The Impact of ICT on Logistics in Taiwan*

Cheng-Min Feng¹ Chien-Yun Yuan²

Abstracts

This paper explored the impact of ICT on Taiwanese ICT manufacturers and transport/logistics firms. A post-mail survey was conducted to 600 firms on the Taiwan Stock Exchange. The results revealed that internet and EDI were the most popular two ICTs. The primary objectives of using ICT were to communicate customers, to improve quality and increase revenues. The impact level was large. The barriers had compatibility of ICT systems, information security and etc. They expected to obtain government supports on providing technology information, establishing a shareable platform and providing training courses. There were no statistically significant difference in all questions answered between two type firms and between SME and LE.

INTRODUCTION

The use of the ICT (Information and Communication Technology) in logistics is a relatively recent phenomenon. It has made real-time, on-line communications throughout the entire supply chain a reality. Although the importance of ICT to logistics management is evident, the applications and impacts are not at all clear. It is interesting to note that several ICTs have been available for Taiwanese ICT manufacturers and transport/logistics firms for a number of years; however which are most popular ones? What

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are objectives of using ICT? What are the application areas? What impacts have been occurred? What are the barriers? and etc. This paper has mainly focused on answering the above questions.

There are four sections in this paper. Section 2 describes research methodology including sample, respondents’ characteristics, main questions in the questionnaires. Section 3 presents the major findings from the survey analysis. Section 4 summaries the results and suggests the future study directions.

**METHODOLOGY**

**Sample**

In order to explore the impact of ICT on logistics in Taiwan, a post-mail survey was conducted to 600 ICT manufacturer and transport/logistics firms listed on the Taiwan Stock Exchange. Following the mailing survey, in-depth interviews through telephone and face-to-face interviews were also conducted. The objective of the interview process was to clarify the related details of ICT impacts and to validate findings from the survey analysis. The survey was conducted from May 2002 to August 2002. Before sending the questionnaire via post-mail, a pretest survey via E-mail was conducted. Twenty firms from 302 firms answer the questionnaires via E-mail. The relatively low response rate of 6.6% made us to use the post-mail survey. After using the post-mail survey, 101 firms returned the questionnaire with our postage-paid return envelope. One of them did not provide most information, this study thus treat this as an unusable response. Therefore, the effective response rate is 16.8% better than that of the e-mail survey.

The firms chosen included two main categories: transport/logistics
firm and ICT manufacturer (see Table 1). Transport/logistics firms surveyed included air transport carrier, airfreight forwarder, integrated carrier, sea transport carrier, sea freight forwarder, shipping agent, air terminal operator, and warehousing operator.

Table 1 Types of Firm

<table>
<thead>
<tr>
<th>Firm Type</th>
<th>Number of Firms</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Transportation / Logistics</td>
<td>77</td>
<td>77</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Characteristics of the respondents

Respondents were asked to provide demographic information relating to their firm. Regarding the major business function, 23% of the respondents were involved in ICT manufacturing, 73% in transport/logistics. Firm size was measured by number of employees and annual sales. Since Taiwan usually categorized firm size into small and medium enterprise (SME) and large enterprise (LE) by number of employees, this study thus took the employees instead of annual sales for the further analysis. 57.6% of the respondents had employees of 200 or less (SME), 41.5% had employees more than 200 (LE). (see Table 2)

Table 2 Firm Size

<table>
<thead>
<tr>
<th>Firm Size (Number of Employees)</th>
<th>Number of Firms</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5</td>
<td>2</td>
<td>58</td>
</tr>
<tr>
<td>5–19</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>20–49</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>50–99</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>100–199</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>200–299</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>300–499</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>&gt; 500</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
**Main questions**

The study has focused on answering several questions:

1. What kind of ICT are your company using on logistics business?
2. What is the primary objective of using ICT in your company?
3. Which application areas does your company use ICT on logistics business?
4. Is your company different because of the use of ICT?
5. What impacts have been occurred in your usage of ICT?
6. How much percentage of costs and revenues are affected?
7. What barriers are your particular concerns?
8. What kind of changes in your operation and management policy after using ICT on logistics business?
9. What are the applications of ICT on logistics for your future plan?

All of the impacts of ICT on logistics business addressed in the questionnaire were analyzed using multiple response, crosstable analyses and student T-test.

**FINDINGS**

**Information and Communications Technology (ICT)**

The research revealed that the most popular ICT used for ICT manufacturers or transport/logistics firms is internet, followed respectively by electronic data interchange (EDI), bar coding and scanning, data warehouse, and electronic order system (EOS) for ICT manufacturers, and by EDI, E-commerce, bar coding and scanning and data warehouse for transport/logistics firms. In addition, the ICT used for SME and LE in first five ranks is almost the same, although the remaining ranks are somewhat different. (see Table 3)
The primary objective of using ICT for ICT manufacturers and transport/logistics is to communicate with customers easily and quickly, followed by to improve quality and increase revenues. To reduce cost is not the primary objective. (see Table 4)

Table 3 ICT Used on Logistics Business

<table>
<thead>
<tr>
<th>Items</th>
<th>Manufacturer</th>
<th>Rank</th>
<th>Transportation/Logistics</th>
<th>Rank</th>
<th>Small and Medium Enterprises</th>
<th>Rank</th>
<th>Large Enterprises</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Electronic Data Interchange (EDI)</td>
<td>12.2%</td>
<td>2</td>
<td>54.1%</td>
<td>2</td>
<td>35.1</td>
<td>2</td>
<td>32</td>
<td>2</td>
</tr>
<tr>
<td>2. Extensible Mark-up Language (XML)</td>
<td>4.1%</td>
<td>7</td>
<td>12.2%</td>
<td>8</td>
<td>6.2</td>
<td>9</td>
<td>10.3</td>
<td>7</td>
</tr>
<tr>
<td>3. Internet</td>
<td>17.3%</td>
<td>1</td>
<td>65.3%</td>
<td>1</td>
<td>47.4</td>
<td>1</td>
<td>36.1</td>
<td>1</td>
</tr>
<tr>
<td>4. E-commerce</td>
<td>8.2%</td>
<td>6</td>
<td>23.5%</td>
<td>3</td>
<td>1.0</td>
<td>15</td>
<td>9.3</td>
<td>8</td>
</tr>
<tr>
<td>5. Electronic Order System (EOS)</td>
<td>10.2%</td>
<td>5</td>
<td>11.2%</td>
<td>9</td>
<td>7.2</td>
<td>8</td>
<td>14.4</td>
<td>6</td>
</tr>
<tr>
<td>6. Automatic Picking System (APS)</td>
<td>4.1%</td>
<td>7</td>
<td>6.1%</td>
<td>13</td>
<td>1.0</td>
<td>15</td>
<td>9.3</td>
<td>8</td>
</tr>
<tr>
<td>7. Bar Coding and Scanning</td>
<td>12.2%</td>
<td>2</td>
<td>20.4%</td>
<td>4</td>
<td>11.3</td>
<td>4</td>
<td>21.6</td>
<td>3</td>
</tr>
<tr>
<td>8. Data Warehouse</td>
<td>12.2%</td>
<td>2</td>
<td>17.3%</td>
<td>5</td>
<td>9.3</td>
<td>6</td>
<td>19.6</td>
<td>4</td>
</tr>
<tr>
<td>9. Global Positioning Systems (GPS)</td>
<td>1.0%</td>
<td>9</td>
<td>8.2%</td>
<td>11</td>
<td>6.2</td>
<td>9</td>
<td>3.1</td>
<td>14</td>
</tr>
<tr>
<td>10. Radio Frequency Identification (RFID)</td>
<td>1.0%</td>
<td>9</td>
<td>4.1%</td>
<td>15</td>
<td>3.1</td>
<td>13</td>
<td>2.1</td>
<td>15</td>
</tr>
<tr>
<td>11. Geography Information System (GIS)</td>
<td>0%</td>
<td>9</td>
<td>1.0%</td>
<td>18</td>
<td>1.0</td>
<td>15</td>
<td>0.0</td>
<td>17</td>
</tr>
<tr>
<td>12. In-Vehicle Sensor</td>
<td>0%</td>
<td>15</td>
<td>0%</td>
<td>19</td>
<td>0.0</td>
<td>18</td>
<td>0.0</td>
<td>17</td>
</tr>
<tr>
<td>13. On-board Data Recorder</td>
<td>1.0%</td>
<td>9</td>
<td>5.1%</td>
<td>14</td>
<td>1.0</td>
<td>15</td>
<td>5.2</td>
<td>10</td>
</tr>
<tr>
<td>14. Mobile Data Communication</td>
<td>0%</td>
<td>15</td>
<td>2.0%</td>
<td>17</td>
<td>0.0</td>
<td>18</td>
<td>2.1</td>
<td>15</td>
</tr>
<tr>
<td>15. Freight and Fleet Management System</td>
<td>1.0%</td>
<td>9</td>
<td>8.2%</td>
<td>11</td>
<td>4.1</td>
<td>12</td>
<td>5.2</td>
<td>10</td>
</tr>
<tr>
<td>16. Inmarsat</td>
<td>1.0%</td>
<td>9</td>
<td>10.2%</td>
<td>10</td>
<td>6.2</td>
<td>9</td>
<td>5.2</td>
<td>10</td>
</tr>
<tr>
<td>17. Container &amp; Equipment Control System</td>
<td>1.0%</td>
<td>9</td>
<td>17.3%</td>
<td>5</td>
<td>11.3</td>
<td>4</td>
<td>7.2</td>
<td>9</td>
</tr>
<tr>
<td>18. Container Storage Planning System</td>
<td>0%</td>
<td>15</td>
<td>13.3%</td>
<td>7</td>
<td>9.3</td>
<td>6</td>
<td>4.1</td>
<td>13</td>
</tr>
<tr>
<td>19. Others</td>
<td>0%</td>
<td>15</td>
<td>3.1%</td>
<td>16</td>
<td>3.1</td>
<td>13</td>
<td>0.0</td>
<td>17</td>
</tr>
</tbody>
</table>

Table 4 Primary Objectives of ICT

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Manufacturer (%)</th>
<th>Rank</th>
<th>Transportation/Logistics (%)</th>
<th>Rank</th>
<th>Small and Medium Enterprises (%)</th>
<th>Rank</th>
<th>Large Enterprises (%)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Communicating with customers easily and quickly</td>
<td>18.8</td>
<td>1</td>
<td>67.3</td>
<td>1</td>
<td>50.0</td>
<td>1</td>
<td>37.0</td>
<td>1</td>
</tr>
<tr>
<td>2. Supporting growth and thus increasing revenues</td>
<td>17.8</td>
<td>2</td>
<td>51.5</td>
<td>3</td>
<td>36.0</td>
<td>3</td>
<td>33.0</td>
<td>3</td>
</tr>
<tr>
<td>3. Reducing cost</td>
<td>14.9</td>
<td>4</td>
<td>51.5</td>
<td>3</td>
<td>35.0</td>
<td>4</td>
<td>32.0</td>
<td>4</td>
</tr>
<tr>
<td>4. Improving quality (e.g., faster and reliable)</td>
<td>17.8</td>
<td>2</td>
<td>63.4</td>
<td>2</td>
<td>45.0</td>
<td>2</td>
<td>36.0</td>
<td>2</td>
</tr>
<tr>
<td>5. Others</td>
<td>3.0</td>
<td>5</td>
<td>2.0</td>
<td>5</td>
<td>1.0</td>
<td>5</td>
<td>4.0</td>
<td>5</td>
</tr>
</tbody>
</table>
The use of ICT for ICT manufacturers in order processing, warehouse management, enterprise resource planning (ERP), purchasing/procurement and product scheduling are the most popular implication areas, while that for transport/logistics firms focuses more in areas of transportation management and customer service, except for the order processing, warehouse management and ERP. The implication areas in first five ranks for SME and LE are the same, except for the orders. (see Table 5)

Table 5 Application Areas of ICT

<table>
<thead>
<tr>
<th>Application areas</th>
<th>Manufacturer (%)</th>
<th>Rank</th>
<th>Transportation /Logistics (%)</th>
<th>Rank</th>
<th>Small and Medium Enterprises (%)</th>
<th>Rank</th>
<th>Large Enterprises (%)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Enterprise Resource Planning (ERP)</td>
<td>16.0</td>
<td>3</td>
<td>21.0</td>
<td>5</td>
<td>12.1</td>
<td>5</td>
<td>25.3</td>
<td>3</td>
</tr>
<tr>
<td>2. Purchasing/procurement</td>
<td>16.0</td>
<td>3</td>
<td>7.0</td>
<td>6</td>
<td>5.1</td>
<td>6</td>
<td>18.2</td>
<td>6</td>
</tr>
<tr>
<td>3. Production Scheduling</td>
<td>15.0</td>
<td>2</td>
<td>2.0</td>
<td>11</td>
<td>2.0</td>
<td>8</td>
<td>15.2</td>
<td>7</td>
</tr>
<tr>
<td>4. Warehousing management</td>
<td>12.0</td>
<td>6</td>
<td>3.0</td>
<td>4</td>
<td>3.0</td>
<td>7</td>
<td>34.2</td>
<td>4</td>
</tr>
<tr>
<td>5. Material handling</td>
<td>7.0</td>
<td>9</td>
<td>4.0</td>
<td>8</td>
<td>2.0</td>
<td>8</td>
<td>9.1</td>
<td>9</td>
</tr>
<tr>
<td>6. Packaging</td>
<td>6.0</td>
<td>10</td>
<td>4.0</td>
<td>8</td>
<td>2.0</td>
<td>8</td>
<td>8.1</td>
<td>10</td>
</tr>
<tr>
<td>8. Transportation management</td>
<td>9.0</td>
<td>8</td>
<td>33.0</td>
<td>1</td>
<td>37.4</td>
<td>2</td>
<td>24.2</td>
<td>4</td>
</tr>
<tr>
<td>9. Order processing</td>
<td>18.0</td>
<td>1</td>
<td>38.0</td>
<td>3</td>
<td>25.3</td>
<td>1</td>
<td>30.8</td>
<td>1</td>
</tr>
<tr>
<td>10. Customer service/ Customer relationship management (CRM)</td>
<td>12.0</td>
<td>6</td>
<td>52.0</td>
<td>2</td>
<td>43.4</td>
<td>1</td>
<td>20.2</td>
<td>5</td>
</tr>
<tr>
<td>11. Others</td>
<td>1.0</td>
<td>11</td>
<td>3.0</td>
<td>10</td>
<td>2.0</td>
<td>8</td>
<td>2.0</td>
<td>11</td>
</tr>
</tbody>
</table>

Benefits of using ICT

After using ICT, both ICT manufacturers (mean=1.45) and transport/logistics firms (mean=1.58) thought that they obtained more than moderate benefits while 4-point scale was used (1=large benefit, 2=moderate benefit, 3=small benefit, and 4=no benefit). In addition, ICT manufacturers are not significantly different from those transport/logistics firms in terms of the degree of benefits obtained (t=-0.864; p>0.05). The degree of benefits obtained for SME and LE, are also not significantly different (t=0.482, P>0.05).
Four main categories of impacts from the use of ICT were: 1. increase ICT hardware and software cost (mean=1.58), 2. produce more business and thus increase revenues (mean=1.55), 3. provide faster and reliable service to customers (mean=1.51), and 4. reduce cost of staffs (mean=1.50). The first one belonged to the cost side while the other three belonged to the benefit side. The impact level for these first four ranks were all between large impact level and moderate impact level. (4-point scale was used, 1=large impact, 2=moderate impact, 3=small impact, and 4=no impact). No statistically significant differences in these impact levels were noted between manufacturers and transport/logistics firms and also between SME and LE. (see Table 6)

<table>
<thead>
<tr>
<th>Impacts of the use of ICT/ITS</th>
<th>Firm Type</th>
<th>Mean*</th>
<th>Total Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.Increase ICT/ITS hardware and software cost</td>
<td>Manufacturer</td>
<td>1.9565</td>
<td>1.5842</td>
<td>1.1473</td>
</tr>
<tr>
<td></td>
<td>Transportation/Logistics</td>
<td>1.4744</td>
<td></td>
<td>.9219</td>
</tr>
<tr>
<td>2.Reduce empty miles of travel and communication cost</td>
<td>Manufacturer</td>
<td>1.3478</td>
<td>1.2475</td>
<td>1.4957</td>
</tr>
<tr>
<td></td>
<td>Transportation/Logistics</td>
<td>1.2179</td>
<td></td>
<td>1.4110</td>
</tr>
<tr>
<td>3.Reduce load-waiting and delivery time</td>
<td>Manufacturer</td>
<td>1.1304</td>
<td>1.2376</td>
<td>1.4240</td>
</tr>
<tr>
<td></td>
<td>Transportation/Logistics</td>
<td>1.2692</td>
<td></td>
<td>1.2450</td>
</tr>
<tr>
<td>4.Reduce cost of staffs</td>
<td>Manufacturer</td>
<td>1.6087</td>
<td>1.5050</td>
<td>1.1176</td>
</tr>
<tr>
<td></td>
<td>Transportation/Logistics</td>
<td>1.4744</td>
<td></td>
<td>1.1478</td>
</tr>
<tr>
<td>5.Provide faster and reliable service to customers</td>
<td>Manufacturer</td>
<td>1.6522</td>
<td>1.5149</td>
<td>.9346</td>
</tr>
<tr>
<td></td>
<td>Transportation/Logistics</td>
<td>1.4744</td>
<td></td>
<td>.7863</td>
</tr>
<tr>
<td>6-Produce more business and thus increase revenues</td>
<td>Manufacturer</td>
<td>1.5652</td>
<td>1.5545</td>
<td>1.0369</td>
</tr>
<tr>
<td></td>
<td>Transportation/Logistics</td>
<td>1.5513</td>
<td></td>
<td>1.1470</td>
</tr>
<tr>
<td>7. Others</td>
<td>Manufacturer</td>
<td>.1304</td>
<td>0.9891</td>
<td>.4577</td>
</tr>
<tr>
<td></td>
<td>Transportation/Logistics</td>
<td>7.692E-02</td>
<td></td>
<td>.5037</td>
</tr>
</tbody>
</table>

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

**Percentage of Costs and Benefits are Affected**

In the appraisals of cost and benefits of using ICT, it was very difficult for respondents to estimate the amounts of cost and benefits. What they could provide was a rough information of percentage of change in costs and benefits. In average, the respondents had 9.14% of revenue increase
while they had 3.24% of cost reduction of using ICT.

**Barriers**

During the use of ICT, most manufacturer respondents thought the first five barriers were 1. compatibility of ICT systems between companies, 2. information security, 3. timeliness of information, 4. shortage of professional staff, and 5. accuracy of information exchange. Most transport/logistics firms had the same barriers except for some difference of rank orders. Again there were no statistically significant difference in terms of major barriers type between LE and SME. (see Table 7)

**Table 7 Barriers of Using ICT**

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Manufacturer (%)</th>
<th>Rank</th>
<th>Transportation /Logistics (%)</th>
<th>Rank</th>
<th>Small and Medium Enterprises (%)</th>
<th>Rank</th>
<th>Large Enterprises (%)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Availability of information</td>
<td>9.2</td>
<td>5</td>
<td>8.2</td>
<td>1</td>
<td>7.2</td>
<td>1</td>
<td>10.8</td>
<td>9</td>
</tr>
<tr>
<td>2. No economic scale to use ICT/ITS on logistics</td>
<td>8.2</td>
<td>7</td>
<td>29.6</td>
<td>3</td>
<td>20.6</td>
<td>5</td>
<td>17.5</td>
<td>4</td>
</tr>
<tr>
<td>3. Accuracy of information exchange</td>
<td>9.2</td>
<td>5</td>
<td>24.5</td>
<td>5</td>
<td>15.5</td>
<td>6</td>
<td>17.5</td>
<td>4</td>
</tr>
<tr>
<td>4. Timeliness of information</td>
<td>11.2</td>
<td>3</td>
<td>24.5</td>
<td>5</td>
<td>18.6</td>
<td>5</td>
<td>17.5</td>
<td>4</td>
</tr>
<tr>
<td>5. Information security</td>
<td>13.3</td>
<td>2</td>
<td>28.6</td>
<td>4</td>
<td>20.6</td>
<td>3</td>
<td>21.6</td>
<td>2</td>
</tr>
<tr>
<td>6. Compatibility of ICT/ITS systems between companies</td>
<td>15.3</td>
<td>1</td>
<td>44.9</td>
<td>1</td>
<td>29.9</td>
<td>2</td>
<td>29.9</td>
<td>1</td>
</tr>
<tr>
<td>7. Government regulation and administrative procedures</td>
<td>6.1</td>
<td>9</td>
<td>20.4</td>
<td>7</td>
<td>14.4</td>
<td>8</td>
<td>11.3</td>
<td>8</td>
</tr>
<tr>
<td>8. Resistance to change</td>
<td>3.1</td>
<td>1</td>
<td>14.3</td>
<td>9</td>
<td>9.3</td>
<td>9</td>
<td>8.2</td>
<td>1</td>
</tr>
<tr>
<td>9. Shortage of professional staff</td>
<td>10.2</td>
<td>4</td>
<td>43.9</td>
<td>2</td>
<td>33.0</td>
<td>1</td>
<td>21.6</td>
<td>2</td>
</tr>
<tr>
<td>10. Lack of information about the possibilities of new technologies</td>
<td>7.1</td>
<td>8</td>
<td>20.4</td>
<td>7</td>
<td>15.5</td>
<td>6</td>
<td>12.4</td>
<td>7</td>
</tr>
<tr>
<td>11. Others</td>
<td>0.0</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>0.0</td>
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</tbody>
</table>
Future Applications

The use of ICT in transport/logistics firms and ICT manufacturers continued to increase. The first five ranks of application areas for ICT manufacturers were customer service/customer relationship management (CRM), enterprise resource planning (ERP), order processing, purchase/procurement and warehouse management. While that for transport/logistics firms were transport management, CRM, order processing, ERP and warehouse management. There were no statistically significant difference in terms of application areas between LE and SME. (see Table 8)

Table 8 Future Applications

<table>
<thead>
<tr>
<th>Future applications</th>
<th>Manufacturer (%)</th>
<th>Rank</th>
<th>Transportation /Logistics (%)</th>
<th>Rank</th>
<th>Small and Medium Enterprises</th>
<th>Rank</th>
<th>Large Enterprises (%)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Enterprise Resource Planning (ERP)</td>
<td>13.4</td>
<td>2</td>
<td>25.8</td>
<td>4</td>
<td>16.7</td>
<td>4</td>
<td>22.9</td>
<td>2</td>
</tr>
<tr>
<td>2. Purchasing/procurement</td>
<td>10.3</td>
<td>4</td>
<td>6.2</td>
<td>8</td>
<td>4.2</td>
<td>7</td>
<td>12.5</td>
<td>7</td>
</tr>
<tr>
<td>3. Production scheduling</td>
<td>8.2</td>
<td>7</td>
<td>3.1</td>
<td>9</td>
<td>2.1</td>
<td>8</td>
<td>9.4</td>
<td>8</td>
</tr>
<tr>
<td>4. Warehousing management</td>
<td>9.3</td>
<td>5</td>
<td>20.6</td>
<td>5</td>
<td>13.5</td>
<td>5</td>
<td>16.7</td>
<td>5</td>
</tr>
<tr>
<td>5. Material handing</td>
<td>9.3</td>
<td>5</td>
<td>7.2</td>
<td>6</td>
<td>2.1</td>
<td>8</td>
<td>14.6</td>
<td>6</td>
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<tr>
<td>6. Packaging</td>
<td>5.2</td>
<td>9</td>
<td>3.1</td>
<td>9</td>
<td>2.1</td>
<td>8</td>
<td>6.3</td>
<td>10</td>
</tr>
<tr>
<td>7. Labeling</td>
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<td>9</td>
<td>3.1</td>
<td>9</td>
<td>1.0</td>
<td>11</td>
<td>7.3</td>
<td>9</td>
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<tr>
<td>8. Transportation management</td>
<td>8.2</td>
<td>7</td>
<td>50.5</td>
<td>3</td>
<td>35.4</td>
<td>1</td>
<td>22.9</td>
<td>2</td>
</tr>
<tr>
<td>9. Order processing</td>
<td>11.3</td>
<td>3</td>
<td>27.8</td>
<td>3</td>
<td>18.8</td>
<td>3</td>
<td>19.8</td>
<td>4</td>
</tr>
<tr>
<td>10. Customer service/Customer relationship management (CRM)</td>
<td>15.5</td>
<td>4</td>
<td>45.4</td>
<td>2</td>
<td>32.3</td>
<td>2</td>
<td>28.1</td>
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</tr>
<tr>
<td>11. Others</td>
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<td>11</td>
<td>7.2</td>
<td>6</td>
<td>6.3</td>
<td>6</td>
<td>1.0</td>
<td>11</td>
</tr>
</tbody>
</table>

GEVERNMENT SUPPORT

Respondents mostly expected the assistance from government sectors were to provide new technology information promptly, to provide a shareable platform, and to provide training courses. (see Table 9)
Table 9 Government Support Expected

<table>
<thead>
<tr>
<th>Government services</th>
<th>Manufacturer (%)</th>
<th>Rank</th>
<th>Transportation /Logistics (%)</th>
<th>Rank</th>
<th>Small and Medium Enterprises (%)</th>
<th>Rank</th>
<th>Large Enterprises (%)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Provide a shareable platform</td>
<td>11.9</td>
<td>2</td>
<td>47.5</td>
<td>2</td>
<td>34.0</td>
<td>3</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td>2. Data standardization</td>
<td>10.9</td>
<td>4</td>
<td>42.6</td>
<td>4</td>
<td>28.0</td>
<td>4</td>
<td>25.0</td>
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</tr>
<tr>
<td>3. Strengthen the security of information</td>
<td>10.9</td>
<td>4</td>
<td>37.6</td>
<td>5</td>
<td>27.0</td>
<td>5</td>
<td>21.0</td>
<td>4</td>
</tr>
<tr>
<td>4. Provide training courses</td>
<td>11.9</td>
<td>2</td>
<td>46.5</td>
<td>3</td>
<td>37.0</td>
<td>1</td>
<td>21.0</td>
<td>4</td>
</tr>
<tr>
<td>5. Provide new technology information promptly</td>
<td>13.9</td>
<td>1</td>
<td>48.5</td>
<td>1</td>
<td>37.0</td>
<td>1</td>
<td>25.0</td>
<td>1</td>
</tr>
<tr>
<td>6. Others</td>
<td>0.0</td>
<td>6</td>
<td>2.0</td>
<td>6</td>
<td>2.0</td>
<td>6</td>
<td>0.0</td>
<td>6</td>
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</tbody>
</table>

CONCLUSIONS

The ICT manufacturers and transport/logistics firms responding to the survey indicated internet and EDI were the most popular two technologies they used. The primary purpose of using ICT were to communicate with customers easily and quickly and also to improve quality and increase revenues rather than to decrease costs. The respondents indicated that they gained moderate to large benefit level and they will continue to use in more application areas. The barriers they concerned had compatibility of ICT systems, information security, timeliness of information, shortage of professional staff and accuracy of information exchange. They expected to obtain the government supports on providing technology information promptly, establishing a shareable platform and providing training courses. It was found that there were no statistically significant difference in all items between manufacturers and transport logistics firms, and between LE and SME.

This paper employed a rather subjective measure of ICT impacts, i.e. the respondents’ perceptions of their firms’ ICT impact areas and levels. A further research is needed using more quantifiable measures of ICT impacts.