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An ICT Infusion Model for Nigerian Transport Sector

Idowu, P.A.
Department of Computer Science and Engineering
Obafemi Awolowo University
Ile-Ife, Nigeria.
paidowu@oauife.edu.ng

Oyetunji, M.O.
Department of Computer Science & Mathematics
Mountain Top University
Km 12 Lagos-Ibadan Express Way
Prayer City, Ogun State, Nigeria
mooyetunji@mtu.edu.ng

Oladeji, F.A.
Department of Computer Science
University of Lagos
Akoka, Lagos, Nigeria
foladeji@unilag.edu.ng

Balogun J.A.
Department of Computer Science and Engineering
Obafemi Awolowo University
Ile-Ife, Nigeria.
paidowu@oauife.edu.ng

ABSTRACT

This study was aimed at identifying the ICT devices used in the Nigerian transport sector and the formulation of infusion models for each identified ICT device. Structured questionnaires were used to collect information regarding the use of the ICT devices used in the Nigerian transport sector identified from 100 staffs selected from six (6) different transport companies in south-western Nigeria. The different ICT devices identified were: smartphones, SMS, e-mails, company website, bulk sms, ticket reservations, vehicle trackers, POS systems and 2-way radio. The results of the study showed that majority of respondents were married male drivers of Ibo ethnicity within ages of 31 – 40 years which was 57% of the respondents selected. The results of the study also showed that the earliest ICT tools adopted were: SMS, e-mails, bulk sms, company websites, ticket reservations and vehicle trackers in 2001 while smartphones, POS and 2-way radios were adopted by 2006. The results showed that more people adopted SMS and smartphone use but none of the adopted users were up to 25% of the total number of respondents selected for this study. Although, 52% of the respondents were computer compliant it was observed that only a small number of respondents (24% of respondents) were adopters of the identified ICT technologies. Polynomial functions of degree, m were used to formulate the infusion model for each ICT devices identified based on the yearly cumulative distribution of the number of users. The infusion models formulated can be used to estimate the number of users of ICT devices for any given year from the year of adoption of the ICT device.

Keywords - Information and Communications Technology, devices, infusion modeling, Nigeria, private transport companies.

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1. INTRODUCTION

Today's society is evolving from a type where the physical world and the information world are joined into a form where the physical world is integrated into the information network. This can be seen in the reduction of manual effort exerted in monitoring the environment, gathering data and analyzing such data. Other everyday activities that involves smartness which technology promises to deliver through Internet of Things (IoT) include monitoring products movement, controlling devices in houses, allowing devices send information about their mechanical and physical states to the producers for faster maintenance,

1. INTRODUCTION

Information and Communications Technology (ICT) covers any equipment or interconnected system or subsystem of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information. It includes computer ancillary equipment, software, firmware and similar procedures, services (including support services, and related resources(Idowu, Adagunodo, & Adedoyin, 2006). Many organizations of all types are currently utilizing Information and Communication Technology (ICT) around the globe, not only for cutting costs and improving efficiency, but also for providing better customer services(Irefin, Abdul-Azeez, & Tijani, 2012). Information Technology infusion is defined as the degree to which a different information technology tools are integrated into organizational activities. More specifically, information technology infusion pertains to the frequency of technology usage, the full use of the application capabilities, the level of integrated and complimentary use of different technologies and the usage of technology for the organizational purpose (Love, Irani, & Edwards, 2004).

Also Governments world over are adopting ICT to provide better services to their citizens. The adoption of ICT by organizations requires a business environment that encourages open competition, trust and security, interoperability, and standardization and the availability of finance for ICT. However, as the global economy became increasingly reliant on ICT to receive, process, and send out information, the small businesses within the developing countries – which form a significant portion of their developing economies – have yet to reap these benefits evenly. The existence of efficient value chains depends on the efficient and systematic flow of relevant information, which in turn depends on the existence of an efficient and reliable ICT infrastructure and the associated services to connect to a diverse range of stakeholders along the transportation value chain (Amadi et al., 2012).

In this regard, ICTs could provide a unique opportunity to facilitate transportation related technological adoption and access, provision of information on markets and market prices, weather, transport and transportation technique. The need to provide efficient transport services has resulted in a dramatic infusion of Information and Communications Technology (ICT) based solutions(Ashrafi & Murtaza, 2008). The uneven spread of infrastructure – market, finance, administrative (e.g., government services) and physical (roads, etc.) – is equally problematic in developed and developing nations, leading to significant differences in the ability to leverage individual and regional strengths (van Geenhuizen, 2011). Insufficient extension services and poor access to information widen the gap in the adoption of new technologies and can lead to lower long-term productivity.

One of the first visible effects is the integration of traditional services (transportation and warehousing) with information-based services. Although transport and logistics companies have used telecommunication systems and networks for some time, the sector may not be considered a leader in the field of technological innovation(Tilanus, 1997). Today, the main transport and logistics service firms are in a position to provide a variety of information via the Internet and to secure transactions online with customers. Another feature emerging alongside the Internet and e-business is the creation of a new category of service provider called Fourth Party Logistics Provider (4PL). According to (Bade, Mueller, & Youd, 1999), a Fourth-Party Logistics Provider is a supply chain integrator who assembles and manages the resources, capabilities and technology of its organization with those of complementary service providers to deliver a comprehensive supply chain solution(Bade et al., 1999; Rockwell, 1999).

In developed nations around the world there is a growing application of ICT technologies into many small and medium scale enterprise (SME) businesses which have credited their success and achievements to human capacity development in the areas of ICT adoption and use among workers. In Nigeria, many SME are yet to imbibe the culture of fully integrating ICT into their business for the purpose of improving business-business and business-customer relationships. This problem is attributed to the lack of information about ICT use and its importance in improving business operations which includes the Nigerian transport sector. There is no way for stakeholders in the Nigerian transport sector to estimate the users of ICT technologies at any given period of time from a pre-defined period of infusion.

This study intends to look into SME business using the Nigerian private transport companies as a case study into understanding the adoption of ICT technologies by identifying the types of technologies adopted, for what purpose used the extent of use and overall impact of the device in use. This study is aimed at identifying the ICT devices used in the Nigerian transport sector alongside the formulation of an ICT infusion model for each ICT devices used, hence this study.

2. RELATED WORKS

The adoption of ICT in logistics operations as an emerging trend for sustainable as an emerging trend for sustainable development and human capacity building in south-eastern Nigeria was proposed by (Ekene, 2014). 30 recognized logistics companies formed the sample of the study based on the multi-staged sampling techniques. Descriptive statistics was adopted for the data analysis. The study revealed that the level of ICT adoption on logistics operations in the study area was about 37%; the ICT devices were used in a high extent in the logistics operations in the study area; the study further revealed that the impact of ICT on logistics operations were also high in South-Eastern Nigeria.

This is based on the fact that the mean values of the extent and impact of ICT on logistics operations in the study area had grand mean values of 3.38 and 4.16 respectively which were above the expected mean value of 3.00. The questionnaires were structured in a 5 point Likert measurement. The results of the study revealed the need for increased awareness on the adoption of ICT on logistics operations in the study area because of its multidimensional benefits in enhancing swift logistics operations which will in turn add to sustainable development and human capacity building to the society at large.

Amadi et al. (2012) worked on the deployment of ICT for effective transportation systems in Nigeria by proposing a design model of Nigerian Intelligent system. The study identified Intelligent Transport Systems (ITS) as the solution to the National traffic congestion, by exploring and exposing to the Nigerian populace the benefits, technologies as well as how ITS can be deployed in Nigeria majoring interests on advanced traveler information system. In a highly mobile society, accurate and timely traffic information could help travelers reach their destinations quickly and safely. To serve this information need, Advanced Traveler Information Systems (ATIS) that provide real-time pre-trip and en-route traveler information were introduced to help drivers avoid congestion and choose timesaving and safe route. This research work highlighted examples of countries that have and are deploying ITS. It equally went further to explain the technologies involved and the working principles, limiting ITS application to only Advance traveler Information System.

A number of applications of ICT for the sustainability of urban road transport was proposed by (van Geenhuizen, 2011). This paper addressed the impact of information and communication technology (ICT) on sustainable transport by examining the direct application of ICT in urban transport. Following a discussion of various negative externalities of transport, the paper examined the extent to which existing and potential ICT applications in the transport sector can assist in making urban transport more sustainable than it is at present. The focus of analysis is on qualitative and quantitative impacts of several ICT applications on travel behaviour (including fatalities), factors that influence adoption, and impacts of adoption including potentially secondary effects. The literature suggests that ICT innovations are most effective in fatality reduction, but it seems that these are also quite effective in reducing fuel consumption through fuel-intelligent vehicles.

A paper on ICT innovation and sustainability of the transport sector of the United States and Europe was presented by (van Geenhuizen, 2011). In this paper we address the influence of information and communication technology (ICT) on sustainable transport in two ways, i.e. by examining the relation between ICT use and transport demand and by examining the direct application of ICT in the transport system. Following a discussion of the various negative externalities of transport and a discussion of the latest insights into the impacts of ICT on transport demand, we examine the extent to which existing and potential ICT applications in the transport sector can assist in making transport sustainable or at least more sustainable than it is at present.

3. Materials and Methods

This study made use of structured questionnaire for the purpose of eliciting information about the ICT devices used within the Nigerian transport sector, how many people used the resources and for how long the IT devices had been in use among the respondents considered for the study. The study considered respondents selected from 6 transport agencies, namely: ABC Transport Company Limited, EFEX Transport Limited, Chisco Transport Limited, Cross Country Transport Limited, Corporate Transport Limited and E-Ekesons Transport Limited all located in south-western Nigeria.

The instrument of data collection was used to collect information from the respondents of the study, such data included: demographic information, ICT components used at each sites alongside the impact of the IT components. Following the collection of data from the respondents, the data was analyzed using standard descriptive statistics tools: tables for data presentation and graphs for data presentation. The ICT infusion model was formulated using polynomial expressions of degree, m estimated from cumulative total of users for each year from the year of infusion of each device. The study population for this study was identified as staffs (drivers, security and managers) of the six (6) transport companies identified. 100 questionnaires were distributed among the respondents with the necessary information provided.

This study incorporated the use of descriptive statistical techniques for the purpose of analyzing the data collected for this study from the respondents. The descriptive statistics methods used helped in the simplification of large amount of data in a much sensible way by the provision of summary using both numerical and graphical tools using frequency tables and charts respectively. The IT infusion model was formulated using the Microsoft® Excel's built-in functionality for estimating the trend line of graphical tables and charts – which in this case is a polynomial function of degree, m.

For the purpose of this study, the IT infusion model was formulated as a function of the number of years, x from the base year, up to a required year using a polynomial equation of degree, m for each identified IT component. Equation 1 shows how to determine number of years, x that is required to determine the number of users of the ICT devices by the year, from the base year, Y_0.

$$x = Y_x - Y_0 + 1 \qquad (1)$$

The number of ICT devices adopted by the respondents of the six (6) transport companies for each year, was considered as a sequence of terms (equation 2) following which the cumulative total for each successive year was determined till the present year - 2016 (equation 3). Assuming an ICT device which was used starting from a base year, Y0 = 2001; it will be discovered that the total number of terms in the sequence of users from 2001 till 2015 is t = 2015-2001+1=15 years.

$$n_x = n_1, n_2, n_3, n_4, \ldots\ldots\ldots, n_{15} \qquad (2)$$

The cumulative total number of ICT devices used by respondents of the 6 locations for each year from the base year till the present year was considered as a series of terms (equation 3). In equation (2), it is observed that each for represents the number of users of the IT device for each successive year from 2001 till 2015. Equation (2) was converted to a sequence of the cumulative sum of users for each successive year (equation 3). Thus each represents the cumulative total number of users of ICT devices x years after the base year of infusion, Y0 (see equation 4).

$$S_x = n_1, (n_1 + n_2), (n_1 + n_2 + n_3), \ldots (n_1 + n_2 \ldots\ldots + n_{15}) \qquad (3)$$

$$S_x = S_1, S_2, S_3, S_4, \ldots\ldots, S_{15} \qquad (4)$$

Where:

$$S_1 = n_1, S_2 = (n_1 + n_2), \ldots\ldots, S_{15} = (n_1 + n_2 + n_{15})$$

Hence, the infusion model is thus a polynomial equation of degree m which is the best line fit of the cumulative number of users of each ICT device by year, Yx - x years after the base year, Y0. Thus, the IT infusion model is a polynomial fit of equation (4) expressed in terms of x (the number of years after the base year). Hence, the IT infusion model is expressed as shown in equation (5).

$$S(x) = a + bx + cx^2 + \ldots\ldots + dx^n \qquad (5)$$

Where a, b, c, d ϵ $\mathbb{R}$

4. RESULTS AND DISCUSSIONS

After distribution of 100 questionnaires among the respondents selected from the six (6) transport companies, a number of results were reported. Based on the findings of this study, the ICT tools investigated among the 100 respondents chosen for this study were: smartphones, SMS, e-mails, company website, bulk sms, ticket reservations, vehicle trackers, POS systems and 2-way radio. The distribution of the 100 questionnaires among the six (6) transport companies selected is shown in table 1 below with majority of respondents selected from E-Ekesons followed by Chisco and Corporate transport companies.

TABLE I: RESPONDENTS SELECTED FOR THIS STUDY

Transport Company	TOTAL	%
ABC	12	12.00
EFEX	13	13.00
CHISCO	20	20.00
CROSS-COUNTRY	13	13.00
CORPORATE TRANS	20	20.00
E-EKESONS	22	22.00
Total	100	100

Of the 100 respondents selected for this study, 85% were drivers, 10% managers while 5% were security personnel of the transport companies (Table 2) among whom 93% were male (Table 3) consisting of 88% married and 8% single (Table 4). Regarding the age groups of the respondents selected from the transport companies, majority were within the age interval of 21 – 40 years (with 30% in the interval 21 – 30 years and 57% in the interval of 31 – 40 years) as shown in Table 5. The majority tribe among the respondents was identified as Ibo representing 91% of respondents (Table 6). 51% of respondents whom were drivers drove cars while 41% drove buses and large vehicles (Table 7) while 52% of the respondents were identified to be compute compliant (Table 8) with majority of users for up to 5 – 10 years (Table 9)

TABLE 2: JOB DESCRIPTION OF THE RESPONDENTS SELECTED FOR THIS STUDY

Job-nature	ABC	EFEX	CHISCO	X-COUNTRY	CORPORATE	E-EKESONS	TOTAL	%
Security	2	0	0	2	0	1	5	5.00
Manager	5	1	1	0	2	1	10	10.00
Driver	5	12	19	11	18	20	85	85.00
Total	**12**	**13**	**20**	**13**	**20**	**22**	**100**	**100.00**

TABLE 3: SEX OF RESPONDENTS SELECTED FOR THIS STUDY

Gender	ABC	EFEX	CHISCO	Cross-Country	Corporate	E-EKESONS	TOTAL	%
Male	9	13	19	11	19	22	93	93.00
Female	3	0	1	2	1	0	7	7.00
Total	**12**	**13**	**20**	**13**	**20**	**22**	**100**	**100**

TABLE 4 : MARITAL STATUS OF RESPONDENTS SELECTED FOR THIS STUDY

Marital Status	ABC	EFEX	CHISCO	X-COUNTRY	CORPORATE	E-EKESONS	TOTAL	%
Married	7	12	15	12	20	22	88	88.00
Single	4	1	3	0	0	0	8	8.00
Missing	1	0	2	1	0	0	4	4.00
Total	**12**	**13**	**20**	**13**	**20**	**22**	**100**	**100**

TABLE 5: AGE GROUPS OF RESPONDENTS SELECTED FOR THE STUDY

Age-group	ABC	EFEX	CHISCO	Cross-Country	CORPORATE	E-EKESONS	TOTAL	%
< 20	0	0	2	0	0	1	3	3
21-30	3	1	11	0	0	15	30	30
31-40	3	12	7	11	19	5	57	57
41-50	3	0	0	0	0	1	4	4
> 50	3	0	0	2	1	0	6	6
Total	**12**	**13**	**20**	**13**	**20**	**22**	**100**	**100**

TABLE 6: ETHNICITY OF THE RESPONDENTS SELECTED FOR THIS STUDY

Ethnicity	ABC	EFEX	CHISCO	X-COUNTRY	CORPORATE	E-EKESONS	TOTAL	%
Hausa	1	0	1	0	0	0	2	2.00
Yoruba	3	0	1	1	1	0	6	6.00
Ibo	8	12	18	12	19	22	91	91.00
Benin	0	1	0	0	0	0	1	1.00
Total	**12**	**13**	**20**	**13**	**20**	**22**	**100**	**100**

TABLE 7: VEHICLE TYPE DRIVEN BY DRIVERS OF THE RESPONDENTS SELECTED FOR THIS STUDY

Vehicle-type	ABC	EFEX	CHISCO	X-COUNTRY	CORPORATE	E-EKESONS	TOTAL	%
Car	9	12	4	8	18	0.00	51	51.00
Bus	3	0	15	3	0	20.00	41	41.00
Nil	0	1	1	2	2	2.00	8	8.00
Total	**12**	**13**	**20**	**13**	**20**	**22**	**100**	**100.00**

TABLE 8 : COMPUTER COMPLIANCE AMONG RESPONDENTS SELECTED FOR THIS STUDY

Computer-compliance	ABC	EFEX	CHISCO	X-COUNTRY	CORPORATE	E-EKESONS	TOTAL	%
Yes	6	12	6	10	17	1	52	52.00
No	6	1	14	3	3	21	48	48.00
Total	12	13	20	13	20	22	100	100.00

TABLE 9: LENGTH OF TIME OF COMPUTER COMPLIANCE AMONG RESPONDENTS SELECTED FOR THIS STUDY

Time-Computer-compliance	ABC	EFEX	CHISCO	X-COUNTRY	CORPORATE	E-EKESONS	TOTAL	%
less-than-5	2	0	3	0	0	0	5	5.00
5-10	3	12	5	10	17	0	47	47.00
above-10	1	0	0	1	0	1	3	3.00
Nil	6	1	12	2	3	21	45	45.00
Total	**12**	**13**	**20**	**13**	**20**	**22**	**100**	**100.00**

5. RESULTS AND DISCUSSION OF ICT INFUSION MODELS

Based on the results of this study, it was discovered that the most commonly used ICT tool between the years 2001 till 2016 was the SMS which represented 24% of respondents followed by smartphones 20% and company websites with 15% of respondents. The least commonly used ICT tools were: 2-way radio with 5%, bulk sms and vehicle tickets with 12% of respondents each. The results also showed that despite the high proportion of computer compliant users, it was observed that less than half used ICT devices in the discharge of their respective duties (Table 10). The cumulative number of users of each ICT devices from 2001 till 2016 is shown in Table 11.

Based on the information displayed in Tables 10 and 11 the year of adoption of each identified ICT device used among the respondents selected from the two (2) security agencies is shown in Table 12. Table 12 gives a description of the base year (the year of adoption or infusion) of each ICT devices used among private transport companies in Nigeria alongside the initial number of users. The earliest adopted ICT devices were SMS, emails, company websites, bulk sms, ticket reservation and vehicle trackers in 2001. The most adopted ICT devices were SMS (24%), smartphones (20%) and company websites (15%). The number of smartphone users is believed to influence the number of SMS and company website users from the respondents selected for this study due to the easy access of the services (SMS and websites) via smartphones. 2-way radios were used by less than 10% of transport company users of ICT devices.

The results of the study further showed that the ICT devices identified were adopted between the years 2001 and 2006 with 6 ICT devices adopted in 2001 and 3 in 2006. The graphical distribution of the cumulative number of adopters of ICT devices is shown in Fig. 1. For the purpose of formulating the IT infusion model using the polynomial function S(x) with respect to x which represents the number of years after the base year, Y0 for each ICT device considered for the study. The Microsoft Excel Data Analysis Toolkit for the estimation of trend lines using polynomial fits from the graphs and charts of the cumulative total number of ICT users was used to formulate the infusion model for each ICT device. Thus, the total number of users of ICT tools can be determined for a given year, Y_x given the number of years x from the year of infusion as determined from equation 1 using equation 5.

TABLE 10: DISTRIBUTION OF THE NUMBER OF ADOPTERS OF ICT DEVICES BETWEEN 2001 TILL 2016

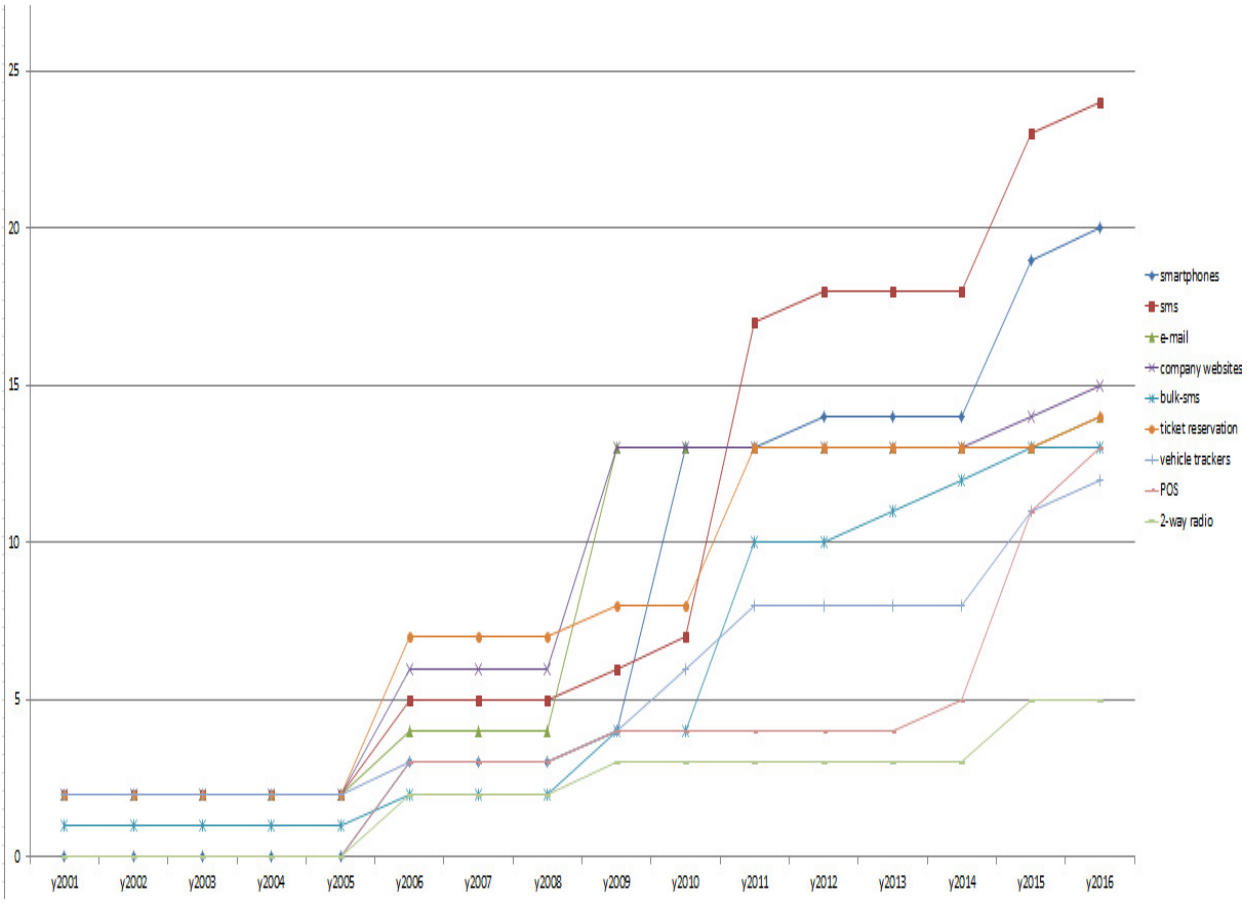
	ICT DEVICE ADOPTERS PER YEAR																TOTAL	%
YEAR	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	'15	'16		
Smartphones	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**1**	**9**	**0**	**1**	**0**	**0**	**5**	**1**	**20**	**20**
SMS	**2**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**1**	**1**	**10**	**1**	**0**	**0**	**5**	**1**	**24**	**24**
E-mails	**2**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**14**	**14**
Company website	**2**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**15**	**15**
Bulk sms	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**2**	**0**	**6**	**0**	**1**	**0**	**1**	**0**	**12**	**12**
Ticket reservation	**2**	**0**	**0**	**0**	**0**	**5**	**0**	**0**	**1**	**0**	**5**	**0**	**0**	**0**	**0**	**1**	**14**	**14**
Vehicle trackers	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**2**	**2**	**0**	**0**	**0**	**3**	**1**	**12**	**12**
POS	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**6**	**2**	**13**	**13**
2-way radio	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**5**	**5**

TABLE 11: DISTRIBUTION OF CUMMULATIVE TOTAL NUMBER OF ADOPTERS OF ICT DEVICES BETWEEN 2001 TILL 2016

	ICT DEVICE ADOPTERS PER YEAR																TOTAL	%
YEAR	**'01**	**'02**	**'03**	**'04**	**'05**	**'06**	**'07**	**'08**	**'09**	**'10**	**'11**	**'12**	**'13**	**'14**	**'15**	**'16**		
Smartphones	**0**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**4**	**13**	**13**	**14**	**14**	**14**	**19**	**20**	**20**	**20**
SMS	**2**	**2**	**2**	**2**	**2**	**5**	**5**	**5**	**6**	**7**	**17**	**18**	**18**	**18**	**23**	**24**	**24**	**24**
E-mails	**2**	**2**	**2**	**2**	**2**	**4**	**4**	**4**	**13**	**13**	**13**	**13**	**13**	**13**	**13**	**14**	**14**	**14**
Company website	**2**	**2**	**2**	**2**	**2**	**6**	**6**	**6**	**13**	**13**	**13**	**13**	**13**	**13**	**14**	**15**	**15**	**15**
Bulk sms	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**4**	**4**	**10**	**10**	**11**	**11**	**12**	**12**	**12**	**12**
Ticket reservation	**2**	**2**	**2**	**2**	**2**	**7**	**7**	**7**	**8**	**8**	**13**	**13**	**13**	**13**	**13**	**14**	**14**	**14**
Vehicle trackers	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**4**	**6**	**8**	**8**	**8**	**8**	**11**	**12**	**12**	**12**
POS	**0**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**4**	**4**	**4**	**4**	**4**	**5**	**11**	**13**	**13**	**13**
2-way radio	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**5**	**5**	**5**	**5**

TABLE 12: YEAR OF INFUSION (BASE YEAR, Y_0) FOR EACH ICT TOOLS USED AMONG NIGERIAN TRANSPORT COMPANIES

ICT Device	Year of Infusion	Initial Users	Present Users	Percentage number of users (%)
Smartphones	2006	3	20	20
SMS	2001	2	24	24
E-mails	2001	2	14	14
Company website	2001	2	15	15
Bulk sms	2001	1	12	12
Ticket reservation	2001	2	14	14
Vehicle trackers	2001	2	12	12
POS	2006	3	13	13
2-way radio	2006	2	5	5



Fig, 1: Graphical plot of the cumulative total user of ICT tools between 2001 till 2016

A. Infusion Model for the Use of Smartphones and Mobile Phones

Following the results of cumulative sum of the number of users of smartphones and mobile phone users among private transport companies in Nigeria, it was observed that the year of infusion was 2006 with 3 initial users. Using equation 1, the number of years from 2006 till 2016 is 11 years which corresponds to the 11 points of the cumulative frequency distribution curve shown in Fig. 2. In Fig. 2, the base year, Y_0 is point x=1 which corresponds to 3 on the y-axis while each consecutive year, Y_x on the x-axis corresponds to the total number of users of smartphones x years after the base year (year of infusion). Using the auto-generated polynomial that forms the best fit for the use of smartphones and mobile phones from the cumulative distribution in table 11, the results showed that the infusion model for the use of projectors can be represented using a polynomial of degree m=4 as shown in equation which had a coefficient of determination, $R^2 = 0.9972$.

$$S(x) = 0.021x^4 - 0.5175x^3 + 4.2343x^2 - 10.955x + 10.545 \quad (6)$$

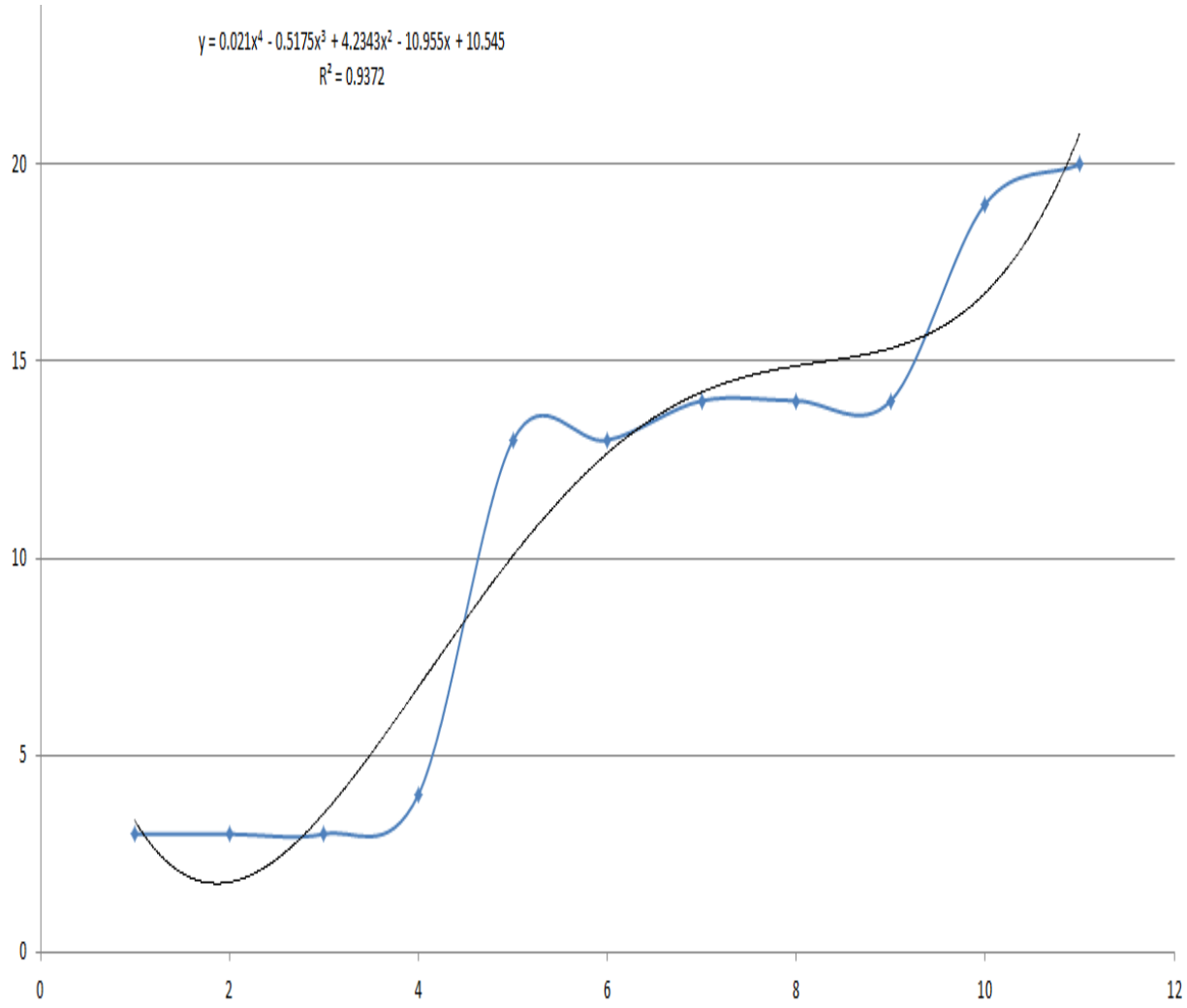


Fig. 2: Polynomial fit of the infusion model for smartphones users

Infusion Model for the Use of SMS Services

Following the results of cumulative sum of the number of users of sms services users among security agencies in Nigeria, it was observed that the year of infusion was 2001 with 2 initial users. Using equation 1, the number of years from 2001 till 2016 is 16 years which corresponds to the 16 points of the cumulative frequency distribution curve shown in figure 3. In Fig. 3, the base year, Y_0 is point x=1 which corresponds to 2 on the y-axis while each consecutive year, Y_x on the x-axis corresponds to the total number of users of sms services x years after the base year (year of infusion). Using the auto-generated polynomial that forms the best fit for the use of sms services from the cumulative distribution in table 11, the results showed that the infusion model for the use of sms can be represented using a polynomial of degree m=5 as shown in equation 7 which had a coefficient of determination, $R^2 = 0.9526$.

$$S(x) = 0.0002x^5 - 0.0104x^4 - 1.2225x^3 - 1.222x^2 + 3.2459x - 0.5481 \quad (7)$$

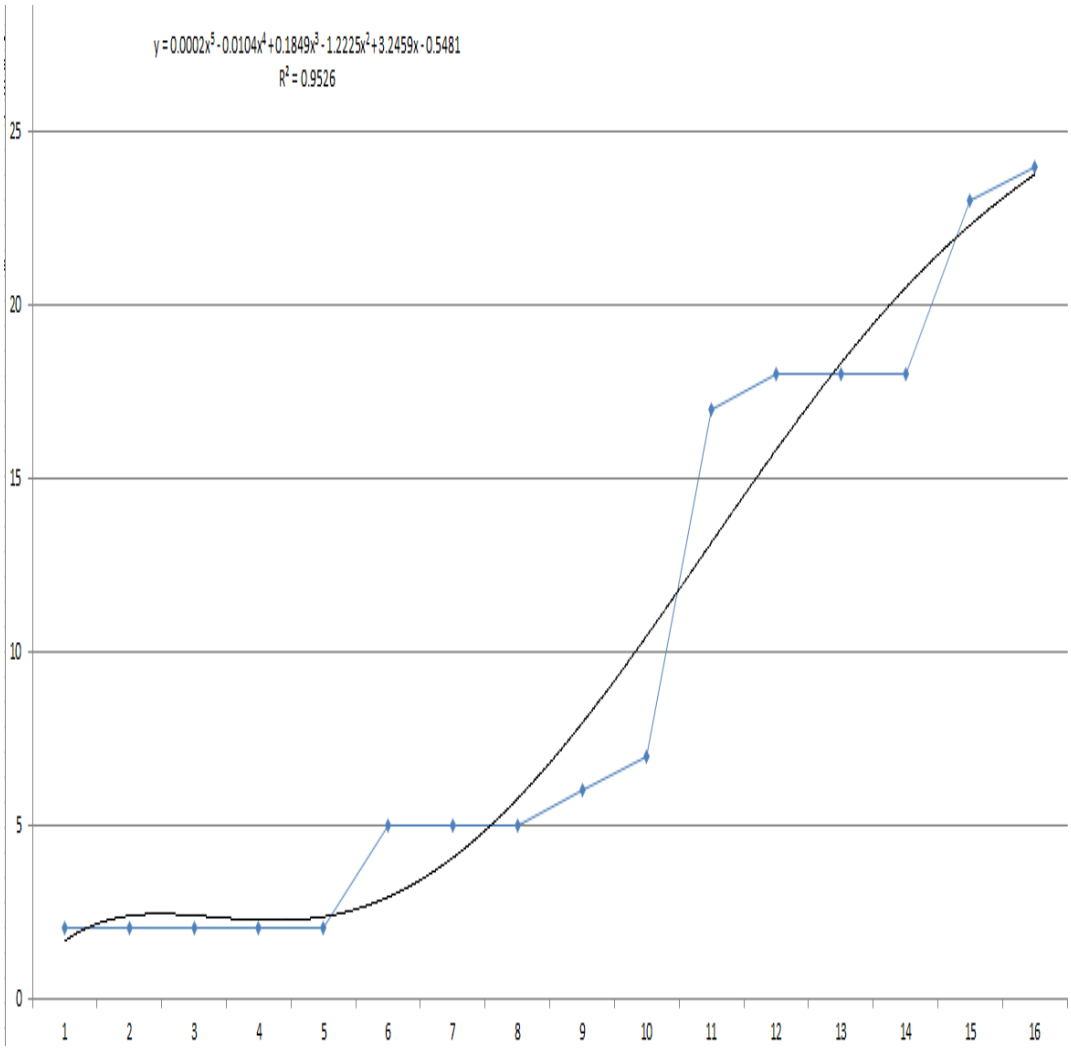


Fig. 3: Polynomial fit of the infusion model for SMS users

Infusion Model for the Use of E-Mail Services

Following the results of the cumulative sum of the number of users of e-mail services users among security agencies in Nigeria, it was observed that the year of infusion was 2001 with 2 initial users. Using equation 1, the number of years from 2001 till 2016 is 16 years which corresponds to the 16 points of the cumulative frequency distribution curve shown in Fig. 4. In Fig. 4, the base year, Y_0 is point x=1 which corresponds to 2 on the y-axis while each consecutive year, Y_x on the x-axis corresponds to the total number of users of e-mail services x years after the base year (year of infusion). Using the auto-generated polynomial that forms the best fit for the use of e-mail services from the cumulative distribution in table 11, the results showed that the infusion model for the use of e-mails can be represented using a polynomial of degree m=5 as shown in equation 8 which had a coefficient of determination, $R^2 = 0.9408$.

$$S(x) = 0.0008x^5 - 0.0341x^4 + 0.4824x^3 - 2.6975x^2 + 5.9113x - 1.8751 \quad (8)$$

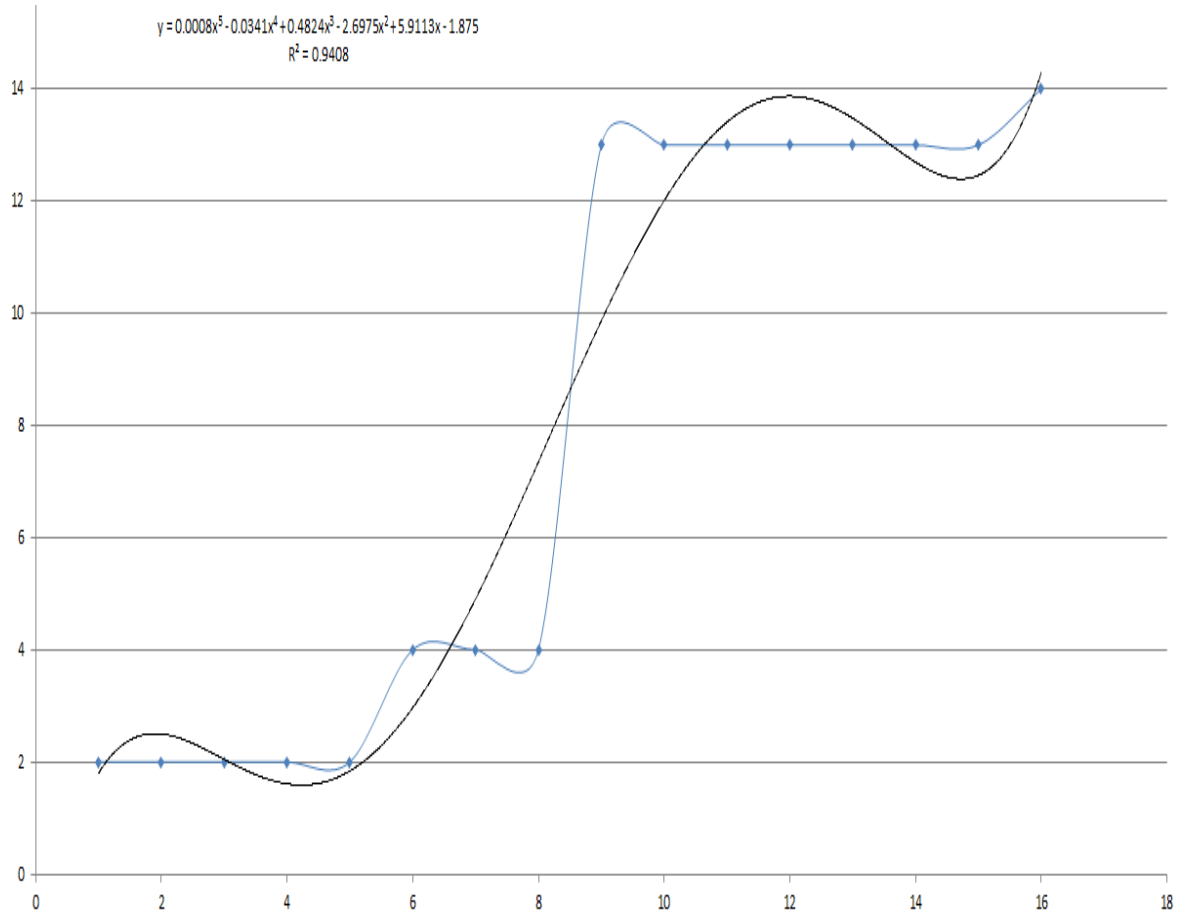


Fig. 4: Polynomial fit of the infusion model for e-mail users

Infusion Model for the Use of Company Websites Services

Following the results of cumulative sum of the number of users of company websites services users among security agencies in Nigeria, it was observed that the year of infusion was 2001 with 2 initial users. Using equation 1, the number of years from 2001 till 2016 is 16 years which corresponds to the 16 points of the cumulative frequency distribution curve shown in Fig. 5. In Fig. 5, the base year, Y_0 is point x=1 which corresponds to 2 on the y-axis while each consecutive year, Y_x on the x-axis corresponds to the total number of users of company websites services x years after the base year (year of infusion). Using the auto-generated polynomial that forms the best fit for the use of company websites services from the cumulative distribution in table 11, the results showed that the infusion model for the use of company websites can be represented using a polynomial of degree m=5 as shown in equation 9 which had a coefficient of determination, $R^2 = 0.9526$.

$$S(x) = 0.0009x^5 - 0.0344x^4 + 0.445x^3 - 2.2288x^2 + 4.4237x - 0.7223 \quad (9)$$

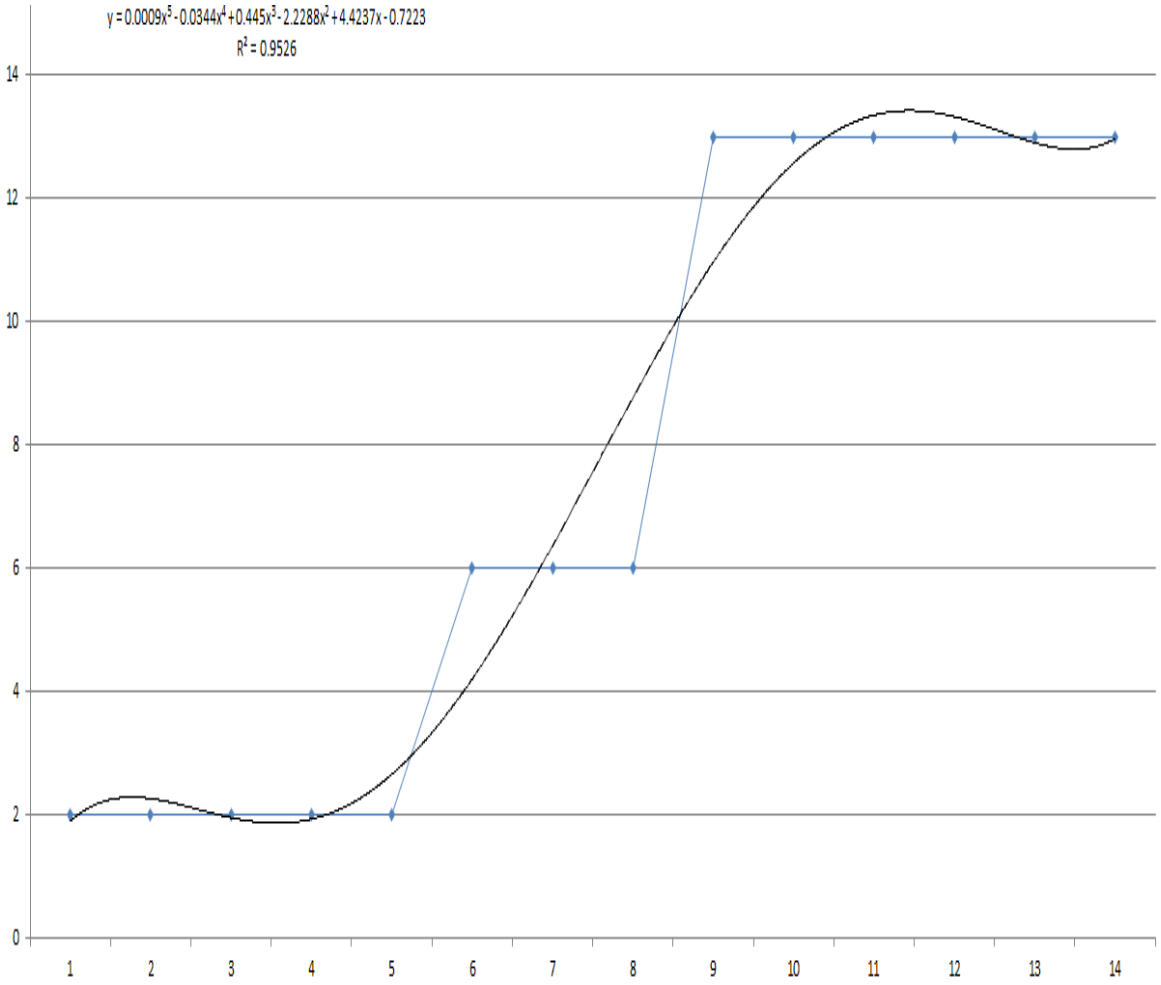


Fig. 5: Polynomial fit of the infusion model for company websites users

Infusion Model for the Use of Bulk SMS

Following the results of cumulative sum of the number of users of bulk sms users among security agencies in Nigeria, it was observed that the year of infusion was 2001 with 1 initial user. Using equation 1, the number of years from 2001 till 2016 is 16 years which corresponds to the 16 points of the cumulative frequency distribution curve shown in Fig. 6. In Fig. 6, the base year, Y_0 is point x=1 which corresponds to 1 on the y-axis while each consecutive year, Y_x on the x-axis corresponds to the total number of users of bulk sms x years after the base year (year of infusion). Using the auto-generated polynomial that forms the best fit for the use of bulk sms from the cumulative distribution in table 11, the results showed that the infusion model for the use of bulk sms can be represented using a polynomial of degree m=5 as shown in equation 10 which had a coefficient of determination, $R^2 = 0.9707$.

$$S(x) = 0.00004x^5 - 0.0035x^4 + 0.0804x^3 - 0.5785x^2 + 1.4848x \quad (10)$$

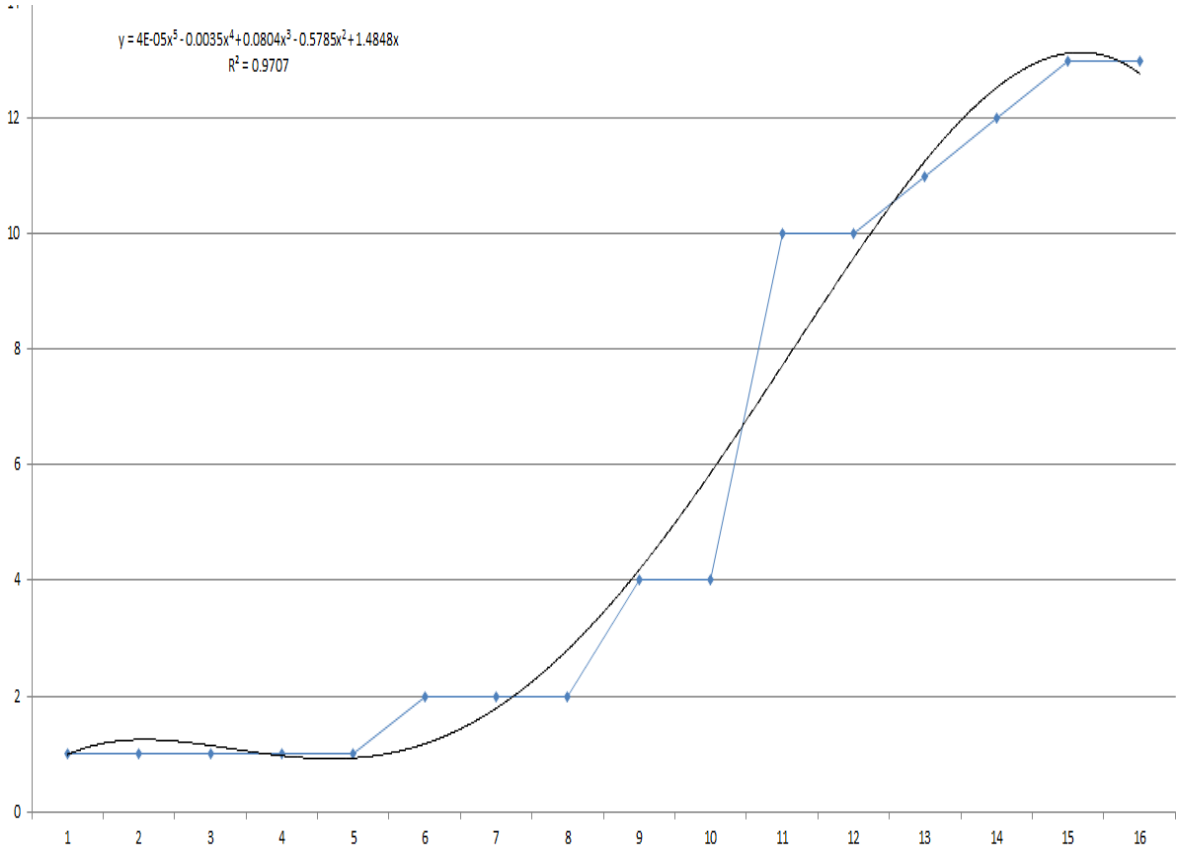


Fig. 6: Polynomial fit of the infusion model for bulk SMS users

Infusion Model for the Use of Ticket Reservations

Following the results of cumulative sum of the number of users of ticket reservations users among security agencies in Nigeria, it was observed that the year of infusion was 2001 with 2 initial users. Using equation 1, the number of years from 2001 till 2016 is 16 years which corresponds to the 16 points of the cumulative frequency distribution curve shown in Fig. 7. In Fig. 7, the base year, Y_0 is point x=1 which corresponds to 2 on the y-axis while each consecutive year, Y_x on the x-axis corresponds to the total number of users of ticket reservations x years after the base year (year of infusion). Using the auto-generated polynomial that forms the best fit for the use of ticket reservations from the cumulative distribution in table 11, the results showed that the infusion model for the use of ticket reservation can be represented using a polynomial of degree m=3 as shown in equation 11 which had a coefficient of determination, $R^2 = 0.9451$.

$$S(n) = -0.0106x^3 + 0.2622x^2 - 0.8059x + 2.4121 \quad (11)$$

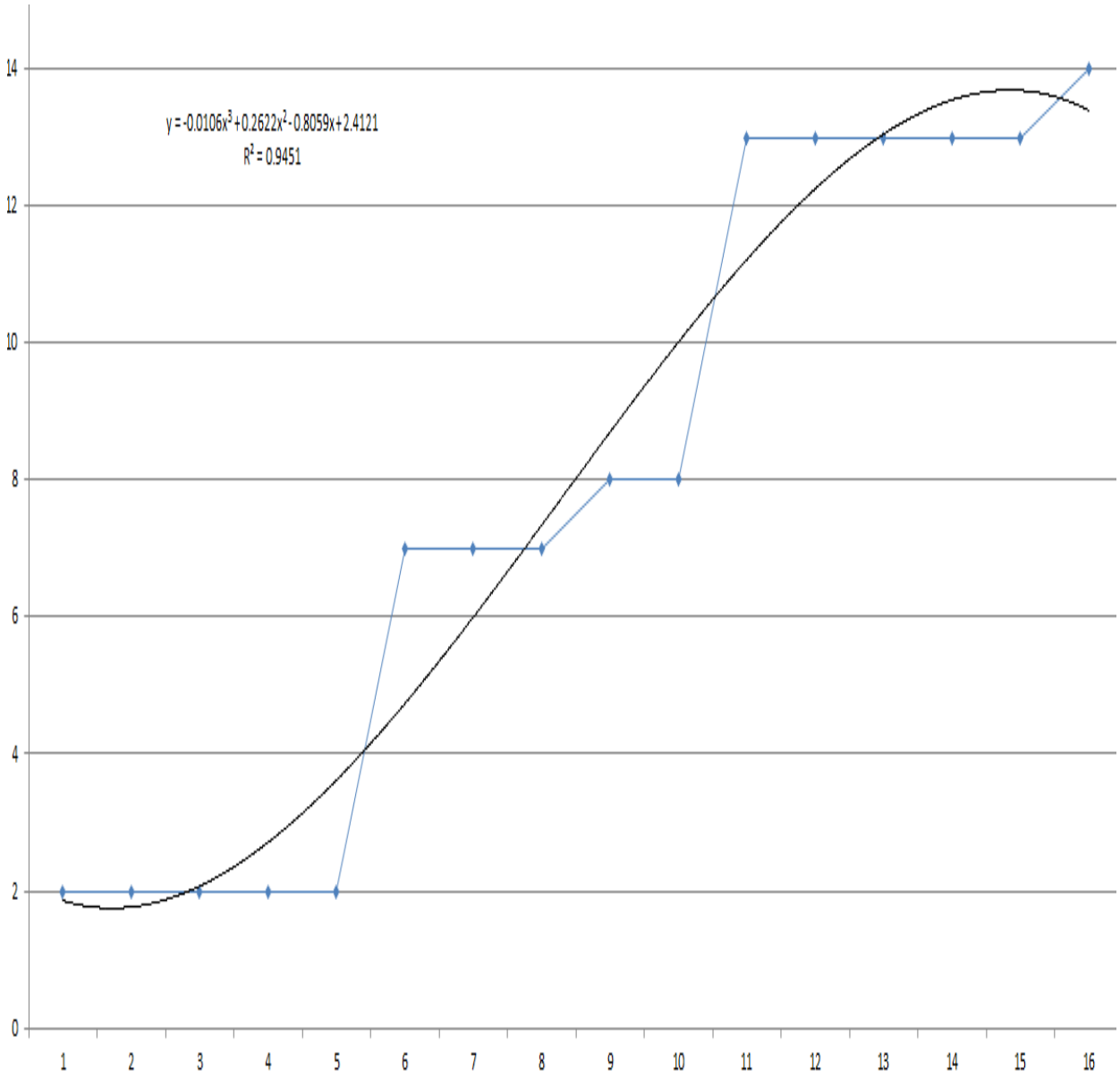


Fig. 7: Polynomial fit of the infusion model for ticket reservation users

Infusion Model for the Use of Vehicle Tracking

Following the results of cumulative sum of the number of users of vehicle tracking users among security agencies in Nigeria, it was observed that the year of infusion was 2001 with 2 initial users. Using equation 1, the number of years from 2001 till 2016 is 16 years which corresponds to the 16 points of the cumulative frequency distribution curve shown in Fig. 8. In Fig. 8, the base year, Y_0 is point x=1 which corresponds to 2 on the y-axis while each consecutive year, Y_x on the x-axis corresponds to the total number of users of vehicle tracking x years after the base year (year of infusion). Using the auto-generated polynomial that forms the best fit for the use of vehicle tracking from the cumulative distribution in table 11, the results showed that the infusion model for the use of vehicle tracking can be represented using a polynomial of degree m=6 as shown in equation 12 which had a coefficient of determination, $R^2 = 0.9975$.

$$S(n) = 0.00004n^6 - 0.002n^5 + 0.032n^4 - 0.23n^3 + 0.81n^3 - 1.27n + 2.64 \quad (12)$$

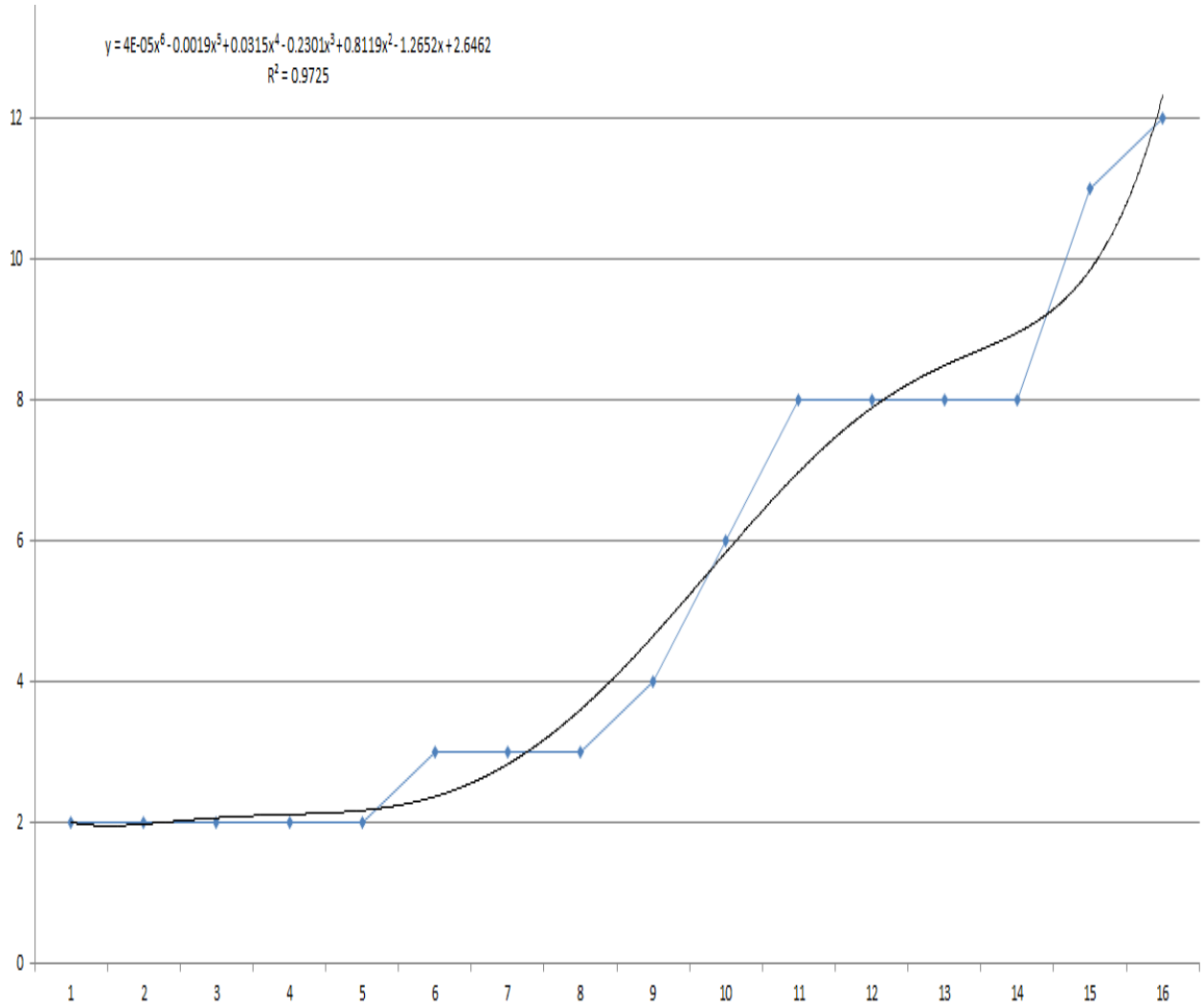


Fig. 8: Polynomial fit of the infusion model for users of vehicle tracking users

Infusion Model for the Use of Point-Of-Sale (POS)

Following the results of cumulative sum of the number of users of POS users among security agencies in Nigeria, it was observed that the year of infusion was 2006 with 3 initial users. Using equation 1, the number of years from 2006 till 2016 is 11 years which corresponds to the 11 points of the cumulative frequency distribution curve shown in Fig. 9. In Fig. 9, the base year, Y_0 is point x=1 which corresponds to 3 on the y-axis while each consecutive year, Y_x on the x-axis corresponds to the total number of users of POS x years after the base year (year of infusion). Using the auto-generated polynomial that forms the best fit for the use of POS from the cumulative distribution in table 11, the results showed that the infusion model for the use of POS can be represented using a polynomial of degree m=4 as shown in equation 13 which had a coefficient of determination, $R^2 = 0.9412$.

$$S(x) = 0.0035x^4 - 0.0435x^3 + 0.1224x^2 + 0.2906x + 2.4242 \quad (13)$$

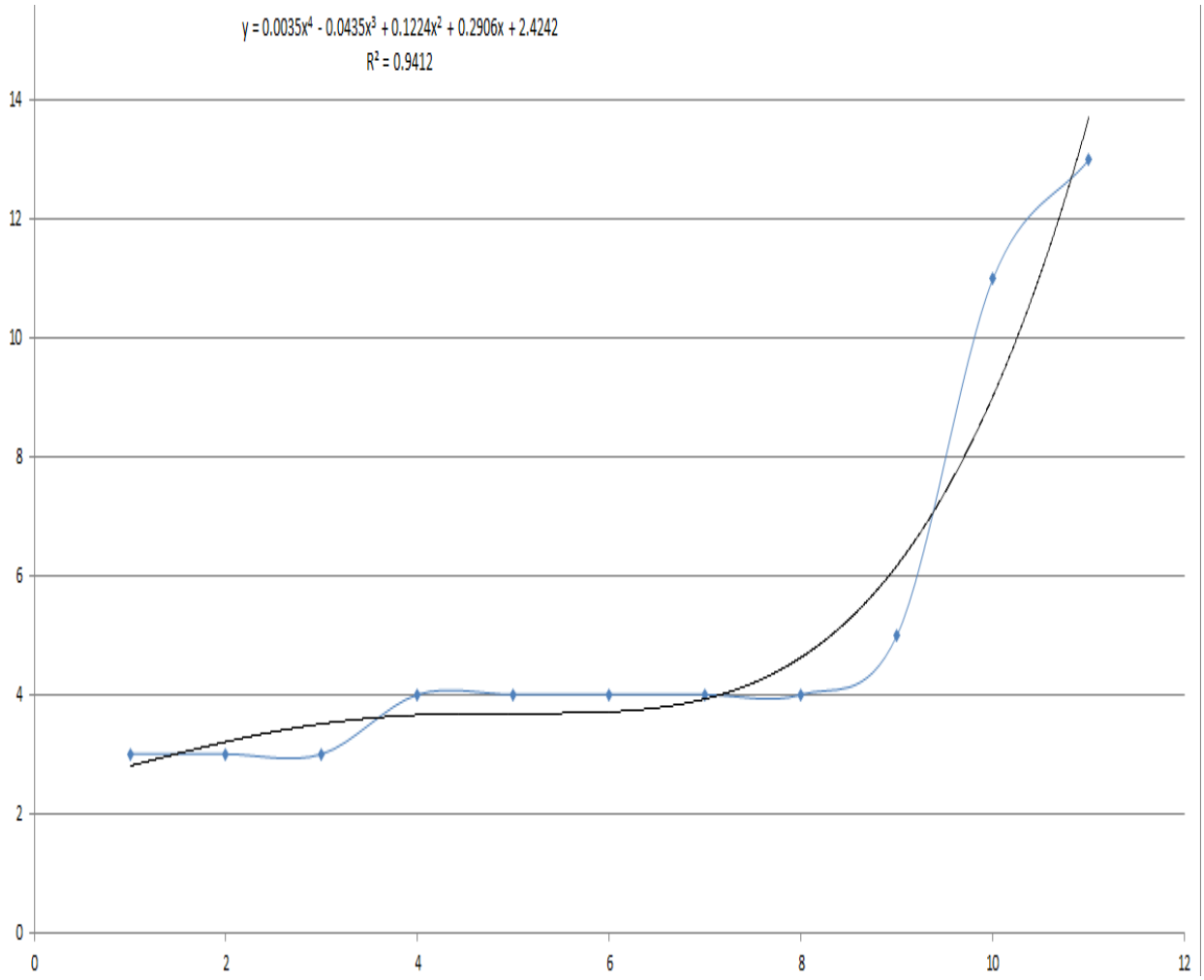


Fig. 9: Polynomial fit of the infusion model for POS users

Infusion Model for the Use of 2-Way Radios

Following the results of cumulative sum of the number of users of 2-way radios users among security agencies in Nigeria, it was observed that the year of infusion was 2006 with 2 initial users. Using equation 1, the number of years from 2006 till 2016 is 11 years which corresponds to the 11 points of the cumulative frequency distribution curve shown in Fig. 10. In Fig. 10, the base year, Y_0 is point x=1 which corresponds to 2 on the y-axis while each consecutive year, Y_x on the x-axis corresponds to the total number of users of 2-way radios x years after the base year (year of infusion). Using the auto-generated polynomial that forms the best fit for the use of 2-way radios from the cumulative distribution in table 6, the results showed that the infusion model for the use of 2-way radio can be represented using a polynomial of degree m=4 as shown in equation 14 which had a coefficient of determination, $R^2 = 0.8667$.

$$S(x) = 0.0035x^4 - 0.0435x^3 + 0.1224x^2 + 0.2906x + 2.4242 \quad (14)$$

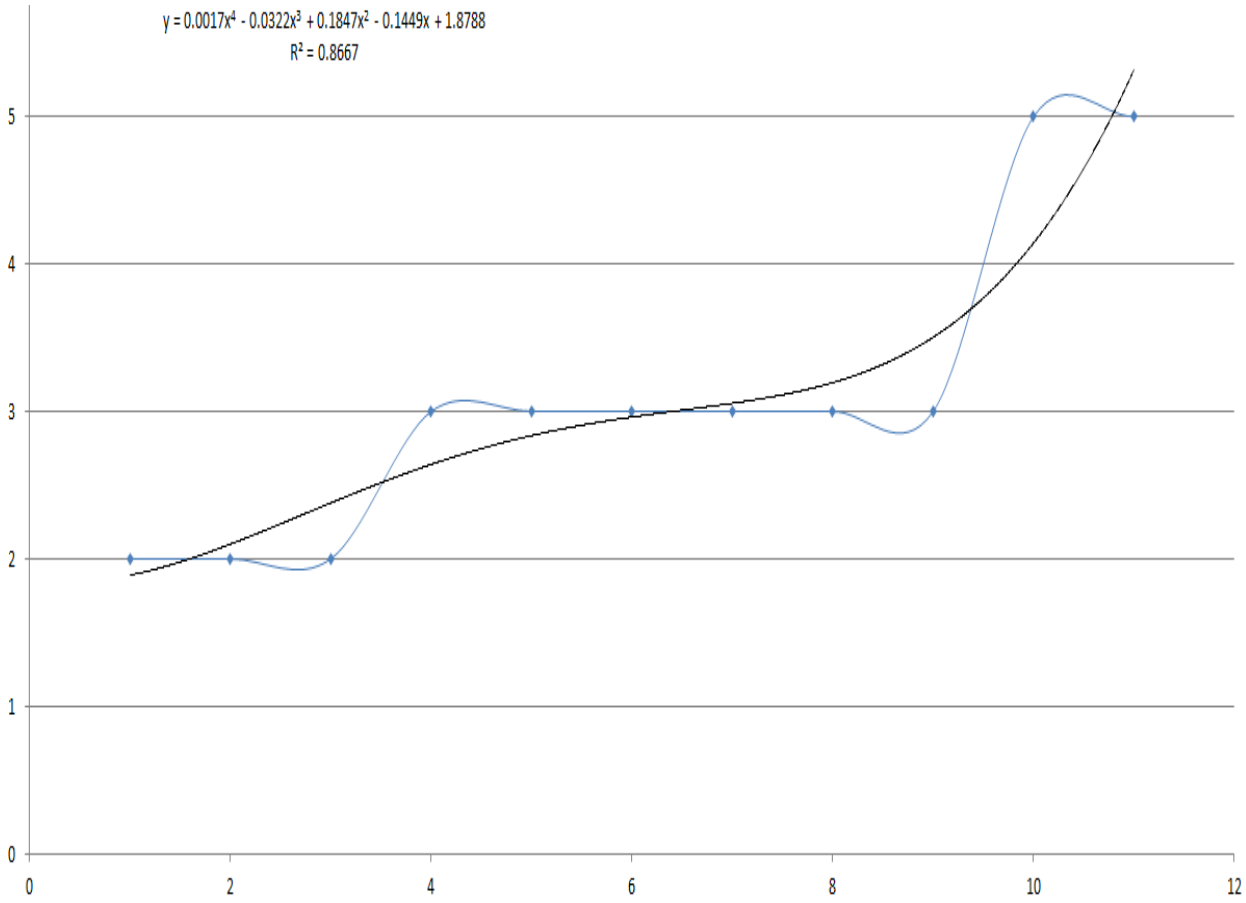


Fig. 10: Polynomial fit of the infusion model for 2-way radio users

6. CONCLUSIONS

This study revealed the infusion of ICT devices used among staffs of the Nigerian transport sector using information collected from 6 private transport companies operating in south-western Nigeria. Based on the findings of this study, the ICT devices identified to be used among the 120 respondents chosen for this study were: smartphones, SMS, e-mails, company website, bulk sms, ticket reservations, vehicle trackers, POS systems and 2-way radio. Following the analysis of the information collected using 100 questionnaires distributed among the respondents selected for this study; a number of observations were made. Majority of the respondents were married Ibo men within the age intervals of 31 – 40 years representing 47% of the respondents. The results also showed that about half the respondents were computer compliant with the same amount of users familiar with computers for 5-10 years. Although, the results showed that respondents from the transport sector were familiar with ICT technologies a number of them had not the opportunity to engage their use in the daily discharge of their duties. This could be as a result of the fact that more drivers were available in the datasets than administrative officers which were mostly done by one administrative individual, the manager.

The results of the study also showed that the earliest ICT tools adopted were: SMS, e-mails, bulk sms, company websites, ticket reservations and vehicle trackers by 2001 while smartphones, POS and 2-way radios were adopted by 2006. The results showed that more people adopted SMS and smartphone use but none of the adopted users were up to 25% of the total number of respondents selected for this study. The results showed that using the infusion model developed using a polynomial expression of a certain degree m in terms of x – the number of years after ICT infusion; the expected number of users adopting the technology can be determined.

References

1. Ashrafi, R., & Murtaza, M. (2008). Use and Impact of ICT on SMEs in Oman. *The Electronic Journal Information Systems Evaluation, 11*(3), 125-138.
2. Bade, D., Mueller, J., & Youd, B. (1999). Technology in the next level of supply chain outsourcing. Leveraging the capabilities of Fourth Party Logistics. *materiale interno Andersen Consulting*.
3. Ekene, E. A. (2014). ICT adoption in logistics operations; An emerging trend for sustainable development and human capacity building in South-Eastern Nigeria. *Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS), 5*(7), 24-28.
4. Idowu, B., Adagunodo, R., & Adedoyin, R. (2006). Information technology infusion model for health sector in a developing country: Nigeria as a case. *Technology and Health Care, 14*(2), 69-77.
5. Irefin, I., Abdul-Azeez, I., & Tijani, A. (2012). An investigative study of the factors affecting the adoption of information and communication technology in small and medium scale enterprises in Nigeria. *Australian Journal of Business and Management Research, 2*(2), 1.
6. Love, P. E., Irani, Z., & Edwards, D. J. (2004). Industry-centric benchmarking of information technology benefits, costs and risks for small-to-medium sized enterprises in construction. *Automation in construction, 13*(4), 507-524.
7. Rockwell, B. (1999). *Seamless Global Logistics and the Internet, presentation given at.* Paper presented at the Electronic Commerce for Freight Transportation Conference.
8. Tilanus, B. (1997). *Information systems in logistics and transportation*: Pergamon London.
9. Van Geenhuizen, M. (2011). ICT applications on the road to sustainable urban transport.