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Pervasive Computing in Sugar Industry

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***Abstract*: In the last decade, we have had several computing technology applications in the IT industry out of which Pervasive or Persistent computing has proved to be an enabler for everyday objects to become smarter and interactive in ubiquitous environment.Pervasive computing promises to revolutionize the way of doing things on field operations context in agriculture with regard to managing data using mobile technologies. There are however challenges facing adoption of mobile computing for ubiquitous data management computing technique as well as proposition ways to solve the challenges and abundant computing on basis of cloud computing. The research proposes new innovations based on pervasive computing, its interactions in agro-industrytechnology and its future.This paper proposes a Sugar Enterprise Mobility Framework (SEMF) to embrace adoption of mobile computing in sugar companies.**

***Keywords:* Pervasive Computing, Ubiquitous DataKeywords: Pervasive Computing, Abundant Computing, cloud, challenges.**

1. INTRODUCTION

There are various technology applications in IT Industry such ashuman computing, Autonomic computing, mobile computing, Cloud computing, Green computing, Grid computing, Supercomputing, Parallel computing among others., out of which Pervasive computing has proved to be an enabler for everyday objects to become smarter and interactive in ubiquitous environment offering control with interactive service such as refrigerators that can create grocery lists, dispensers, buildings that can adjust temperature and light according to the weather, animal feeding monitoring, power management and control just to mention but a few. Pervasive computing therefore promises to revolutionize the way of doing things on field operations context in agriculture setup with regard to managing data using mobile technologies and enhance human interaction in field-based operations. .

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 devices 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). In Kenya's sugar sector, Mobile Computing is of negligible effect as being adapted in their IT innovations and thus this study may motivate the technology adoption.

Organizations are increasingly assuming smart environments. These include Smart grids, Smart power systems, Smart housing, Smart transportation systems like in the case sugar haulage, Smart retail store such as sugar warehouses and retail outlets etc. Smart environments collect sensor data from the real world, which comes from multiple integrated sensors, which are distributed across positions which would help pervasive computing platform to become much attractive and usable. The emerging technology around Cloud computing is a booster towards taking the ubiquitous computing to the next frontier with capability to offer computing power anywhere, at any time and on any device. Cloud computing has advantages such as lower costs, faster time to market, high degree of elasticity, unlimited organization

growth capability and low incremental cost. Creating a cloud based system for communication of all sensors for field-based operations would make field officers more productive; utilize less time on data processing, minimize delays, and helps to create a smart environment with smart results for easy decision making.

The first objective of the study is to understand about pervasive computing and to analyse the challenges posed for adoption of mobile computing in agro-industry for ubiquitous data management. The second objective of the study is to find out the huddles faced by pervasive computing and proposed ways to solve it.

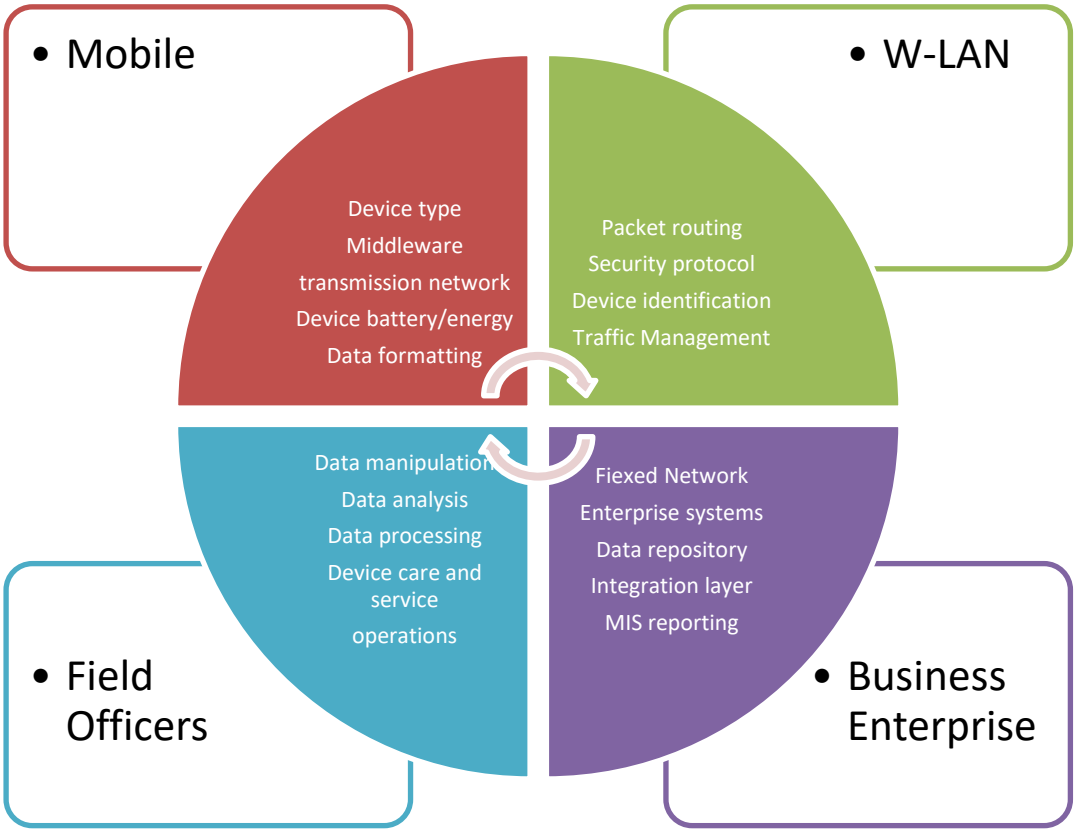

Figure 1.0 Pervasive Computing Framework

2. FIELD-BASED PERVASIVE COMPUTING

The Framework can be developed by a commercial Java and HTML5-based environment for building and extending enterprise-applications. Based on a hybrid mobile architecture, HTML5 provides common, cross-platform interfaces. Java, the world's most popular programming language, is used to develop the application logic. Applications are installed on-device, and offer access to native device services such as the camera, contacts, SMS, RFID, USSD and GPS. Offline application use is supported with the added persistence and security of encryption in a SQLite database. Overall, the development should be designed for security and protection of enterprise investments from future technology shifts. Leveraging Java and HTML5, the framework design enables developers to easily build and extend enterprise applications for iOS and Android platforms from a single code base.

Developers do not need to learn a new platform-specific language. They can build mobile apps once and deploy them to multiple operating systems with support for various form factors such as PDAs, smartphones and tablets. Given the popularity and flexibility of Java and HTML5, this framework setup empowers enterprises to leverage their existing developer skill sets. Anyone with Java skills can readily build mobile applications. The Oracle Mobile Platform for example works with popular native, open-source and third party frameworks, just as it works with Oracle Mobile Application Framework.

2.1 Ubiquitous Computing Architecture

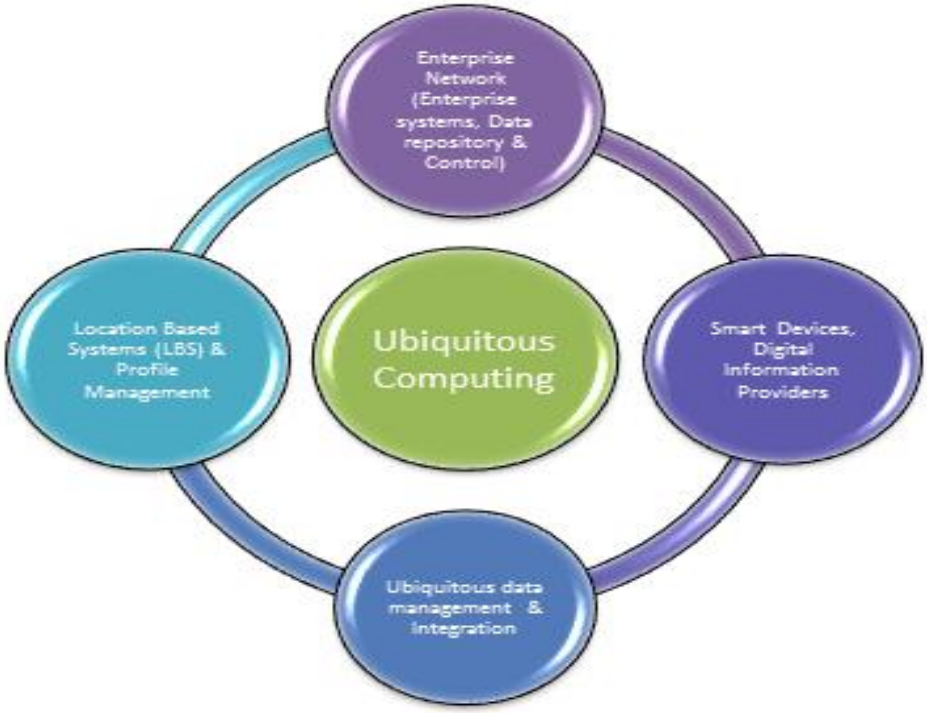

Figure 1.1 Ubiquitous Computing architecture

The growing trend is tending towards embedding microprocessors in the regularly used system objects for purposes of managing information and transmitting. Also called "ubicomp", it applies to software engineering and computer science where computing is made to appear anytime and everywhere making location a non-issue during processing. It's based on this concept that ubiquitous computing is ideal for field-based operations like in sugar companies in Kenya.

2.2 Usability of Mobile Computing technology:

With mobile handsets being used in nearly every country and community, the development of applications for them offers uses that extend well beyond voice and text communications. Mobile applications for Field-Based Operations and rural development are in development to enable pervasive Data Management. Mobile Computing devices, such as smartphones and tablets, proliferate in today's corporate environments (Alshehri, 2012). While there are significant opportunities to leverage these devices to increase the effectiveness of field-based operations for mobile workers, there are also significant concerns about corporate Data Management and improved productivity strategies using mobile devices that IT must handle.

In the context of Mobile Computing in third world countries, the uptake of mobile devices is so rapid but limited to the scope of use basically routine communication by voice call, SMS and e-mail. Mobility implies portability. Mobile Computing is based on the fact that users carry a mobile device with them and can initiate a real-time contact with other systems from wherever they happen to be if they can connect to a wireless network (Imran, 2013). Broad reach computing environment requires that the Mobile Computing people can be reached at any time. When users carry an open mobile device, they can be reached instantly from their location. These two characteristics, mobility and broad reach, create five value-added attributes that break the barriers of topology and time: ubiquity, convenience, instant connectivity, personalization, and localization of products and services. A mobile terminal can fill the need for real-time information and communication, independent of the user's location (ubiquity) (Imran, 2013). This concept appears far from thought by organizations in Kenya especially in sugar industries where mobility is a key fact to improve on field –based operations' Data Management. The underlying literature explores the Mobile Computing devices useful for Data Management in a pervasive environment.

2.3 Utilization of Mobile Computing for Ubiquitous Data Management:

To fully enable the great potential of all services for context-awareness of data, broadly defined as the ability to provide services with full awareness of current execution environment, is widely recognized as one of the cornerstones to build modern mobile and ubiquitous systems (Bolchini, 2006). Data Management solutions in ubiquitous environments have been continuously evolving during the last 10 years in developed countries and somewhat slow in third world economies to answer users' needs and face new technology challenges (Sacramento, 2010). To support problem solutions for Data Management, ontologies have been used as a support for the techniques of managing data. For instance, ontologies may be used to describe the semantics of data at different sources, helping to overcome problems of semantic interoperability and data heterogeneity, and thus assisting schema integration and query answering over the distributed data sources.

2.4 Challenges in adoption of mobile computing for ubiquitous data management:

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. The responses drawn from the study are as shown in table 1.1.

Table 1.1 challenges in adoption of mobile computing for ubiquitous data

.	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, its 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 deterent 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.

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Migration to Pervasive Systems

During migration of data to pervasive systems, data is Vulnerable to attacks such as one might expect when communicating data: Rejection of service of data transmitted over the channel, Data manipulation and eavesdropping. One solution is to use multi-homed devices. It does not prevent an attacker from preventing the user from accessing needed data, but it can greatly increase the cost. The attacker either has to launch the DoS attack closer in the network to the cloud (which likely has greater bandwidth and other resources) or the attacker must launch an attack on the entire communication channel that the pervasive system can use to contact the cloud service.

3. NETWORK BASED PERVASIVE COMPUTING

Sensor networks include a network of nodes that can sense and may control the environment therefore allowing interaction between people or computers and the adjacent environment. The building blocks of the things used to communicate nature of objects and things are, adjustable sensor networks comprising of radio tags which are context-aware, can sense, monitor and report events. Sensor networks are wireless, self-powering, walkable as well as self-organizing.Improved decision making through greater information flow from distributed locations using sensor networks, better observing and improved decision making through enhanced information flow from circulated locations using sensor networks are some of the key enterprise challenges and opportunities after leveraging intelligent technologies.

a. FLIP SIDES:

People, in this modern world are more concerned about the technical improvements that would help them to decrease their physical work and increase mental work. Think of a condition when a man is very tired coming from his job or a man had a leg injury and was made to sit on his sofa. If there is any other person in the house, the man wouldn't have to move for any work. But if no one is there to support and washing machine is on! Car door was not locked! TV remote is far! Also, using separate remotes for different things would take in more E-waste because of using separate batteries for each remotes, separate sensors for each remote etc., are some of the present scenario flip sides.To stunned these situations, we are going to create a smart environment, that would help people in reducing man power, e-waste, money waste and time.

3.1 Smart Environment –Ubiquitous Computing Stack:

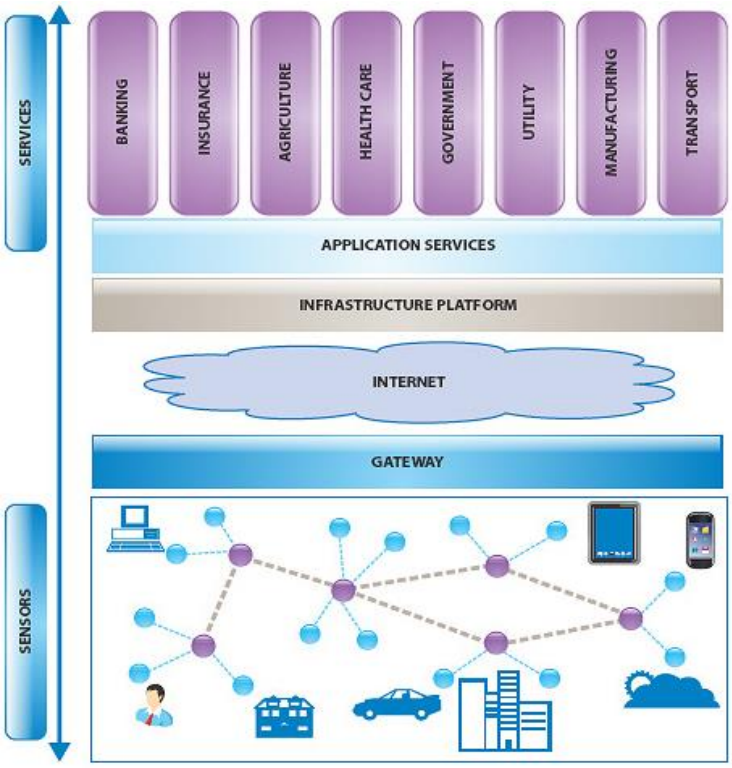

Figure 1.2: Ubiquitous computing stack model

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As abundant computing is one person to many computers, the same methodology is used in creating this smart network. The idea of this origination is to reduce the human efforts. This concept implements a remote television that access like a mobile with services of notification like a normal android mobile.

The person's mobile phone is the main computer, which connects with all the sensors inside the system.We have to connect every sensor in the machines and relationthem with each other. We are keeping two major source points in this smart network. First is mobile phone and second is television.

By this Smart system we could create anattractive atmosphere where in the real world objects can be brought into the scientific world that would help to connect science and humans with common understandings. This method would help disabled persons to know the status of machines running around them through their mobiles. A deaf person could not hear the sound of alarm that rings after washing machine gets over. Thus by keeping in vibration mode, he could get the notification in his mobile. Also when the person is watching television without audio also, he can see the notice in television. The following are some of the key excellence benefits of using smart networks:

- ✓ Decrease human work
- ✓ Reduce time and money ingesting
- ✓ Accurate and protected
- ✓ Reduce e-waste
- ✓ Help restricted

4. CONCLUSION ON UBIQUITOUS COMPUTING

Mobility brings in new dimension to the existing solutions to the problems in distributed data environments. This study identified the key adoption factors for mobile computing technologies at private sector organizations. I have proposed a comprehensive research Framework based on the Technology-Organization-Environment framework, Diffusion of Innovation theory, and Institutional theory. In contrast to a vast body of literature on individual technology adoption, to date, there has been limited research on the organizational technology adoption, specifically smartphones and PDA's for ubiquitous data management in Agribusiness pervasive operations, although these services have recently experienced significant growth.

The study concludes that adoption of mobile computing strategies affected profitability of the companies positively. Further, the companies employed market innovations such as environmental analysis and response to change and aggressive anti-competitors marketing campaigns that greatly improved their profitability and productivity with mobile portal with Customer Relationship Management (CRM).

The study also concludes that inadequate technological infrastructure has been a major hindrance to Mobile Computing adoption in Kenya's sugar sector especially on grower data management. Technological infrastructure plays a key role in adoption of Mobile Computing without which integration of public Information Technology Practice entities not materialize.

Finally, Security of Information Technology Practice Transaction Data is also a major factor inhibiting the adoption of Mobile Computing by the public sector. Individual end users and entire business units naturally resist any change in business processes that poses uncertainty in security and privacy of their transactions. Organizations keep their business information secret as a protective mechanism to ward off competition and remain competitive in the business environment. Public sector organizations on the other have limits to the amount and nature of information to be shared with other third parties. The balance between transparency, protection against unauthorized data disclosure, ensuring the authenticity of a data source and the impact of disclosure of Information Technology Practice process remains hazy.

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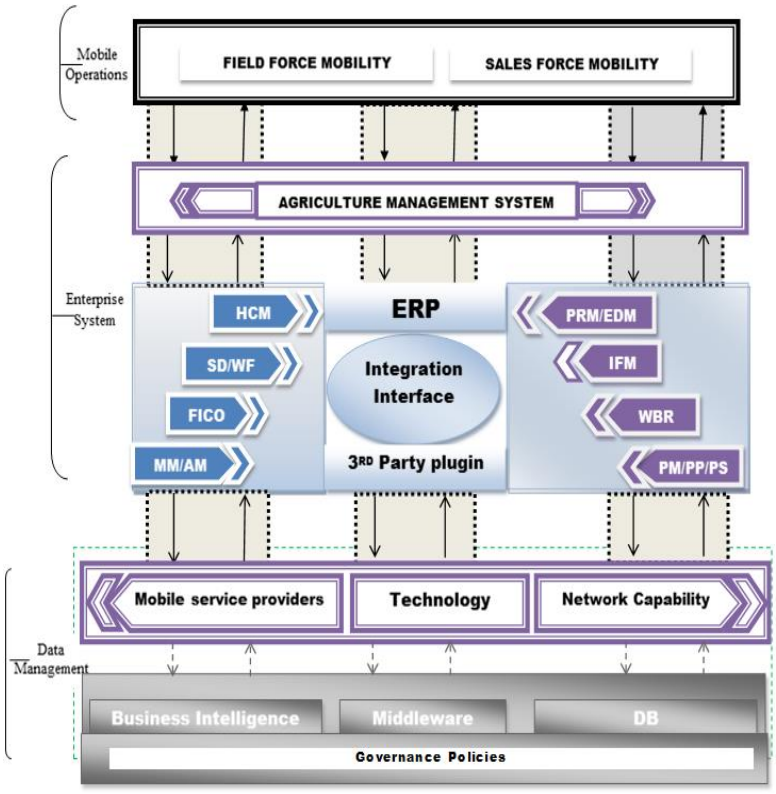

Figure 1.3: Sugar Enterprise Mobility Framework in Kenya (SEMFIK)

Sharma (2008) suggests a long-term mobile services platform with a decentralized framework, adding modules on-demand through Software-as-a-Service architecture based on SOA principles. This approach was adopted to model a framework that can minimize complex integration and accelerate deployment of Enterprise Mobility considering carrier and operating system independence.

5. RECOMMENDATION

The study recommends that the regulator in the telecommunication sector should create an enabling environment that will enhance technology innovations in the sugar sector in order to realize the full benefits of enterprise mobility for data management.

The study also recommends that for all the sugar companies to realize higher performance, increase number of customers, sustain and build confidence of farmers, for their business to grow further and also for them to invest more they should embrace the adoption of mobile computing for ubiquitous data management

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