ISSN 2350-1022

International Journal of Recent Research in Mathematics Computer Science and Information Technology
Vol. 3, Issue 2, pp: (12-21), Month: October 2016 – March 2017, Available at: www.paperpublications.org

Adoption of Mobile Computing for Ubiquitous Data Management within Sugar Companies in Kenya

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Abstract: **Mobile Computing provide users with greater opportunity to manage data and access information and services stored on the Internet and central repositories, regardless of users' physical locations and movement behaviours. Field officers in sugar companies spend more than 50% of their time in the field have their appropriateness of mobile computing in their working. However, field operations and services often experience extensive delays or rework due to information that is unavailable, inaccurate or out dated as a result of manual processes thus leading to production inefficiencies. This study proposed to explore the extent of adoption of mobile technologies for ubiquitous Data Management within Sugar Companies in Kenya. This was achieved through determining usability of mobile computing technologies, establishment of utilization of mobile data management, assessing challenges affecting adoption of mobile computing for ubiquitous data management and eventually proposing an optimum strategy for use of mobile computing for ubiquitous data management within sugar companies in Kenya. The study employed largely survey design. The study sample of 325 workers was selected from two sugar factories in Kenya comprising of 240 Extension officers, 2 Strategy managers, 6 Business systems managers and 40 system active users. The study found out that; Network Capability, Security, Data & services Portability and policy formulation ranked top as critical elements in an enterprise mobility framework. The study established that though a majority of workers had knowledge of mobile technology, just slightly above half of them indicated that they do use mobile technology for data management. The study also found out that though most business operations in sugar companies depend on mobile technologies and data management, most of the transactions are undertaken using desktop computers and not mobile devices. However, most workers appreciate mobile technology as effective for data management. It was also found out that management support for mobile computing was not significant. The study further established that mobile computing adoption was hindered in the sugar industry by inadequate technological infrastructure and concerns about security of information. The study developed a framework for adoption of mobile computing for ubiquitous data management in sugar companies in Kenya. This research creates a platform for developers around mobility with ubiquitous computing as the next computing generation to improve on mobile solutions that are geared towards production efficiency in other organizations in Kenya. The developed framework if used can help factories improve on their operational and production efficiency. The findings of the study are also critical for policy makers on enterprise mobility and integration with IT governance.**

Keywords: **Central repository, Information, Internet, Mobile Computing, Pervasive Environment.**

1. INTRODUCTION

Mobile Computing entails human computer interaction by which a computing device is expected to be in mobility during normal usage. It involves mobile communication, mobile hardware, and mobile software. Communication issues include ad hoc and infrastructure networks as well as communication properties, protocols, data formats and concrete technologies. Hardware includes mobile devices or device components. Mobile middleware deals with the characteristics and requirements of mobile applications (Madan, 2013). There are at least three different classes of Mobile Computing

items in a ubiquitous environment namely; portable computers as compacted lightweight units primarily intended as hosts for software that may be parameterized, as PDA, laptops, iPads, notebooks, notepads among others (Cottrell, 2010). The rapid developments in mobile technology and communication offer new options to realise fast and cost effective Data Management and processing using Mobile Computing for processing systems and provide a window for competitive business production processes, (Gartner, 2014). While the world is becoming more technical, the organizations space in developed world have become more mobile yet the third world economies are still stuck with the old generation computing technologies of Desktop PC and server on a wired network. Successful business organizations strive to embrace new ICT opportunities that simultaneously employ real time operations, business activity monitoring and mobility resources to conduct business as well as handle planned and unplanned activities in the work organization using Mobile Computing devices (Umar, 2005). Data Management plays a major role for future adoption of Mobile Computing in processing systems (John Wiley & sons 2008). Most sugar processing systems in companies are much less productive and profitable than they could be by not adopting Mobile Computing technology solutions (Sawant & Y, 2012). The reasons probably being lack of exposure and awareness to underlying opportunities and the inability to bear risks. Another major contribution could be the information and skills gap that constrains the adoption of available Mobile Computing technologies and management practices, or reduces their technical efficiency when adopted (World Bank, 2007). Field extension services and operations are often undermined to some extent, yet they are the fundamental backbone to an effective supply chain for the e-business success. The study surveys on the impact of adoption of Mobile Computing and ICT in the professional work context of sugar industries Data Management practice. Sugar processing operations are the kind of field based work environments that can be considered as a prime application area of mobility enabling ICT for business purposes. Field based work practice is also a challenge when it comes to designing useful and accepted ICT support systems. ICT use is increasingly becoming a considerable element of these work contexts, but is often perceived by practitioners as something that is not a part of their 'real work' such as coordinating and supervising activities in the field. The complex and sometimes conflicting relationship between ICT use and field based work practice is one of the central analytical aspects of this study.

Purpose of the Study:

The purpose of this study was to explore on adoption of mobile technologies for ubiquitous Data Management in Sugar Companies in Kenya.

2. LITERATURE REVIEW

MOBILE COMPUTING:

It is an advanced computing concept where computing is made to appear everywhere and anywhere. In contrast to desktop computing, ubiquitous computing can occur using any mobile device in any location and in any format as appropriately configured. A user interacts with the computing device which can be; laptop, tablet, terminals, PDAs, Ipads, smart phones among others. This is a new paradigm also referred to as pervasive computing, nomadic computing or ambient intelligence (Poslad, 2009).From common literature, Mobile Computing is a concept that concerns; display, collect, and transfer information from a mobile device to an information system using one or a combination of various data transfer methods. The term "Mobile Computing" is used to describe the use of computing devices which usually interact in some fashion with a central information system while away from the normal, fixed workplace. Mobile Computing technology enables the mobile worker to; create, access, process, store and communicate information without being constrained to a single location. Burley, L., and Fisher, (2005) in their research asserts that Mobile Computing refers to technologies that employ small portable devices and wireless communication networks that allow user mobility by providing access to data "anytime, anywhere". An instance of Mobile Computing technology is Personal Digital Assistants (PDA). From the Latin language, mobilis means "to move", "able to move freely or easily", "able to move freely or easily between occupations, places of work and social classes". In recent years Computer and Communication technologies have been developing fast. Using computers and accessing network information resources have become a necessary part of our daily work and daily life. There are numerous computers around the world that are connected by various kinds of networks. There are numerous applications that allow people to do almost everything they want. But, this situation is mostly restricted to users at fixed locations with static desktop computers and static wired networks. There is still a lot of time we are mobile moving among offices, homes, planes, trains, automobiles, conference rooms, classrooms and such. There is need to access computing resources not only when stationary but also while mobile or in transit (Obaidat, 2011). As technology

improves in the area of wireless facilities and mobile computers, Mobile Computing has become feasible (Thomas Phan, 2010). As of today, a variety of advanced mobile devices, some mobile wireless systems and Mobile Computing applications exist already. For example, people can send and receive emails and access Internet web sites using mobile computers via wireless networks. The future trend of telecommunication is to extend the telecom and computing services to mobile users, to break the restriction of user locations, to allow people access to computing resources anywhere and anytime. However, this is not a trivial task. Compared to static systems, Mobile Computing systems are constrained in important ways. These constraints are intrinsic to mobility, and are not just artefacts of current technology (Indulska, 2008). Mobile elements are resource-poor relative to static elements. Wireless links have low bandwidth and are unstable. Mobile elements must operate under a much broader range of networking conditions. The nature of wireless communication media and the mobility of computers combine to create fundamental new problems in networking, operating systems, and information systems (Lyons, 2011). Mobile Computing is still at its early stage. In recent years there has been a lot of research in the Mobile Computing area. It has still a long way to go to reach the goal of connecting anywhere and anytime. Nevertheless, one of the central anticipated contributions of mobile and wireless ICT for business purposes is to facilitate an extension of an organization's existing ICT systems infrastructure into the hands of remote and distributed personnel, enabling a virtual office for mobile workforces to access more or less at anytime and anyplace (Barnes, 2003). The 'mobile work model' (Barnes, 2004) can be used to map out the opportunities of Mobile Computing for different requirements of work organizations, shown in the figure below as a motivation of adoption of Mobile Computing devices for Data Management.

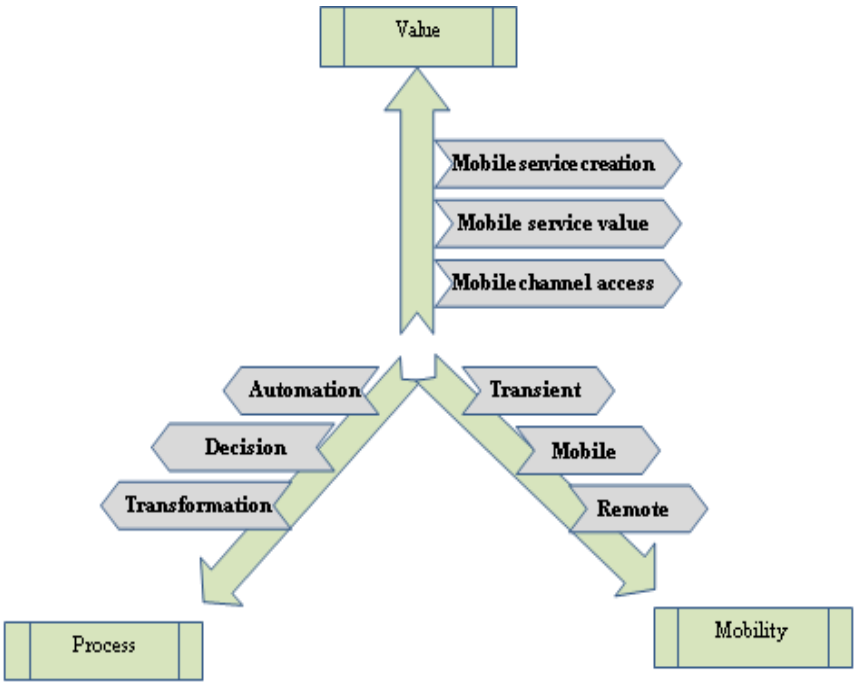

Figure 1.0: The mobile work model (Barnes, 2004)

The mobile work model and its three axes of mobility, process and value can be used to schematically position an organization's work mobility and how Mobile Computing technology possibly could enable changes in work processes and create value for a firm together with its associated partner organizations. The lowest level of work mobility is 'transient', describing people who basically are geographically tied to the locations between which they move. The second level is 'mobile', where people have higher geographic independence from the enterprise, regularly for prolonged periods of time, but commonly return to some home base to perform certain actions. Finally, the highest level of work mobility is 'remote'. At this level, employees of an organization are almost completely independent of a certain location or home base. The initial level of process change that may be enabled by Mobile Computing technology is 'automation', which refers to efficiency gains in existing processes through access of ICT resources via wirelessly connected Mobile Computing devices. Further improvements can include 'decision support', which brings a higher degree of effectiveness through the development and use of new Mobile Computing applications for specific work purposes. Islam (2011) carried

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out a study on the adoption of mobile devices among farmers in rural areas of Bangladesh and came up with his findings as in Fig. 3 that exhibits the sources of awareness prior to subscribing to mobile services, which clearly points to a strong social influence. Although the choices of handsets and operators are distinct to each other, they are typically marketed together and often purchased at the same time.

Table 1.0: Sources of awareness prior to subscription of devices

Category	Responses	Rate of responses (N= 210, Year 2009)
Social norms	Community use	65%
Reasons of choosing the brand of handsets (not mutually exclusive)	Human influence(friends, relatives, neighbours and other early adaptors)	75%
	Media influence (Radio, TV and newspapers)	32%
Reasons of choosing the operators (not mutually exclusive)	Human influence(friends, relatives, neighbours and other early adaptors)	58%
	Media influence (Radio, TV and newspapers)	53%

Source: Islam, 2011

3. RESEARCH METHODOLOGY

This study employed descriptive research design to achieve the stated objectives. The research design was chosen because it helpful to determine and report on the way things are in the Sugar Companies on Mobile Computing, describe behaviour, attitudes, opinions, values, perception and characteristics as accurately as possible regarding people's perceptions on Mobile Computing adoption. It seeks to identify the nature of Mobile Computing Data Management approaches and socio technical factors involved, determine the degree in which they exist and discover the link that exists between them. This research was designed to take into account the adoption of Mobile Computing devices for Data Management in sugar industries in order to construct a framework for its adoption to improve on the quality of Data Management. The researcher used both descriptive methods by use of means, percentages & standard deviation and frequencies to achieve the objectives of study.

4. DATA ANALYSIS AND PRESENTATION

Level of education of respondents:

This analysis shows the distribution of highest level of education for the respondents

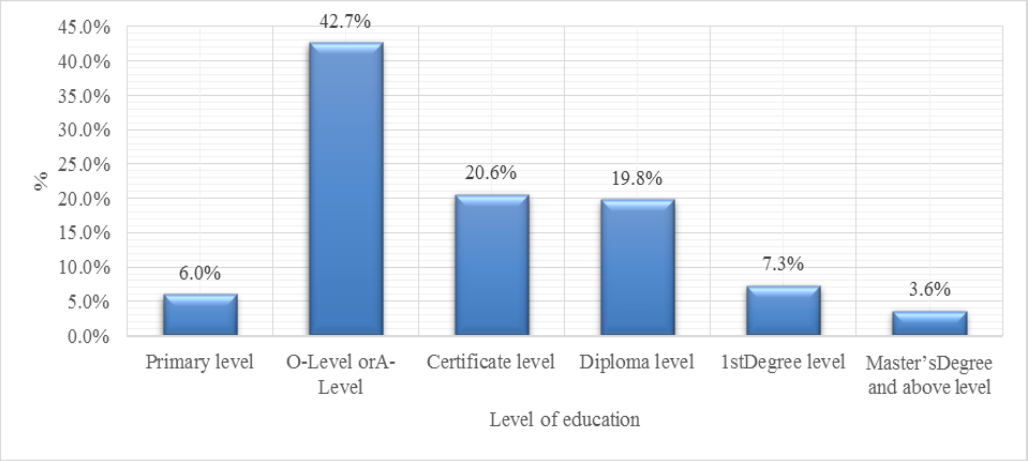

Figure 1.1: Level of education

From the figure 4.4 the research found that most of the respondents had 'O' Level as the highest level of education with 47.7%, followed by certificate and diploma levels at 20.5% and 19.8% respectively,1st degree level had 7.3%. Masters level holders were the least at 1.6%. Combined with interview, it was realized that most employees join the organizations with O-level education as corporate social responsibility of creating employment. The level of education among workers

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is sufficient to have knowledge and understanding of mobile computing as a key factor that can influence adoption considering the digital divide. According to Czaja (1999), the respondents appear to be learnable and capable of adopting to technological change.

Mobile computing technologies being used for data management:

The study targeted workers who use mobile devices for data management in their areas of work, the extent of use and whether there is an integration interface with any business enterprise system. The results are as show in Table 1.1.

Table 1.1: Mobile computing technologies being used for data management

Mobile Computing Technologies Being Used For Data Management.	Disagree	Agree	unknown
Heard about mobile technology for Data Management	3.85	90.66	5.49
Mobile technology is being used for Data Management	23.08	76.92	0.00
Mobile technology is being utilized for Data Management	25.82	63.19	10.99
My mobile device is installed with an enterprise application	25.82	67.57	6.61
My mobile device is used for Data Management of enterprise system	23.08	73.71	3.21
My department /section rely much on mobile technology for Data Management.	56.98	39.01	4.01

These results shows that majority of the workers at 90.66% have knowledge of mobile data management, 76.92% have used mobile devices for data management with 63.19 agreeing that they use the mobile technology for data management. However, over half of the respondents at 56.98 confirms that mobile technology is not the most relied on for data management, meaning that mobile technology is integrated with Enterprise system as shown by the response on mobile device is installed with an enterprise application at 63.19%. It is then likely that most organizations are slowly accepting the technology and adopting it gradually. See the distribution of responses in graphical form in figure 1.2

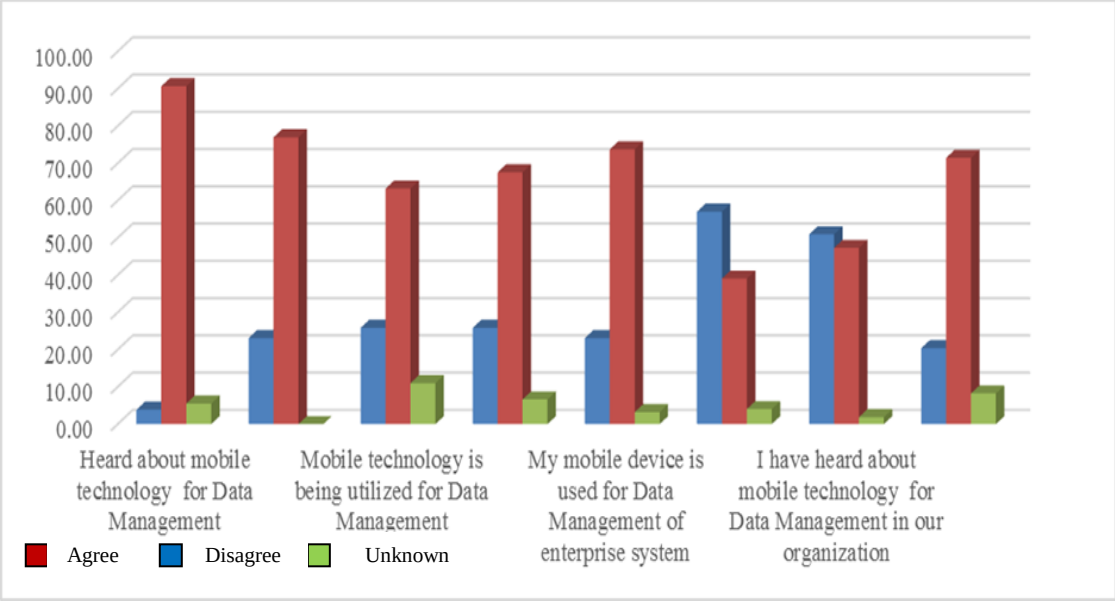

Figure 1.2: Mobile computing technologies being used for data management

The study sought to establish if in the two companies had heard about mobile technology for Data Management, 25.82% of the respondents disagreed, majority with 63.19% agreed while 10.99% had no response. It also sought to know for the two companies if mobile device is installed with an enterprise application, majority with 67.57% agreed, 25.82% disagreed while 6.61% had no response. When respondents were asked if the department /section rely much on mobile technology for Data Management, 73.71% agreed, 23.08% disagreed and 3.21% had no response. In addition, when they were asked if they have heard about mobile technology for Data Management, 47.25% agreed, closely followed by 50.9% disagreeing while 1.85% had no response. Furthermore on asking if Mobile technology is being used for Data Management, 71.43% agreed. 20.35% disagreed and 8.22% had no response.

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Utilization of Mobile Devices for Data Management:

This table shows a distribution of response on specific aspects on the utilization of mobile devices in the organizations under study.

Table 1.2: Utilization of Mobile Devices for Data Management

Utilization of mobile devices for data management	Disagree	Agree	unknown
Almost 70% of my work depends on mobile technologies and Data Management	25.80	74.18	0.02
I execute my duties and obligations on Data Management without mobile technologies but basically with my Computer	12.64	87.36	0.00
Without mobile technologies, Data Management on all the field operations will be affected and transaction processing delayed	6.59	93.41	0.00
If I had an opportunity to utilize Mobile Devices for Data Management, It would ease my field data processing operations	8.79	91.21	0.00
Mobile Technology is not effective for field-based Data Management in sugar Companies	88.46	11.54	0.00
Mobile technologies improves on operational productivity by offering an environment that is collaborative, accessible and integrated with the world beyond the boundaries of sugar Companies	11.54	82.97	5.49
Sugar Companies should consider Smart phones and mobile devices like PDAs compatible with its field operations and adopt Mobile Computing and Data Management.	0.00	97.90	2.10
In general, I am hesitant to try mobile technology innovation	68.68	12.64	18.68
I would like to use mobile technology as the current technology trending from web technology but I think it is too costly to implement	34.07	65.93	0.00
All users share the central database for access and update	0.00	97.16	2.84

Challenges in adoption of mobile computing for ubiquitous data management in sugar companies:

Ubiquitous computing is pervasive operation also known as “anytime anywhere” computing. The study intended to assess the underlying challenges that may be affecting adoption of mobile computing in sugar company organizations.

	Disagree	Agree	unknown
Investment cost is a barrier to provision of Mobile Computing technologies for Data Management	8.79	88.46	2.75
Usability of the Mobile Technologies for Data Management affects their uptake and usage in sugar Companies	6.59	93.41	0.00
Technology changes and Reliability of solution providers among others are barriers for adoption of Mobile Computing in our company Network Constraints	15.38	65.38	19.23
In our company , mobile technologies for Data Management are frequently maintained (weekly/monthly)	76.92	1.10	21.98
There is frequent break down of mobile technologies for Data Management and frequently interrupts field operations in our company	74.18	6.59	19.23
The company has enough technical support to attend to any complication that arises in the mobile technologies and Data Management systems	54.40	34.62	10.99
The company has enough infrastructures to support the adoption of Mobile Computing for Data Management.	76.92	1.10	21.98
The rate of adoption of mobile computing for data management within our company is very slow according to rating	10.80	82.44	6.86
Employees have negative attitude towards uptake of Mobile Technologies	79.66	3.60	16.74

From the research results, an average of 45% disagree with the outlined factors as likely challenges of adoption of mobile computing. However, an average of 42% agree to the factors with the highly rated factors being; Investment cost being a barrier to provision of Mobile Computing technologies for Data Management at 88.46%, Usability of the Mobile Technologies for Data Management affects uptake and usage of mobile computing in sugar Companies at 93.41% and The rate of adoption of mobile computing for data management within sugar companies was slow according to a rating of 82.44%. From the results, it's also evident that mobile devices are not frequently maintained thus less maintenance costs with the rating of 74.18%, a factor that should motivate adoption and that Infrastructure is a major deterrent to the adoption of Mobile computing in sugar companies at a rating of 76.92% an implication of inadequate infrastructure to support the adoption of Mobile Computing for Data Management thus a limitation to spur mobile computing uptake. Discuss the finding above

Preparedness to adopt Mobile Computing for field-based Data Management:

Out of the 182 respondent's questionnaires 32 ICT staff responded, this gives a 17.58% the chart in figure 1.3 shows the representation of ICT staffs and other respondents.

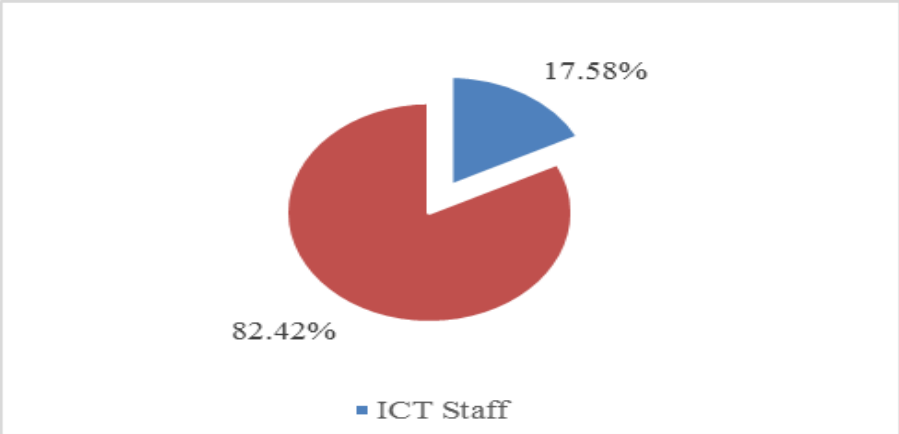

Figure 1.3 : ICT Staff Response

Mobile computing is applicable to various usage functions in a business enterprise. The study also focused on a few areas of enterprise mobility drawn from the questionnaire as to whether they are critical or not important.

Table 1.3: ICT staff response

	Critical	Important	Not Important	Unknown
ERP Applications Access	68.4	13.2	2.6	15.8
Collaboration Framework	78.9	16.6	1.9	2.6
Personal or Business service	57.9	24.6	0	17.5
Business Intelligence	68.4	22.6	2.6	6.4
Mobile payments	68.9	21.8	0	9.3
Mobile data processing/transmission	98.7	1.3	0	0
Mobile Data Management and storage	90.5	4.1	2.6	2.8
E-mail and Intranet	63.4	12	4.8	19.8
CRM Applications access	48.4	32.8	8.6	10.2
Cloud based applications	55.6	16.9	4.7	22.8
Average	69.91	16.59	2.78	10.72

Type of Back-end systems that are likely to drive the mobile application:

The respondents were also asked if in the event that your organization adopts/adopted Mobile Computing, which back-end systems are likely to drive the mobile applications, it was revealed that Existing enterprise applications and Services, Public cloud-based (SaaS) applications and Private cloud-based (SaaS) applications had a definite response with an average of 46.4%

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary of Findings:

From the study, it was revealed that employee competency, inadequate legal framework, inadequate technological infrastructure and security of Information Technology Practice transaction data were a challenge to Mobile Computing adoption in the organizations under review.

Bigger percentage ratings with 73% of the respondents were of the ages' between18 and 49 years. This age bracket is known to be more receptive towards technology acceptance and enhancement (Czaja, 1999). This implies that their responses are bound to lead to development of a framework with a high potential for adoption and acceptance of mobile technology in sugar companies.

Most sugar companies have experienced workers with knowledge that can spur adoption of mobility innovation with a rating of 81.3% having more than 5 years of experience. This implies that a likely larger population of the workforce could have a wider understanding of the organizational business processes with possible solutions for the future which could be necessary for informed innovations.

The study found out that most of the business operations in sugar companies depend on mobile technologies and Data Management with a rating of 74.18% and that besides mobile technologies most of the transactions are done using the desktop computer with 87.36% rating. This implies that about 12.64% of workers utilize mobile technologies for data management.

Further to the research results 93.41% of the workers opinion implies that most field operations rely on mobile technologies for ubiquitous data management. The agreement is in line with the use of PDA for field operation. In addition, 91.21% agreed that mobile computing technologies would ease field operations

The research found out that majority of the workers appreciates Mobile Technology as being effective for field-based Data Management in sugar Companies with a rating of 88.46%. This is a resounding response to applaud the use of mobile devices that integrate with Agriculture Management system (AMS) within the target organizations.

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