Mobility Plans (SUMPs): **i)** Set up the working structures, **ii)** Determine planning framework, **iii)** Analyze mobility situation, **iv)** Build the scenario – Night Deliveries, **v)** Develop vision and strategy with stakeholders, **vi)** Set targets and indicators, **vii)** Define the details with stakeholders, **viii)** Agree actions and responsibilities, **ix)** Prepare for adoption and financing, **x)** Manage implementation, **xi)** Monitor, adopt and communicate and **xii)** Review and learn lessons.

Any derogation from this process or fragmentary implementation, could easily lead to failures and ultimately unsuccessful implementation of Night Deliveries. The present paper is focused on addressing to a specific part of the stakeholders (residents) the possible implementation of Night Deliveries at the city of Thessaloniki. For this to happen, a questionnaire was firstly developed and then used in a questionnaire-based survey. The analysis of the collected data of this survey are summarized in the following as well as a comparison with the results of a previous respective survey implemented at the city of Volos, Greece by Hatzistamatis et al. (2019). It must be mentioned that this comparison incorporates difficulties and a certain amount of risk as researchers highlight the fact that there are factors that “*limit the comparability of the results obtained from other case studies (population size, density, traffic conditions, research methodology, vehicle fleet composition, etc.)*” according to Savadogo & Adrien (2021).

As e-commerce has recorded exponential growth is leading to an increase in the volume, frequency and capillarity of urban logistics activities. Greater coordination of all stakeholders involved is therefore necessary to minimise the impact on the urban ecosystems. In this sense, it is important that Public Authorities regulate logistics activities in an integrated and harmonious way, manage public spaces and their use, encourage virtuous behaviours of both Producers and Distributors in order to reduce the negative externalities generated by transport activities, activating virtuous processes of collaboration.

2. Methodology

The first step towards the questionnaire-based survey concerned the identification of the stakeholders and the ways they interact among them related to the objectives set by the implementation of Night Deliveries policy. The identified stakeholders are the following: **i)** Receivers, **ii)** Carriers, **iii)** Local Authorities, and **iv)** Residents.

The second step concerned the identification of the under-study area. Based on the characteristics of the city of Thessaloniki, it was decided that the survey would be conducted in the commercial center of the city, an area covering 2km² and hosting almost 200,000 residents.

The third step concerned the development of the questionnaire, which in its final version was divided into two (2) sections. The first section concerned information about the following: **a)** gender, **b)** age, **c)** education, **d)** occupation,

e) monthly income and **f)** area of residence. The second section concerned information about the following: **a)** deterioration of road infrastructure, **b)** emissions, **c)** produced noise, **d)** nuisance due to the commercial vehicles' presence along the road network, **e)** delays, **f)** level of safety for the rest users, **g)** reliability of delivering on time the goods, **h)** transport cost, **i)** impacts of traffic to the economic development of the city and **j)** micro vibrations. For the second section, the participants had to choose their answer among seven (7) available using a Likert scale. Moreover, the second sections included three (3) questions concerning the following: **a)** the level of dissatisfaction of the residents related to the traffic congestion phenomena along the road network in the under-study area, **b)** their tolerance on possible produced noise during loading/ unloading activities during night time and **c)** if they agreed and in which level with the enforcement of an environmental fee in order Night Deliveries policy to be funded.

The fourth step concerned the implementation of the questionnaire-based survey. The survey endured from December 2019 to March 2020, just before the lockdown was set in force by the central government due to the Covid-19 pandemic. In total, 200 questionnaires were collected with in situ interviews at locations inside the boundaries of the under-study area.

2.1. Descriptive statistical analysis

The first section of the questionnaire concerned general information. Regarding the gender of the survey's participants 56.0% were men and the rest 44.0% were women. Most of them were highly educated (41.5% - university degree or higher) while 36.5% were university students during the survey. Regarding their age, 40.0% of the participants had age between 18-24 years old, 37.5% between 25-39 years old and 14.0% between 40-54 years old. Based on the analysis of the data about their monthly income, the majority (62.0%) had a monthly income between 1001-2000 euros, while 27.0% had an income between 501-1000 euros. Although the interviews were implemented in the above presented area, a significant percentage of the participants (64.5%) were not living inside the borders of this area (35.5% were living inside the area).

The second section of the questionnaire, as mentioned on the above, was focused on the participants' point of view on the problems produced by road freight transport in the city of Thessaloniki. It must be mentioned that a Likert scale (1-7) was used to record the participants' opinion. Specifically, option 1 was equal to 'Strongly Disagree', option 2 was equal to 'Disagree', option 3 was equal to 'Slightly Disagree', option 4 was equal to 'Neutral', option 5 was equal to 'Slightly Agree', option 6 was equal to 'Agree' and option 7 was equal to 'Strongly Agree'. This scale was chosen as the participants were asked to state their opinion on how road freight transport is involved to the creation of specific problems. Table 1 presents the frequency of the recorded answers of the Likert scale on those problems.

Table 1. Number of recorded answers (highest values in bold) regarding the problems produced by road freight transport in the city of Thessaloniki based on a questionnaire-based survey (relative frequencies in *italics*)

Likert scale	1	2	3	4	5	6	7
Micro vibrations	36 (18%)	45 (23%)	43 (22%)	37 (19%)	27 (14%)	8 (4%)	4 (2%)
Damaging road infrastructure	6 (3%)	10 (5%)	28 (14%)	34 (17%)	64 (32%)	32 (16%)	26 (13%)
Delays	0 (0%)	4 (2%)	7 (4%)	10 (5%)	29 (15%)	46 (23%)	104 (52%)
Other users' disturbance	2 (1%)	4 (2%)	17 (9%)	35 (18%)	38 (19%)	41 (21%)	63 (32%)
Energy consumption by commercial vehicles	0 (0%)	1 (1%)	2 (1%)	5 (3%)	10 (5%)	46 (23%)	136 (68%)
Noise produced	4 (2%)	19 (10%)	46 (23%)	53 (27%)	51 (26%)	11 (6%)	16 (8%)
Other users' safety and security	6 (3%)	22 (11%)	30 (15%)	43 (22%)	38 (19%)	34 (17%)	27 (14%)
Transport cost	46 (23%)	47 (24%)	49 (25%)	35 (18%)	15 (8%)	6 (3%)	2 (1%)
Reliability on goods' delivery	54 (27%)	59 (30%)	45 (23%)	22 (11%)	12 (6%)	5 (3%)	3 (2%)
Required transport time	51 (26%)	39 (20%)	60 (30%)	26 (13%)	14 (7%)	8 (4%)	2 (1%)
Economic development of the city	24 (12%)	38 (19%)	59 (30%)	58 (29%)	18 (9%)	2 (1%)	1 (1%)
Air pollution	17 (9%)	24 (12%)	48 (24%)	43 (22%)	46 (23%)	13 (7%)	9 (5%)

Regarding the highest values recorded for each problem, these are the most important findings: **i)** 22.5% consider URFT is not significantly related with produced micro vibrations, **ii)** 32% consider URFT is related to the damages produced along the road infrastructure, **iii)** 52% consider URFT is highly related to other users' delays, **iv)** 31.5% consider URFT is highly disturbing for other users, **v)** 68% consider URFT consumes high amount of energy, **vi)** 26.5% consider URFT is moderate related with the produced noise, **vii)** 21.5% consider URFT is moderate related with users' low perceived level of safety and security, **viii)** 24.5% consider URFT is moderately related to goods' transport cost, **ix)** 29.5% consider URFT does not affect delivering goods reliability (on time), **x)** 30.0% consider URFT is moderately related to other users' required transport time, **xi)** 29.5% consider URFT is moderately related to the economic development of the city and **xii)** 24% consider URFT is moderately related to produced air pollution.

The average scores of the above-mentioned problems (see Figure 1) are compared (except of those regarding micro vibrations and damaging of road infrastructure) with the respective values of a similar questionnaire-based survey conducted in the city of Volos, Greece as presented by Hatzistamatis et al. (2019).

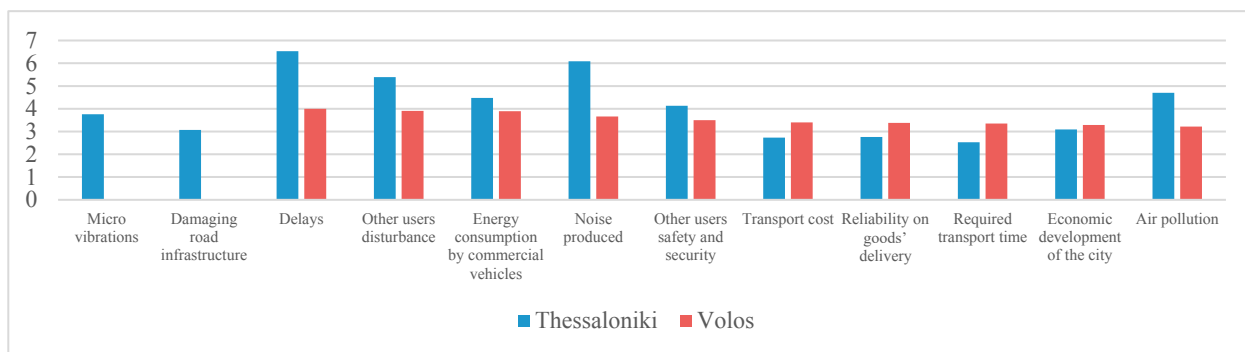


Fig. 1. Comparison of average scores regarding the problems produced by road freight transport based on questionnaire-based surveys in the cities of Thessaloniki and Volos, Greece [Own process]

Regarding the participants' perception on whether Night Deliveries could be a solution to some of the problems produced by URFT in the Municipality of Thessaloniki, most of them (91.0%) replied positively (182 positive and 18 negative answers were recorded). Participants were also asked to reply on two scenarios concerning their level of tolerance of produced noise during loading/ unloading activities for two time periods: **a)** from 08:00 pm to the beginning of quite hours and **b)** from the beginning of quite hours to 07:30 am. The percentage of them replied that they would tolerate the noise for scenario (a) was 92.0% (options 5-7 of the Likert scale) and for scenario (b) the percentage was reduced to 38.0% (options 5-7 of the Likert scale). These number concern the sample as a whole (n=200), so when then sample was reduced to those participants living in the area to which the Night Deliveries could hypothetically be implemented (n=129), the respective values were for scenario (a) 91.5% and for scenario (b) 38.0%. There are no differences among the examined values regardless the sample used. The participants were very clear based on their replies that they would easily tolerate the produced noise before the beginning of quite hours, but they would not tolerate the noise produced by loading/ unloading activities during quite hours.

2.2. In depth statistical analysis

In depth statistical analysis was performed with the usage of IBM SPSS Statistics version 25.0. The first step concerned the examination of whether the collected data were Normally Distributed. By applying Shapiro-Wilk and Kolmogorov-Smirnov statistical tests, it was found that the data were not Normally Distributed and thus a non-parametric analysis was performed. At the next step, the Mann-Whitney test was applied to compare the mean ranks of two unpaired groups on the dependent variable as well as the Kruska-Wallis test was applied for those cases which compare three (3) or more unpaired groups of the same variable. As a result, the following tests were implemented:

- Micro-vibrations and residence (Mann-Witney U test): there is no statistically significant difference between participants residing inside and outside the city centre on concerns about micro-vibrations.

- Congestion phenomena and residence (Mann-Witney U test): there is no statistically significant difference between participants residing inside and outside the city centre on concerns about congestion phenomena.
- Produced noise and residence (Mann-Witney U test): there is no statistically significant difference between participants residing inside and outside the city centre on concerns about produced noise.
- Monthly income and “green tax” (Kruskal-Wallis H and Pairwise Mann-Whitney U tests): participants’ opinion about the hypothetical implementation of “green tax” on the commercial vehicles differs significantly based on their level of monthly income. Specifically, participants with a monthly income level of 1001-2000 (€) seem to be more in favour of a “green tax” than those with a monthly income level of 501-1000 (€).
- Age and level of knowledge about URFT problems (Kruskal-Wallis H and Pairwise Mann-Whitney U tests): Regarding air pollution, age group 65+ seems to be significantly more concerned. Regarding, safety and security, age group 50-64 is more concerned than age groups 18-24 and 40-54. Regarding reliability on goods’ transport two group ages (18-24 and 25-39) were more concerned than the rest. Regarding commercial vehicles’ energy consumption, age group 55-64 is more concerned than age groups 18-24, 25-39 and 40-54. Regarding how urban road freight transport contributes to the city’s economic development age group 25-39 is more concerned than age group 18-24. Finally, regarding micro-vibrations, there are significant differences almost between all age groups. Specifically, age group 40-54 is more concerned than age groups 18-24 and 25-39, similarly age group 65+ is more concerned than age group 18-24.

Participants were well informed about the problems created by urban road freight in the city of Thessaloniki and specifically about the delays occurred, the produced noise and the disturbance in general. Concerning air pollution, safety of other users along road network, commercial vehicles’ energy consumption and micro-vibrations the participants were moderate informed. Finally, the level of knowledge regarding road’s infrastructure damaging, reliability on goods delivery, time and cost transport and the effect of urban road freight on the city’s economic development, was low. Overall, younger ages seem to be more concerned about the problems urban road freight transport create.

3. Conclusions

The analysis of the collected data for the case on the city of Thessaloniki revealed that the participants are aware of the problems that Night Deliveries create on different levels depending on the problem’s nature. Commercial vehicles’ energy consumption as well as occurring delays (due to loading/ unloading activities) for other users are the most significant problems based on their opinion. They also consider urban road freight transport to be disturbing for other users mainly in terms of damaging road infrastructure. Although it could seem surprising that the produced noise level or micro vibrations do not disturb participants, an explanation to that could be that they have not experienced these problems, as Night Deliveries were not applied in the city of Thessaloniki. An interesting finding is that participants do not consider urban road freight transport to be a threat to their safety and security and that transport cost and goods’ delivery reliability are not affected by the system’s level of performance. Finally, participants do acknowledge the system’s involvement to the city’s economic development.

Participants’ level of knowledge and perhaps interest, regarding the problems occurred by the urban road freight transport, differs based on their age group. Specifically, group age 18-24 are more concerned about problems related to urban road freight, as air pollution, safety and security, reliability on delivering goods and micro-vibrations. The same group age acknowledges in a higher level that the rest that urban road freight contributes to the city’s economic development.

Overall, participants are not satisfied by urban road freight system’s performance and up to a point are worried about its negative effects on their quality of life. Concerning Night Deliveries and a hypothetical implementation, participants clearly stated that they could easily tolerate the produced noise before the beginning of quite hours, but they would not tolerate the noise produced by loading/ unloading activities during quite hours.

In order Night Deliveries to be implemented in the city of Thessaloniki (not in a theoretical base but in reality), local decision makers should examine based on a scientific approach if it would be helpful not only for urban road freight system itself but also for the rest of road’s infrastructure users. Furthermore, and equally important, they must ensure that all necessary measures regarding residents’ protection over produced noise and/ or micro-vibrations will be implemented as well as proper supervision and policing, taking into consideration that significant funds have to be

used for this purpose. Night Deliveries, based on the experience from other cases, can have an impact on daily traffic volumes by decreasing them as commercial vehicles will not be serving, but only if all necessary precautions are implemented. Moreover, the policy must be correctly communicated to all stakeholders, for as much time needed and through different channels and means in order to be fully understood by all group ages.

Our approach has limitations with the most important being that the survey was implemented in the central area of the city of Thessaloniki, an area in which traffic is heavier and thus there is a strong possibility of not recording participants' opinions from the western or eastern areas of the city (with less problems occurred by traffic congestions phenomena, delays, etc.). Another limitation concerns the fact that as Night Deliveries were not implemented in the city, participants were not fully aware of the problems they create as the level of produced noise and/ or the micro-vibrations. This fact might have led some of the participants to underestimate the severity of these problems.

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