

## **A STUDY ON THE IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGY ON URBAN LOGISTICS SYSTEM: A CASE IN METRO MANILA**

Marilyn H. OBOGNE  
Graduate Student  
School of Urban & Regional Planning  
University of the Philippines  
Diliman, Quezon City  
Philippines 1101  
Fax: : +632-9828362  
E-Mail: [mars4short@yahoo.com](mailto:mars4short@yahoo.com)

Hussein S. LIDASAN  
Associate Professor  
School of Urban & Regional Planning  
University of the Philippines  
Diliman, Quezon City  
Philippines 1101  
Fax: +632 - 9828362  
E-Mail: [hussein.lidasan@up.edu.ph](mailto:hussein.lidasan@up.edu.ph)

**Abstract:** This study examined the impact of Information and Communication technology (ICT) on urban logistics system in Metro Manila. This was done by conducting a survey to 114 companies with focus on ICT logistics users on their use of ICT by getting the types of ICT use, the application areas, the barriers and future applications from ICT use by the private sectors. One of the major findings of the research is the impact level on ICT use by private firms in Metro Manila which falls into moderate impact and majority of the tested variables showed that no significant differences on the level of impacts on ICT use between firm types and sizes. Government perception and awareness was also considered to know if there are existing policies and initiatives that focus on monitoring the use of ICT in logistics. Case study of innovative ICT transport/logistic user was done to develop insights into how the technology impacts operational relations in the logistics chain and how technology can leverage operations management in a synergistic manner.

**Keywords:** ICT, Impact, Urban Logistics System, Case study

### **I. INTRODUCTION**

Goods transport in and out of urban areas like the Metro Manila has a major impact on the economic power, quality of life and attractiveness of the local community. The rapid and uncontrolled growth of the demand for the supply of goods is one of the main reasons for the severe traffic congestion in the metropolitan area and it really needs immediate attention. Further, different subsystems are being accommodated on the network of the streets especially since not only movements of people but also movements of internal goods distribution from warehouses, terminals, wholesale establishments, stores and different business establishments and premises. This complex scenario in the movements of people and goods needs to be addressed to be able to have an efficient and cost effectiveness in planning the system of transportation. Therefore, private and public sector have roles to play in the benefits of new discoveries by developing a stronger bond between transportation planning and operations. This will be essential if we are to realize the benefits in using the advanced information and communication technology (ICT) in creating a better and more cost-effective transportation system with focus on the movements of goods. Reliable and comprehensive indicators are needed to track the development of ICT in order to understand their impact on our economies and societies.

This study will serve as an important step in considering the role of ICT to increase transport efficiency in physical distributions and logistics in urban areas. Not only to look into the

innovations adopted for the freight logistics industry, in particular ICT, but also the government sector that can facilitate experimentation with the private sector in establishing a framework for ICT in infrastructure and it should be utilized to maximize the logistics efficiency with respect to safety, environment and infrastructure needs. The focus of the study will be on ICT logistics users. "USERS" refer to transport/logistics firms and ICT manufacturers rather than individuals.

## **1.2 Objectives**

In general, the study aims to investigate the impact of information and communication technology (ICT) on urban logistics system in the Philippines with focus on the interaction of shipment, transport, and warehousing industries as well as its operation and management. The study specifically is a tool to gather information about the different types of ICT use, the application areas, the barriers and future applications from ICT use by the private sectors that could be useful to improve the system in transporting urban commodities. It also intends to examine the implications for government as well as the private sector in ensuring that the future transport services are performed in an efficient and safe manner using the new trends in technology.

## **1.3 Brief Profile of the Study Area**

Metro Manila or the National Capital Region (NCR) is regarded as the Philippine's premier urban center. It is composed of 17 separate local government units (LGU)-13 cities and 4 municipalities with an average area of 636 square kilometers. The metropolitan's population shares more than 20% of the country's population and urban transport congestion is one of its main key areas of concern. The metropolitan is the seat of financial and governmental institutions and accounts for fully half of the country's industrial and commercial establishments.

Metro Manila acts as a center of most domestic movements of goods primarily for road movements in mainland Luzon. Most bulk of international and domestic cargoes to and from other areas of the country are controlled and handled through the only port in Metro Manila. A movement of commodities to and from the metropolis is via the Manila International Airport, Port of Manila and the major roads network leading to provincial areas of Luzon.

## **2. CONCEPTUAL AND METHODOLOGICAL FRAMEWORK**

The major purpose of the survey is to gather data directly from the ICT logistics users concerned in freight logistics transport as well as the concerned government agencies in the Philippines. This will capture simultaneously first hand information, which is essential to acquire knowledge and information regarding the diffusion of information and communication technology and to record open-ended comments in addition to the information called for. To obtain the significant data and perceptions about the impact of ICT on freight logistics system for possible attainment of actions concerning its positive or negative effect, interviews with the different key players such as ICT manufacturers, transport/logistics firms, and the government authority is conducted.

## 2.1 Conceptual Framework of the Study

The conceptual framework of the study (Figure 1) shows the nature of ICT that needs to be investigated by considering its type of use, objective of using it, current applications, barriers, and future applications coming from the private firms. The framework identifies the system impacted by the ICT. Knowing the impact level of ICT use on the logistics system, it is needed to identify existing policies and initiatives by taking into consideration the input of the different players involved. This gives assurance to the ability of the policy measures to be functional to attend the existing problems. Furthermore, this also provides the basis of understanding and to makes clear the relationship between the private and the public sectors in the determination of necessary data and input from all concerned parties in the analytical process to identify specific problem and apparently define the study parameters concerning the impact of ICT.

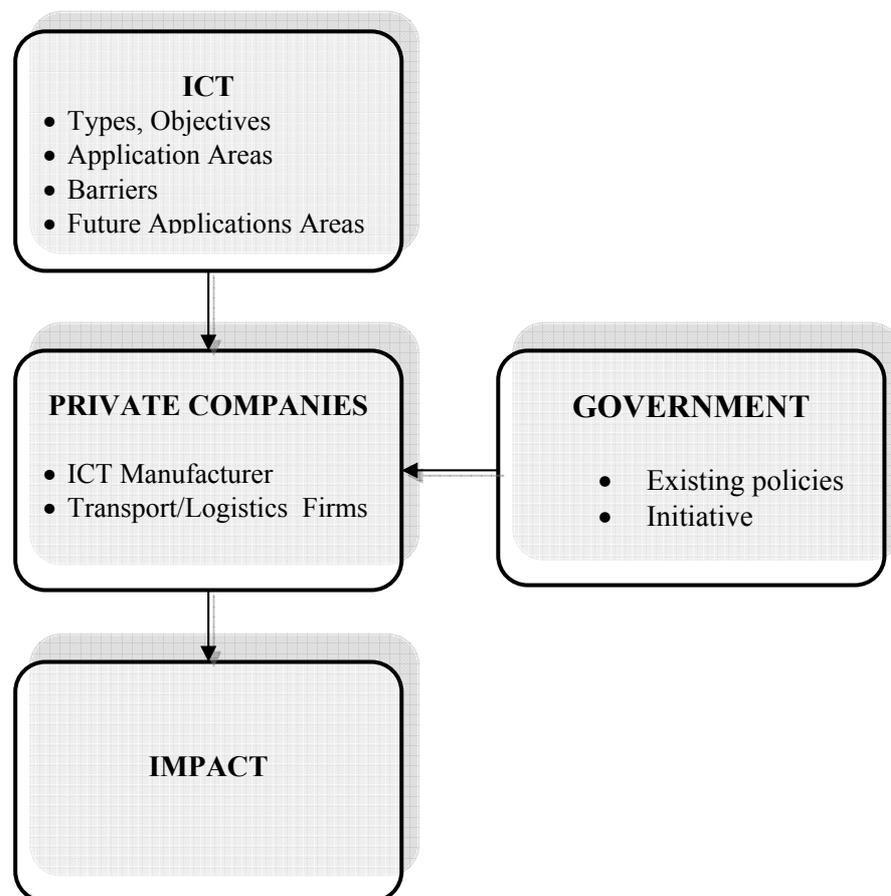


Figure 1. Conceptual Framework of the Study

## 2.2 Research Design

Data used in this study was collected from a survey interview that has been conducted last April until July 2004. Selections of samples were done randomly from the cities of Manila, Paranaque, Pasay and Makati. Direct interviews with the ICT logistics users and government authorities were done at their respective offices guided by the self administered survey questionnaire to ensure highly reliable data and to maximize the data samples. The survey was also done by taking advantage of electronic mail (e-mail) and using the fax machine for fast and easy communication. Responses were obtained from 114 companies consisting of 37 air

and sea transportation carriers, 44 forwarders, 16 terminal and warehouse operator, 6 ICT manufacturers, 11 from wholesalers and retailers and 8 government agencies.

Data analysis and validation was done using an electronic spreadsheets and simple statistical analysis using SPSS. This software has a variety of statistical tabulations in user-friendly interface and very useful in manipulating and managing data sets.

### 2.3 Case study of Transport/Logistics Firm

A case study was performed on a selected transportation/logistic firm to “thrill down” into the impacts of ICT. The survey of one firm could give potential in contributing additional depth and first-hand relevance to the general information obtained.

## 3. DATA PRESENTATIONS AND DISCUSSION

### 3.1 Profile of Respondents

Among the 250 firms contacted in Metro Manila, 114 responded to the survey. Based on firm types, 5.3% of the respondents are ICT manufacturers and 94.7% are transport/logistics firms. Out of 17 ICT manufacturers contacted, only six (35%) firms are ICT manufacturers who can provide solutions and services to logistics operations. According to firm size, 72% of the respondents are small and medium enterprises (SMEs) and 28% are large enterprises (LEs). (Table 1)

Table 1. Profile of Firm Respondents

No	Category	Number of Respondents	Percent (%)	
1	Based on Firm Type			
	a. Manufacturer	6		5.3
	b. Transport / Logistics	108		94.7
	Total 1	114		100.0
2	Based on Firm Size			
	Number of Employees:			
	a. SMEs	82		71.9
	0-19	17	14.9	
	20-49	20	17.5	
	50-99	30	26.3	
	100-199	15	13.2	
	b. LEs	32		28.1
	200-299	27	23.7	
	300 or more	5	4.4	
Total 2	114	100.0	100.0	

The interviewed logistics companies located in Paranaque shared the highest percentage (48%). This is expected due to the presence of the airport and followed by Manila (35%) due to its strategic location where the principal port is located, the port of Manila. It is interesting to note that Paranaque and Manila, known as the main gateways of trade in the country got the first and second rank, respectively. Makati (10%) is in third rank being the center of business in the country and the adjacent city to Paranaque, which is Pasay as the fourth (7%).

With regards to services offered by the respondents, forwarders for Air/Sea freight were identified to have the highest percentage (39%) followed by Air/Sea transport carrier and shipping agents (33%) mostly located near the airport and Port of Manila. The terminal and

warehouse operators (14%) ranked third, while one-tenth (10%) are wholesalers and retailers and last 5% are the ICT Manufacturers.

As to the status of ownership from the survey revealed that the domestic privately owned companies (73%) operating locally and internationally have the largest share and operate on their own. Companies which are joint-venture of domestic and foreign owners, which have connections with parent or affiliated companies in other countries, accounts for fourteen percent (14%), followed closely by private-owned domestic company (13%) that operates within the vicinity of the country. No responses were elicited from government owned companies and other forms of ownership.

### 3.2 Familiarization of Respondents on ICT Use

The result of the survey revealed that a little more than two-thirds (68%) of the respondents are familiar with the use of ICT in logistic. Surprisingly, the other one-third (32%) of the respondents are not familiar with the use of ICT in logistic and thus, not be able to recognize the new trends of technology mostly used in logistics. Those who are saying “No” during the survey are the companies who are still using the traditional way in logistics operations.

## 3. IMPACTS OF ICT USE ON LOGISTICS AND THE GOVERNMENT SUPPORT/INITIATIVE EXPECTED BY FIRM RESPONDENTS

### 4.1 Types and Kinds of ICT Use in Logistics

Table 2 shows the response of the two concerned sectors (private and government) in identifying the types and kinds of ICT used in logistics in Metro Manila.

Table 2. Types/Kinds of ICT Used in Logistics

Types/Kinds of ICT Used in Logistics	Percentage of Response	
	Private	Government
<b>EDI (Electronic Data Interchange)</b>	<b>74%</b>	<b>88%</b>
XML (Extended Mark-up Languages)	18%	<b>38%</b>
<b>Internet</b>	<b>89%</b>	<b>100%</b>
<b>E-commerce</b>	<b>31%</b>	<b>75%</b>
Electronic Order System (EOS)	<b>31%</b>	13%
Automatic Picking System (APS)	18%	13%
<b>Bar Coding and Scanning</b>	<b>12%</b>	<b>50%</b>
<b>Data Warehouse</b>	<b>30%</b>	<b>38%</b>
Inmarsat	0%	0%
In-Vehicle Navigation Systems	0%	0%
<b>Container &amp; Equipment Control System</b>	<b>19%</b>	<b>75%</b>
<b>Container &amp; Storage Planning system</b>	<b>15%</b>	<b>75%</b>
Global Positioning System (GPS)	14%	<b>25%</b>
Radio Frequency Identification (RFID)	13%	0%
Geographic Information System (GIS)	8%	13%
On-Board Data Recorder	0%	0%
Mobile Data Communication	13%	<b>38%</b>
Freight & Fleet Management	0%	0%

- EDI (Electronic Data Interchange) - generally, there is a high percentage of awareness both for the private and government authorities.
- Internet - 89 percent of private sector and 100 percent of government authority are aware of the usefulness of this technology.
- E-commerce - more than half of the government authority identified it while there is a low percentage rate from the private sector.
- Bar Coding and Scanning - half of the government authority (50%) recognized the advantages of using this technology and a low rate (12%) response from the private sector.
- Data Warehouse - only 30 percent of private sector and 38 percent of the government authority pointed out on the use of this technology.
- Container & Equipment Control System - three-fourth of government authority (75 percent) respondents are aware of it while there is a low rate of response from the private sector (19 percent).
- Container & Storage planning system - only 15 percent of private sector pointed out on the use of this technology while 75 percent of government authority recognized this technology.

#### 4.2 ICT Use on Logistics by Firm Type and Firm Size

As reflected on Table 3, technologies were rank to identify which among the type of technologies have been mostly used by the respondents. The internet is the most widely used ICT based on the survey results wherein both ICT manufacturers and transport/logistics have the same top three responses and similarities of ICT used. The adoption rate of internet in the transport/logistics is 70.4%, followed by EDI (63%), bar coding and scanning (31.5%), e-commerce (29.6%), and data warehouse (28.7%). In the ICT manufacturers, the popularity of internet (66.7%) is followed by EDI, bar coding and scanning, and container equipment control system (all with 50%) which got the same response rate.

Table 3. Types and Kinds of ICT Use in Logistics

Items	Firm Types				Firm Size			
	Manufacturer N=6		Transport/ Logistics N=108		SMEs N=82		LEs N=32	
	Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank
1. Electronic Data Interchange (EDI )	50	2	63.0	2	57.3	2	75.0	2
2. Extensible Mark-up Language XML)	16.7	4	10.2	11	8.5	8	8.5	10
3. Internet	66.7	1	70.4	1	67.1	1	78.1	1
4. E-Commerce	33.3	3	29.6	4	18.3	5	62.5	3
5. Electronic Order System (EOS)	16.7	4	17.6	6	7.3	9	43.8	5
6. Automatic Picking System	--	--	13.0	8	7.3	9	25.0	7
7. Bar Coding and Scanning	50.0	2	31.5	3	20.7	4	62.5	3
8. Data Warehouse	33.3	3	28.7	5	18.3	5	59.4	4
9. Global Positioning System	16.7	4	12.0	9	8.5	8	28.1	6
10. Radio Frequency Identification (RFID)	33.3	3	6.5	12	4.9	10	15.6	8
11. Geography Information System GIS)	--	--	1.9	13	--	--	6.3	11
12. In-Vehicle Sensor	--	--	--	--	--	--	--	--
13. On-board Data Recorder	--	--	--	--	--	--	--	--
14. Mobile Data Communication	33.3	3	12.0	9	13.4	7	12.5	9
15. Freight and Fleet Management	--	--	--	--	--	--	--	--
16. Inmarsat	--	--	--	--	--	--	--	--
17. Container and Equipment Control System	50.0	2	15.7	7	22.0	3	12.5	9
18. Container & Storage Planning System	33.3	3	11.1	10	15.9	6	12.5	9

For SMEs and LEs, Internet (67.1%) indicated the most dominant technologies being used by most firms. Next to internet, the four most popular ICT used by SMEs are EDI (57.3%), container and equipment control system (22.0%), bar coding and scanning (20.7%), and data warehouse and E-commerce (both 18.3%). Whereas, the LEs stated that EDI (75.0%), bar coding and scanning, and e-commerce (both 62.5%) and data warehouse (59.4%) are the most popular. Next to this, container and storage planning system (15.9%), and mobile data communication (13.4%) are widely used by SMEs, while electronic order system (43.8%) and global positioning system (28.1%) are popularly used among LEs. The results of responses for EDI in LEs, shows that majority of companies can adapt to this technology compared to responses from SME. Most likely the reason for this is the high cost of EDI in which only large companies have the financial capability to acquire it. Another thing is, there is a high rating on the types of ICT use in the LEs which indicates that large companies, aside from having the financial resources in acquiring the ICT, have strong initiative to fully utilize the technology. (Table 3)

There seem to be some consistent trends across those types of ICT that are not currently being used. Primarily the non-utilized technologies are: on board data recorder, in-vehicle navigation system, Inmarsat and freight and fleet management.

### 4.3 Primary Objectives of ICT Use

Table 4 shows the summary on the primary objectives of firms in using ICT on logistics by firm types and firm size. Both the ICT manufacturers and transport/logistics share the same idea with “positive” ratings that “improving quality and efficiency both in services and operation” is the primary objective in using ICT on logistics. For transport/logistics firms, this objective is followed by “improving communication and information exchange with customers” (81.5%), “reducing costs” (57.4%), “improving communication and integration within organization” (50.9%), “faster planning and system integration” (both 47.2%), “increase revenue and income” (45.4%) and “others” (1.9%). The survey shows that for ICT Manufacturers, the next primary objectives to consider are “reducing costs” (83.3%), “improving communication and information exchange with customers” and “increase revenue and income” (both got 66.7%); and “improving communication and integration within organization” and “faster planning and system integration” (both got 50.0%).

Table 4. Primary Objectives of Using ICT on Logistics

Items	Firm Types				Firm Size			
	Manufacturer N=6		Transport/ Logistics N=108		SMEs N=82		LEs N=32	
	Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank
1. Improving Communication and information exchange with customers	66.7	3	81.5	2	75.6	2	90.6	2
2. Reducing Cost	83.3	2	57.4	3	54.9	3	68.8	3
3. Improving quality and efficiency both in services and operations	100.0	1	83.3	1	79.3	1	100	1
4 Increase revenue and income	66.7	3	45.4	6	41.5	5	56.3	5
5 Improving communication and integration within organization	50	4	50.9	4	46.3	4	62.5	4
6 Faster planning and system integration	50	4	47.2	5	41.5	5	62.5	4
7 Others	-	-	1.9	7	2.4	6	-	-

All respondents for SMEs (79.3%) and LEs (100.6%) agreed on “improving quality and efficiency both in services and operation” which is also the primary objective of ICT use on logistics business. As shown on Table 4, both SMEs and LEs have their next top three objectives: “improving communication and information exchange with customers (SMEs: 75.6%, LEs: 90.6%), “reducing costs” (SMEs: 54.9%, LEs: 68.8%), and “improving communication and integration within organization” (SMEs: 46.3%, LEs: 62.5%). Most of the firms, regardless of firm types and sizes have indicated that the reasons for them in acquiring the technology is by assuring that fast communication among the customers and actors in the supply chain will be attained by making paperless transactions that can lead to reducing costs and increase in income and revenue.

#### 4.4 Application Areas of ICT Use on Logistics

The application areas of ICT use vary between firm types rather than between firm sizes. In transport/logistics, ICT is mostly utilized for customer relationship management (62.0%), “warehousing management” (48.1%), material handling (44.4%), and “transportation management (33.3%). While, ICT use in ICT manufacturer is mostly applied for “warehousing management” (83.3%), “order processing” (66.7%), “purchasing and procurement” (50.0%), “customer relationship management” and “material handling” (both got 33.3%). Survey results have indicated that the nature and the types of services offered by each firms are the factors needed to be considered why application areas of ICT varies between firm types. (See Table 5)

Table 5. Application Areas of ICT in Logistics Business

Items	Firm Types				Firm Size			
	Manufacturer N=6		Transport/ Logistics N=108		SMEs N=82		LEs N=32	
	Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank
1. Enterprise Resource Planning (ERP)	16.7	5	18.5	6	13.4	7	31.3	6
2. Purchasing and Procurement	50.0	3	22.2	5	17.7	5	40.6	5
3. Production Scheduling	16.7	5	9.3	10	13.7	6	12.5	9
4. Warehousing Management	83.3	1	48.1	2	32.9	4	46.9	4
5. Material Handling	33.3	4	44.4	3	42.7	3	50.0	3
6. Packaging	16.7	5	11.1	8	12.2	8	15.6	8
7. Labeling	16.7	5	10.2	9	7.3	9	18.8	7
8. Transportation Management	16.7	5	33.3	4	45.1	2	56.3	2
9. Order Processing	66.7	2	16.7	7	13.4	7	31.3	6
10. Customer Service/ Customer Relationship Management (CRM)	33.3	4	62.0	1	61.0	1	59.4	1
11. Others	16.7	5	2.8	11	4.9	10	3.1	10

The same expectations were observed between SMEs and LEs. Major application areas of ICT used by SMEs are: “customer relationship management” (61%), “transportation management” (45.1%), “material handling” (42.7%), “warehousing management” (32.9%), and “purchasing and procurement” (17.7%), followed by two equally important application areas which are: “enterprise resource planning” and “order processing” (all got 13.4%). In LEs, five major application areas of ICT are mostly for “customer relationship management” (59.4%), “transportation management (56.3%), and “material handling” (50.0%), “warehousing management” (46.9%), and “purchasing and procurement” (40.6%), followed by “enterprise resource planning” and “order processing” (both 31.3%), as reflected in Table

5. The results of the survey maybe an indication that both SMEs and LEs face the same areas of application in making new alignments in using the technology to give reliable and efficient services to their customers.

#### 4.5 Impact Level and the Barriers on ICT Use

Table 6 reveals that most manufacturer and transport logistics firms surveyed in Metro Manila considered the impact level of ICT as moderate impact. Table 10 shows the mean score on each criterion. A point four scale was used to describe the impact from ICT use on logistics. (1 = large impact, 2 = moderate impact, 3= small impact, 4= no impact). The degree of impacts obtained from the survey mostly falls between large impact and moderate level (1= large impact and 2 = moderate impact) as shown on the mean value of each variable on the impact of the use of ICT. The three biggest impacts of ICT use on logistics are “increases ICT/ITS hardware and software cost” (mean=1.6105), “provides faster and reliable service to customers” (mean=1.3860), and “produces more business and increases revenue” (mean=1.9035). Statistically, no significant differences in these impacts levels are noted between manufacturers and transport/logistics firms and also between SMEs and LEs.

Table 6. Impact Level on the Use of ICT among Firms

Impacts of the use of ICT/ITS	Firm Type	Mean *	Total Mean	Standard Deviation
1. Increase ICT/ITS hardware and software cost	Manufacturer	1.8333	1.6105	0.4082
	Transport / Logistics	1.7037		0.8345
2. Reduce empty miles of travel & communication cost	Manufacturer	2.3333	2.2456	1.5055
	Transport / Logistics	2.2407		0.9055
3. Reduce load-waiting and delivery time	Manufacturer	2.5000	2.3158	1.1643
	Transport / Logistics	2.3056		0.9517
4. Reduce cost of staff	Manufacturer	1.3333	2.2456	0.5164
	Transport / Logistics	2.2963		0.8675
5. Provide faster and reliable services to customers	Manufacturer	1.0000	1.3860	0.0000
	Transport / Logistics	1.4074		0.8431
6. Produce more business and thus increase revenue	Manufacturer	1.5000	1.9035	0.5472
	Transport / Logistics	1.9259		0.9638
7. Others	Manufacturer	4.000	3.9386	0.0000
	Transport / Logistics	3.9352		0.3424

**Note:** \* 1= large impact, 2= moderate impact, 3= small impact, 4= no impact

In the appraisal of costs and benefits of using ICT, most respondents had difficulty in accurately assessing the impacts of ICT in terms of financial measures. Only half of the total numbers of respondents give their rough estimation. Most companies are not willing to give any data when financial matters are involved and asked during the survey. More in depth study is needed to accurately measure the impacts of ICT use on costs and benefits.

Private firms face a number of constraints in adopting ICT. As shown on Table 7, transport/logistics respondents surveyed in Metro Manila chose their top three main barriers which are: “ICT expenditure too high (initial capital)” (82.4%) one of the serious barrier, “compatibility of ICT/ITS systems between companies” (73.1%), and “government regulation and administrative procedures” (61.1%). Next to these are: “information security” (38.9%), “resistance to change” (37.0%), and “availability of ICT professional skills” (34.3%). Some of the barriers mentioned in the list of transport logistics reflected also in the list of ICT manufacturers. So the major barriers considered by the ICT manufacturer are: “government

regulation and administrative procedures” and “Compatibility of ICT/ITS systems between companies” (both got 66.7%), and “ICT expenditure too high (initial capital)” and “Information Security “(both got 50.0%).

Table 7. Barriers to ICT Use

Items	Firm Types				Firm Size			
	Manufacturer N=6		Transport/ Logistics N=108		SMEs N=82		LEs N=32	
	Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank
1. ICT expenditure too high	50	1	82.4	1	74.4	1	96.9	1
2. Information Security	50	2	38.9	4	37.8	4	43.8	4
3. No economic scale to use ICT/ITS on logistics	-	-	11.11	10	9.8	10	12.5	8
4. Lack of information about the possibilities of new technologies	-	-	21.3	7	20.7	7	18.8	7
5. Accuracy of Information exchange	16.7	3	15.7	9	13.4	9	21.9	-
6. Compatibility of ICT/ITS systems between companies	66.7	1	73.1	2	72	2	75	2
7. Government regulation and administrative procedures	66.7	1	61.1	3	64.6	3	53.1	3
8. Availability of Information	16.7	3	19.4	8	17.1	8	25	5
9. Timeliness of information	-	-	10.2	11	4.9	11	21.9	6
10. Resistance to change	16.7	3	37	5	32.9	5	43.8	4
11. Availability of ICT professional skills	16.7	3	34.3	6	29.3	6	43.8	4

According to firm size as shown in Table 7, SMEs and LEs had the same top three major barriers from ICT use. The top three most critical barriers are: “ICT expenditure too high (initial capital),” (SMEs: 74.4%, LEs: 96.9%), “compatibility of ICT/ITS systems between companies” (SMEs: 72.0%, LEs: 75.0%), and “government regulation and administrative procedures” (SMEs: 64.6%, LEs: 53.1%). Smaller companies are more likely to agree strongly that limited resources are constraining their ability to invest in new ICT technologies. Larger organizations would be more likely to use a wider variety of new ICT technologies compared to smaller firms. The next critical barriers for SMEs are: “information security” (37.8%), “resistance to change” (32.9%) and “availability of ICT professional skills” (29.3%). While, LEs mentioned that “Information Security”, “Resistance to change” and “Availability of ICT professional skills” (all with 43.8%) are the next three equally main barriers in adopting the use of ICT in logistics. The lack of suitable technical and managerial staff with sufficient ICT expertise is another major barrier. SMEs and LEs critically depend on “on-the-job-competence”.

#### 4.6 Future Application Areas of ICT

The survey proves that ICT diffusion and usage is expected to increase in the future and the advances in ICT would be the main driver of logistical change over the next coming years. Regardless of firm types and firm sizes, the most mentioned application areas of ICT use is “customer service (Customer Relationship Management - CRM) (ICT manufacturer: 83.3%, transport/logistics: 76.9%, SMEs: 80.5%, LEs: 68.8%). Next, four future applications areas were mostly agreed either by manufacturers or transport/logistics firms and these are: “transportation management” (ICT manufacturer: 33.3%, transport/logistics: 58.3%), “material handling” (ICT manufacturer: 33.3%, transport/logistics: 47.2%), “warehousing management” (ICT manufacturer: 33.3%, transport/logistics: 46.3%), and “Enterprise

Resource Planning (ERP)” (ICT manufacturer: 66.7%, transport/logistics: 32.4%). (Table 8)  
 Table 8. Future ICT Application of ICT on Logistics

Items	Firm Types				Firm Size			
	Manufacturer N=6		Transport/ Logistics N=108		SMEs N=82		LEs N=32	
	Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank
1. Enterprise Resource Planning (ERP)	66.7	2	32.4	5	26.8	5	53.1	3
2. Purchasing and Procurement	16.7	4	20.4	6	15.9	7	28.1	6
3. Production Scheduling	0.0	5	9.3	10	11.0	9	3.1	9
4. Warehousing Management	33.3	3	46.3	4	42.7	4	50.0	4
5. Material Handling	33.3	3	47.2	3	51.2	3	31.3	5
6. Packaging	0	5	23.1	7	20.7	6	28.1	6
7. Labeling	0	5	13.0	9	11.0	9	15.6	7
8. Transportation Management	33.3	3	58.3	2	53.7	2	62.5	2
9. Order Processing	16.7	4	15.7	8	14.6	8	15.6	7
10. Customer Service/ Customer Relationship Management (CRM)	83.3	1	76.9	1	80.5	1	68.8	1
11. Others	0	5	2.8	11	2.4	10	9.4	8

According to firm size as shown in Table 8, SMEs and LEs shared the same expectations on the future application areas on ICT use but perceived different magnitude in ranking (Table 8). The five most expected future application on the use of ICT for SMEs are: “customer service (Customer Relationship Management - CRM) “(80.5%), “transportation management” (53.7%), “material handling “(51.2%), “warehousing management” (42.7%), and “enterprise Resource Planning (ERP)” (26.85) “transportation management” (53.7%. With respect to LEs respondents, the anticipated future application areas of ICT are: (Customer Relationship Management - CRM) “(68.8%), “transportation management” (62.5%), “Enterprise Resource Planning (ERP)” (53.1%), “warehousing management” (50.0%), and “material handling” (31.3%).

#### 4.7 Case Study

A case study of one firm gives the macro-view across the general findings on the impacts of ICT on logistics among firms. The sample firm interviewed provides examples of diverse ICT use across the full range of firm operations – systems administration, communication, documentation, purchasing, distribution, warehousing and transport logistics. A typical logistics chain showing the time mode and distance of moving the goods from the outlet/store to the final consignee or consumer are shown below to fully understand where ICT was utilized in the chain. (See Figure2)

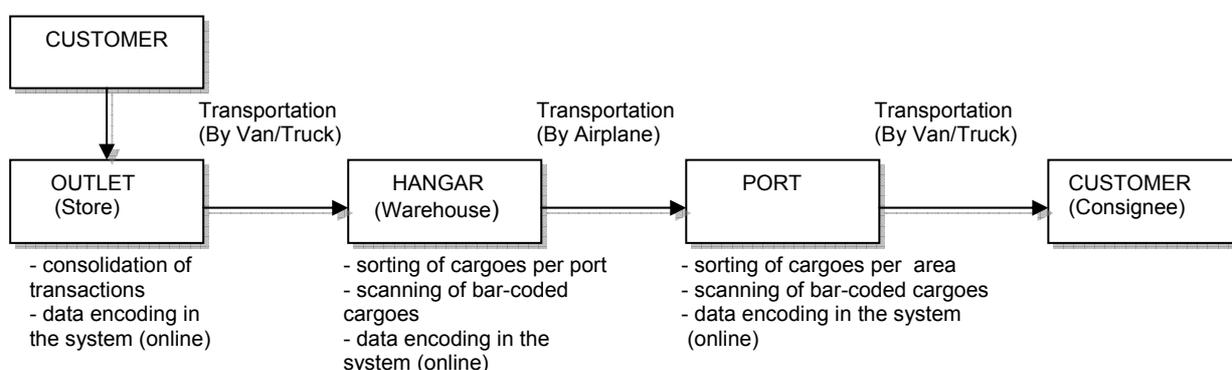


Figure 2. Firm A’s Typical Logistics Chain

The use of ICT in firm A’s logistics operation has allowed less waste, lower transactions and co-ordination costs, enhanced networks, more efficient supply chains, the ability to more quickly and more easily meet the needs of customers, and ultimately a greater variety and level of sophistication in consumer goods available.

Table 9 shows on how the firm used the ICT in specific areas to improve their performance and summarizes the key areas and nature of impacts of ICT use on the business performance of firm A.

Table 9. Impact of Uptake of ICT on Firm Performance

KEY AREA OF IMPACT	NATURE OF IMPACT
1.Labor	Staff reduction in some instance, but not all. Enhancement of human capital and shift to a more highly skilled worker.
2.Facilitates and outsourcing	Reorganization of facilities and increased outsourcing of certain function.
3.Management Practices	More timely and accurate management information. Greater centralization of decision making. Improve communication and reporting systems and improved inventory control.
4.Relationship with customers and suppliers	Better and more frequent communication with customer and wider choices of supplier. Greater responsiveness to customer needs.

#### 4.8 Government Initiatives and Support Expected by the Firm

Figure 3 shows that most firms are very positive about the advantages of using the ICT and expect some support and initiative from the government to boost the use of the technology. Based on the interview, majority (75%) of the respondents are not aware of any government initiative that will sustain the use of ICT in urban freight logistics. The other 25 percent is claiming that there are government support and plans to facilitate an enabling environment for the private sector for the development and enhancement in the use of the technology but asking them to identify it; they cannot specifically identify the support they expect. This only shows that there is lack of co-operation and coordination between the private sectors and government in building an efficient and environmental friendly logistics system using the ICT.

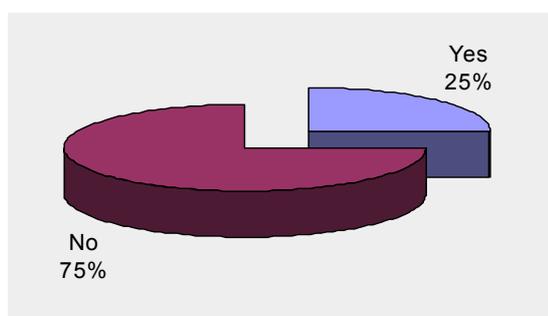


Figure 3. Private Awareness on Government Initiatives Concerning the Use of ICT in Logistics

Figure 4 reveals that majority of the private firm needs assistance in using the new technologies in logistics operations from the public sector. The most highlighted government support expected by the respondents is “provide new technology information promptly” (76.3%), followed by “provide shareable platform “ (62.3%), ”strengthen the security of information“ (60.5%), “provide education and training courses” (59.6%), “data standardization” (54.4%), and “others” ( 4.4%) are additional inputs from the respondents like establishments of ICT commission and government programs/ projects in improving the infrastructure to satisfy the use of ICT. The adoption of ICT by the business sector especially the SMEs and LES is at the center of the information society and economy. Survey result shows that the implementation and development of technology is the main concern for private sector wherein the participants believed that the government can motivate and encourage developments by issuing standards and spreading knowledge about experiences from technical and commercial tests of ICT in logistics.

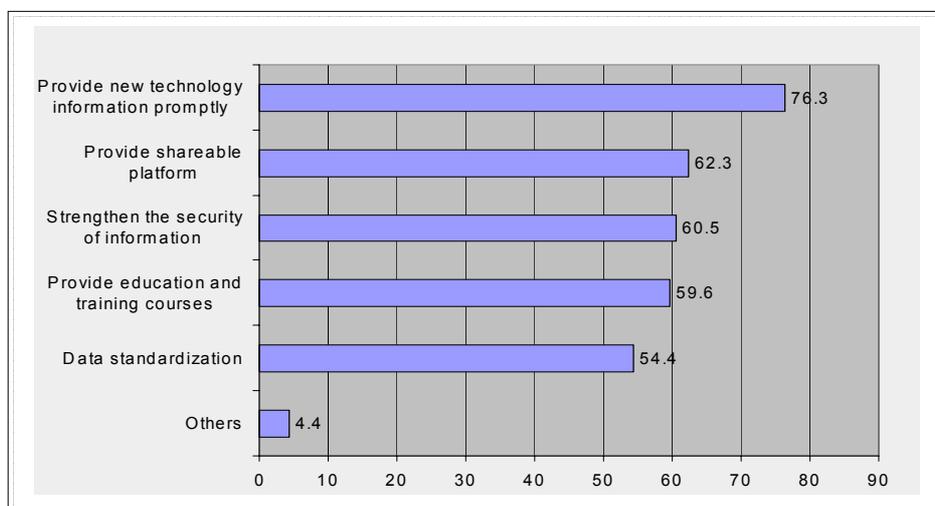


Figure 4. Government Initiatives and Supports Expected by the Firm Respondents

Figure 5 shows that the percentage of awareness from the government (62%) side is quiet high enough to say that they have an idea on technological advancement done by the private sector. The other respondents who said “No” (38%) gave reasons that their involvement mainly is on rules and regulations concerning urban goods movement but monitoring the use of technology by the private sector is not yet put in priority. Survey only reveals that the government is not monitoring or even evaluating the effect of ICT in terms of environmental and social aspect concerning the movements of goods.

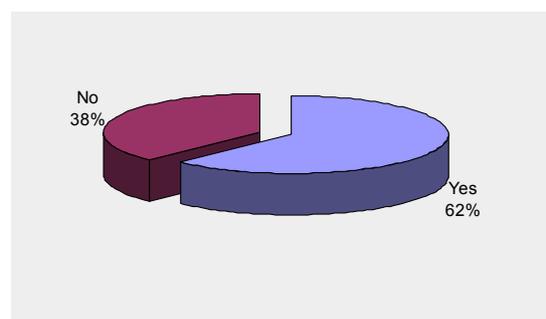


Figure 5. Government Awareness on the Use of ICT by the Private Sector

#### 4.9 Existing Policies and Initiative Concerning the Use of ICT in Logistics

Figure 6 reveals that majority of the respondents who said “No” (75%) claimed that there are no existing policies and regulations that will facilitate the use of ICT by the private sector. Most of the policies they are mentioning are mainly focused on public transportation. The other 25 percent who said “Yes” assert that there are existing policies but they cannot identify what particular regulations are mainly monitoring the use of ICT in the movements of commodities. This only shows that no current plans from government on building a framework for the creation of set of policies that will encourage private sector to participate in the use of ICT.

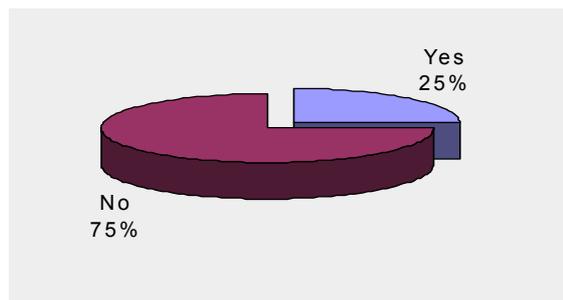


Figure 6. Private Awareness on Existing Government Policies and Initiative

#### 4. SUMMARY OF FINDINGS AND CONCLUDING REMARKS

Generally, the study was able to investigate the diffusion of technology that focus on the interaction of shipment, transport and warehousing industries, as well as its operation and management. There are technologies which have been identified and the application areas of ICT vary particularly between firm types rather between firm sizes .In addition to this, a case study was able to identify the use and application of ICT in a disaggregate way and gives an in-depth explanation of the positive impact of ICT on management, operations, production and distribution process, relationship with customers and suppliers and as well to business operations. The study elicited a great deal of material relating to the influence of ICTs in the firm performance, the way ICTs drive or enable improved performance; and whether there are hindrances to effective use of ICTs.

Moderate impact of ICT signifies that ICT is re-shaping the logistics system from traditional methods to modern logistics. Specifically, it was supported by the current types of ICT, their uses, and the applications as well the barriers presented. Most transport/logistics firms use ICT as facilitating technologies to gather, process, and use knowledge about the application of technologies that will help in making their business to be more progressive and contribute in increasing the efficiency of urban goods transport. Impacts on costs and benefits of ICT needed an in-depth research to fully measure the effect.

There are two broad key challenges to ensuring the optimal use of ICT by the private side based on this study. First, problem on cost and financing in acquiring the ICT or high capital which indicates that most firms are lack of financial resources. Sometimes, firms are not aware about the advantages and cost effectiveness of the technology and why it costs a lot for them to acquire it. Second, no public policy exists as well as environment that is conducive to the efficient use of new ICT by the private firms. The use of information and communication

technologies in private sector received a small attention and there is no constant monitoring and evaluation on how ICT will be fully utilized in freight logistics from the government side.

There are still different ways to fully determine the impact of ICT use in urban logistics system. This study will only give way to other possible study and analysis approach to issues concerning the impact of ICT on logistics system and it is believed that it laid down a substantial input to give first hand information on the use of ICT in logistics. A large sample maybe taken to fully represent the data and could come up to a more acceptable output. Defining the key concepts, standardized indicators and comparative studies will result in better understanding of the extent of ICT and its impact on transportation especially in the movements of goods.

#### **4. RECOMMENDATIONS**

- (1) Government needs to promote a sharing of knowledge about the use and the role of ICT in logistics with the private sector by facilitating a demonstration of technological solutions, experiments and diffusing best practices that requires national, regional, and international approaches that adapt to the international developments in the industry itself.
- (2) Policy makers need to keep up with rapid development of ICT used by the private entities and develop a stable communications framework that is conducive to logistics planning and to support the research and development in the private sector.
- (3) Adopt analysis method, performance measure, and evaluation criteria in monitoring the developments of ICT in the private side. This could identify and propose mitigating measures to prevent the negative impacts of the technology in environment and social aspect.
- (4) Strengthen public participation in the policy formulation for ICT use in logistics through conducting public hearing and consultation. Governments, regional organizations, and the private sector need to cooperate to set the right frameworks for investments and services.
- (5) Expand innovative public and private financing methods in generating finance and building skills for the development of ICT capacities. Human and financial capital building should be fundamental elements of the strategies of the public and private sectors in the development of e-logistics. Training and education policies, together with adequate financing are also important for e-logistics to play its full role in the process of regional economic combination.
- (6) For more consistent and reliable findings and policy basis recommendations, future studies should consider bigger samples from the different ICT logistics users. This can be done through coordination and cooperation with the company's association, direct coordination with private firms, and the different government agencies tasked to handle freight logistics.

#### **ACKNOWLEDGEMENT**

The authors wish to acknowledge the Institute of Behavioral Science of Japan (IBS) and the National Center for Transportation Studies of the University of the Philippines (UP-NCTS) for their financial and technical supports.

## REFERENCES

### a) Books and Books Chapters

OECD (1992), **Advanced Logistics and Road Freight Transport**, France: OECD Publications, pp. 103-150

Taniguchi, E., R. Thompson (2002), **Innovations in Freight Transport**, WIT Press, Southampton

TRILOG (Trilateral Logistics) Asian-Pacific Task Force (2000), **Logistics Integration in the Asia-Pacific Region**, RTR/OECD, Institute of Highway Economics, Tokyo.

TRILOG (Trilateral Logistics) Asian-Pacific Task Force (2003), **Logistics Developments Supported by ICT & ITS in the Asia-Pacific Region**, RTR/OECD, Institute of Highway Economics, Tokyo.

### b) Journal papers

Hall, R., Chatterjee, I. (1996) **Intelligent Transportation Systems: Deployment and User Needs**. Transportation Research Board. Record No.1537, Operations and Safety. National Academy Press, Washington, D.C. 1996. p.1-9.

Klingenberg, B. (1998), **Opportunities for Progressive Deployment of Intelligent Transportation Systems / Automated Highway System Technologies in Support of Commercial Vehicle Operations**, Transportation Research Record No. 1651, National Academy Press Washington D.C., pp.107-110

Kuse, H., Castro, J, Takashi, Y. (1995), **The Role of Information Systems in Establishing the Just-In-Time (JIT) Type Transportation**, Journal of the Eastern Asia Society for Transportation Studies, EASTS, Vol.1 No.3.

### c) Other documents

Hultkrantz O., K. Lumsden (2001), **E-commerce and Consequences for the Logistics Industry**, Department of Transportation and Logistics, Chalmers University of Technology, pp.1-15

Mahmassani, H. S. (1998), ICT and the Logistics: Third Party Providers and Freight Outsourcing. **Impact of Communication Technology (ICT) Seminar. Transport Canada.**

Nemoto, T., J. Visser, R. Yoshimoto (2001), **Impacts of Information and Communication Technology on Urban Logistics System**, Joint OECD/ECMT Seminar on the impacts of E-commerce on Transport, pp. 1-19.

Nissan, (1998), **Automotive Transportation in Perspective**. 7(2), Environment and Transportation Research Laboratory, Nissan Research Center, Tokyo.

Powell, D. (2001), **Governments and Industry Working Together to Implement Modern Logistics**, Transport and Communication Bulletin for Asia and the Pacific No.70, p.1-16.

Rabah, M. and Mahmassani, H., (2002), **Impact Of Electronic Commerce on Logistics Operations: A Focus On Vendor Managed Inventory Strategies**. Research Report 167227-1. Center for Transportation Research, University of Texas Austin, pp. 23-33

Taniguchi, E., Thompson, R., Yamada, T., and Van Duin, R., (2001), **City Logistics – Network Modelling and Intelligent Transport Systems**, Institute of Systems Science. Research.

Visser, E. (2003), **Innovation and Spatial Effects of ICT in the Logistics Service Industry?**, Note prepared for the Nethur School. Version 1.