

## **APPLICATION OF E-COMMERCE IN LOCAL HOME SHOPPING AND ITS CONSEQUENCES ON ENERGY CONSUMPTION AND AIR POLLUTION REDUCTION**

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### **ABSTRACT**

This study discusses at a conceptual level, a number of issues related to the application of E-Commerce in introducing local home shopping and its effects on reduction of urban traffic and air pollution due to minimization of energy consumption. This objective has been achieved through a survey among a number of costumers' community to Farmanieh grocery shopping centers in district 1 of municipality of Tehran in 2006. The ultimate conclusion from considering all data of district's characteristics as well as emissions and average fuel consumption's output resulted for about 88 percent reduction in fuel consumption and 20.12 tons/yr of air emissions. The generalization of the calculation is also done for all 22 districts of Great Tehran to show the tremendous amount of changes in air emissions as well as fuel consumptions. Having in mind the urban environmental issues upon the agenda of the country, make the government, business sectors, consumers and also local authorities aware of the environmental potential of local E-commerce and its contributions to more sustainable environment and greening of online grocery and goods shopping in Tehran.

**Key words:** E-Commerce, home shopping, energy, air pollution, Tehran

### **INTRODUCTION**

The world is experiencing a dramatic societal shift entering into some phenomenon that is so called the information society (Sarkis, *et al.*, 2002). Internet is a media used for both information exchange and sales channels for businesses and consumers, because of the fact than this exchange is fast, convenient, reliable, interactive, global and rich (Li, 2000). Electronic retailers offer lower prices due to the lower costs of market entry and operations, less inventories, less energy consumption, pollution reduction and the most important of all using, the shorter sales chain (Jolfsson and Smith, 2000). Consumers have the opportunity to change their habitat of shopping in order to get benefit of its convenience, speed, lower prices and time saving qualities (Raiyas and Tuunainen, 2000). From the environmental and

energy point of view, shopping for online goods and groceries has the potential to reduce energy consumption (OECD, 1999 and Romm, *et al.*, 1999) as well as reduction in environmental emissions (Oremo and Mallin, 2000 and Johansson, 1995). It is a fact that individual transportation to and from the goods and grocery sectors by the customers can be replaced by an integrated transportation system. Due to change of traditional shopping to online system, the responsibility of transporting of groceries is shifted from customers to the online trader's transportation systems (Dolokia, *et al.*, 2002 and Fitcher, 2003). Having in mind the environmental potential of online shoppings, it is believed that a shift from traditional shopping for groceries have its benefits on energy consumptions and also in reduction of air pollutants emissions while the welfare of people being reserved (Caudill, *et al.*, 2000; Gustafsson and Ebasson, 2000).

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## MATERIALS AND METHODS

In order to perform this study, district one amongst 22 municipality districts of Great Tehran was chosen. District one along with its boundaries is about 74 km<sup>2</sup> in surface area. Maximum number of shopping centers, rapid population growth, pattern of housing, congested traffic and also the number of private cars that is over 3.7 per capita, made this district a good candidate for the survey. Farmanieh goods and grocery shopping center was selected because it was the second main shopping center in the area. Field survey and also interviews were performed to acquire information. Then, by using all the data collected from public and private organizations, such as types of car, Energy consumption rates and air emission rates from active cars running in the district, the calculations were completed.

## RESULTS

In the present investigation, one of the biggest shopping centers was chosen in the north part of Tehran. Farmanieh goods and groceries shopping center is located in north part of Tehran, with 58 goods and groceries stores and a branch of Shahrvand supermarket that attracts too many shoppers per day. The total area of the center is 21000 m<sup>2</sup>, out of which about 4196 m<sup>2</sup> belongs to Shahrvand supermarket and 7000 m<sup>2</sup> for its parking area and nearly 9804 m<sup>2</sup> for goods and groceries shops. The center is very important as the only shopping complex in the district one. An average

number of 2450 cars enter the center every day that is equal to 894250 trips in a year. Through interviews with the customers and various official authorities of the center, the distances of travel to center is computed around 1 to 9 km and as the trips are two ways trips (round trips), the total average of shopping distance is assumed as 10 km (Table 1).

Table 1: Average travel distance by 2450 customers in Farmanieh Center

Trips in a year	Average travel (km)	Total distance traveled for shopping (km/yr)
894250	10	8942500

According to Table 2 which considers types and percentile of cars that are active in district one, the energy consumptions considering uphill and downhill can be computed. Thus; the average fuel consumption in the district is equivalent to:

$$13059 \approx 13.6$$

Total fuel consumption (TFC) =

$$\frac{\text{Average fuel consumption} \times \text{Total distance traveled}}{\% \text{ Traveled}}$$

$$\text{TFC} = (13.6 \times 8942500)/100$$

$$\text{TFC} = 121618 \text{ l/year}$$

Finally, emission of air pollutants is determined based on the average air pollution emission by each type of cars (Table 3).

Table 2: Car distribution index in district one of Tehran city

Type of car	Zantia	Peugeot 405	Peugeot 206	Peugeot RD	Patrol 4DW	Samand	Pride	Mercedes Benz	Paykan	Others
%	1.2	10	7.5	2	1.6	2.7	28.7	2.6	30	11.6

Table 3: Cars' energy consumptions and emissions in district one of Tehran city

Air Pollutants	HC	NO <sub>x</sub>	CO	SO <sub>2</sub>	PM <sub>10</sub>	NMVO	THC
Ton/yr.	392.44	1766	50382	110.79	485.66	3920.90	4313.39

## DISCUSSION

Total fuel consumption by 2450 daily travels to Farmanieh shopping center was about 121618 L/yr. In order to evaluate the effectiveness of E-shopping in reduction of air pollutants as well

as energy, some assumptions were considered that are tabulated in Table 4. It should be noted that vans are considered as transportation systems with load capacity of 30 orders and an average distance 500 m amongst 30 customers.

Table 4: E-shopping assumptions for district one of Tehran city

Number of customers	Orders	Number of trips in a day
2450	30	82
Number of van trips/day	day	Number of trips/year
82	365	29930
Shopping order	Customer's distances (km)	Travels between services
30	0.5	15
Total travel between daily points (km)	Round distance to center (km)	Total travel in each service (km)
15	10	25
Number of trips in a year	Distance in each service (km)	Total distance traveled (km)
29930	25	748250
Yearly travel (km)	FC* (L/km)	Total FC* (L/year)
100	30	
748250	X	224475

\*FC= Fuel Consumption

Then, fuel consumptions difference between present system of shopping and E-shopping system was calculated as shown in Table 5.

By changing the shopping system from traditional to electronically e-shopping about 991705 l/yr. fuel will be saved, in another word, 81.5% saving will occur. For the calculation of emissions, the average emissions for light duty vehicles in the district one (8.9 g/km by AQCC, 1384) and average emissions for van (79.49 g/Km. by AQCC, 1384) was used.

Table 5: Fuel saving as a result of e-shopping in district one of Tehran city

FC* in conventional shopping (L/yr)	FC in E-shopping (L/yr)	Total fuel savings (L/yr)
1216180	224475	991705

\*FC= Fuel Consumption

Table 6: Comparative emissions from traditional shopping and e-shopping practice

	Total distance traveled (km/year)	Average emissions (g/km)	Total emissions (Ton/year)
Traditional Shopping	8, 942, 500	8.9	79.6
E-shopping	784.250	79.49	59.48
Pollution Reduction			20.12

The results of Table 6 clearly shows that 20.12 ton/yr. reduction in air pollutants occur when traditional shopping is replaced with E-shopping. In other words, in spite of 81.5% in fuel consumption reduction about 25.3% of total air pollutants will be reduced. This is partly due to the higher air pollution emission rates between light duty and heavy duty cars. As it was discussed earlier, the above cited computations were carried out for 2450 trips a day. Now, we can use these calculations for all 22 districts of Tehran city. Now, if it is assumed 4 shopping complexes in each

district of Tehran city are suggested. Therefore if in every district in Tehran only 4 online shopping centers start to operate, the total numbers of 88 centers will make a tremendous amount of reduction in fuel consumption and air emissions in Great Tehran (Tables 7 and 8). From the social costs point of view for the total emissions of 20.12 tons, an average amount of 11,183,589 rials have been computed. This amount is related to 10 percent of transportation for shopping. Now, if the calculation is generalized to all 22 districts of Tehran, the total amount of 111,835,890 rials as social costs of emissions will be resulted.

Table 7: Fuel saving in Great Tehran

Number of districts	Number of online center	Total number of online center
22	4	88
Fuel saved from 1 center (L/yr)*	number of centers	Total fuel saving (L/yr)
991705	88	87270040

\* See Table 5.

Table 8: Air pollution reduction in Great Tehran

Emission reduction in 1 center (Ton/year)	Number of centers	Emission reduction in 22 districts of Tehran (Ton/year)
20. 12*	88	1770. 56

\* See Table 6.

According to FOB price of gasoline in the Persian Gulf (5000 R/L) and with consideration of currency exchange rate about US\$ 480 million of energy will be saved. Taking into account the total fuel consumption by cars in Great Tehran that is about 44 billion L/yr, it is obvious that E-shopping through 88 centers can save about 0.2 percent of total cars' fuel consumptions. It should be noted that these 88 centers can only serve 10% of Tehran's population. If through time the shopping pattern of people totally switches over to E-shopping, then 2 percent of total car fuel consumption will be reduced. The local E-commerce, particularly household shopping's (goods and groceries) trade provides the opportunity to design a system that has more efficient management, reduces material consumption, produces less waste and a more efficient delivery system as compared to the traditional way of shopping. If these promising gains are realized, a larger market share of the local E-commerce would raise the chances to achieve these efficiencies. Economic and environmental savings would go further hand to hand with an environmentally consumptions approach for the design and implementation of local E-commerce. This development could significantly contribute to a more sustainable commerce. According to the calculations carried out in this research and having all the assumptions in mind, it is proved that by implementing all the necessities required to carry out e-shopping in district one and also in a larger scale in Great Tehran, could lead to enormous energy saving and air pollution reduction.

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