Implementing Personnel Management System as SaaS

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ABSTRACT
Cloud computing is where software applications, data storage and processing capacity are accessed via the internet. This paper involves with analysis of the importance of cloud computing in software application developed as a service. To achieved that, a web based application OPMaSwas developed to provide service that will improvetheaudit readiness and compliance, couple with conformance to records retention policies and automated record management bundled using SaaS model. The web application is meant to manage personnel of any given organization, providing strong functionalities developed in modules such as; personnel information management module, training information management module, leave management module, resume management module, appraisal management module, document management module, reporting module and payroll management module. This applies to a lot of third world countries especially in Nigeria where interest e-commerce is fast growing. The system was evaluated using software performance methods where a reasonable performance was achieved as compared to state of the art software.

Keywords
Software as a Service (SaaS), Personnel Management System, Cloud Computing, Software Performance Engineering.

1. INTRODUCTION
Cloud computing is a distributed computing technology in which saleable resources are rendered as a subscribe-able services over the internet [1]. the internet where service management are rendered to customerswith the aid of virtualization technologies, while ensuring efficient and optimal performance is provided in the virtual world. A cloud computing application provides scalable, flexible and dynamic platforms to as many customers as possible with the aim of guaranteeing each customers have total control over their platform.One of the most commonly used services of cloud computing is the SaaS. [2][3]. According to [5], Cloud computing varies from one cloud provider to another. Some vendors provide storage services over network.

Over the years SaaS application have shown tremendous acceptabilitycompared to PaaS and IaaS. SaaS are occasionally referred to as "on demand software" which means components of software are hosted in the cloud centrally [6]. The SaaS vendor therefore provide access to customers' base on demand. When such access is granted to customer, customers gain access through a web browser. Most SaaS vendors have taking advantages of the capabilities of SaaS application thereby extending their horizons to creating SaaS applications such as Enterprise Resource Planning applications (ERP), Customer Relationship Management application (CRM), Human Resource Management application (HRM), Content Management CM application etc.

SaaS is a cloud service where consumers are able to access software applications over the internet". The applications are hosted in "the cloud" andcan be used for a wide range of tasks for both individuals and organizations [7]. Google, Twitter, Facebook and Flickr are all examples of SaaS, with users being able to access the services via any internet enabled device. SaaS philosophy is best described as renting software, just like renting a book from the library rather than buying it. With traditional software applications, one could purchase the software upfront as a package and then install it onto the required computer systems. The software's license may also limit the number of users and/or devices where the software can be deployed. Software as a Service user, however, subscribe to the software rather than purchase it, usually on a monthly or yearly basis depending on the business plan behind the software. Applications are purchased and used online with files saved in the cloud rather than on individual computers thereby allowing users to embark on "pay as you use" plan.

The beauty of software implemented as SaaS is that they make life easy at mobilizing workforce. A SaaS application is expected to provide full functionality based on the business requirement gathered and cost reduction Optimized system is most likely to combine several other systems or sub systems to create a single systemthatusing fewer resources. [8].

A Combination of SaaS and Optimized software to create OPMaS result in a system that consists of six modules which work communicatively and can be parallel accessible to each client like normal traditional software.In this paper we employ some of the SaaS evaluation methods presented in [1], [2] and [3] to evaluate OPMaS as SaaS based application with other state-of-the-art applications. The criteria used is presented in table 1.

2. BACKGROUND
2.1 Review of Cloud Computing
Cloud computing is known for applications that delivers services over the Internet and hardware and systems software in the datacenters that provide those services. According to [9], there exist three basic cloud delivery models, which are Software as a Service, SaaS, Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

2.1.1 Software as a Service (SaaS).

This system has the capability of providing the customer to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The customer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application, apart from limited user-specific application and configuration settings.

2.1.2 Platform as a Service (PaaS).

This system has a capability of providing customers to deploy onto the cloud infrastructure customer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The customer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.

2.1.3 Infrastructure as a Service (IaaS).

The capability provided here to customers is provision of processing, storage, networks, and other fundamental computing resources where the consumer can deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control to select networking components like host firewalls.

Generally, cloud providers use public cloud resources to create their virtual private cloud allowing access to scalable computing resources and IT services. SaaS is one of the service delivery models that changes the way people build, sell, buy and use software. In this model, Software is provided as a service where cloud user can access the software from his web browser without the concerns of deployment or installation and maintenance

Furthermore, cloud user, can run application or software with no upfront costs or investment in database, servers and software licensing. With the advancements of Web and more efficient and faster HTML 5 standards, graphically rich applications can be run smoothly at 60 Frames per second just like running our software on our own personal computers. This service model depicts one to many function as single application running as a service on the server side with many client end users can run it from their web browser simultaneously as they are connected as services.

2.2 Review of SaaS

Software as a Service (SaaS), a popular and critical branch of cloud computing, is a delivery model in which applications are hosted and managed in a service provider's datacenter, paid for on a subscription basis and accessed via a browser over an internet connection. As a mainstream business option, it's often seen as dating from the launch, in 2000, of the hosted Salesforce.com customer relationship management (CRM) service, which has become the 'poster-child' for SaaS. However, its roots lie in earlier developments in virtualization, service-oriented architecture (SOA) and utility/grid computing. Software as a Service has been in common usage for nearly a decade, with its cloud-stack

companions; Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) [10].

2.2.1 Pros and cons of SaaS

Just as any other software will have both advantages and disadvantages; SaaS is not an exception, some of the advantages and disadvantages as presented according to [11]

2.2.1.1 PROS

a)   Cost savings
Moving from the capital-heavy expense of installing, maintaining and upgrading IT infrastructure to the operational cost of a SaaS subscription is a tempting business proposition, particularly in the short-to-medium term. It's important to be aware of potential hidden costs in SaaS adoption though.

b)   Scalability
As your business grows and you need to add more users, rather than investing in additional in-house server capacity and software licenses you can adjust your monthly SaaS subscription as required.

c)   Accessibility
 A browser and an internet connection is all that's usually required to access a SaaS application, which can therefore be made available on a wide range of desktop and mobile devices.

d)   Upgradeability
Your cloud service provider deals with hardware and software updates, removing a significant workload from your in-house IT department (whose extra human bandwidth can, in theory, be released for different tasks, such as integration with existing on premise applications).

e)   Resilience
 Because the IT infrastructure and data resides in the cloud service provider's datacentres, if some form of disaster should strike your business premises, you can get back up and running relatively easily from any location with internet-connected computers.

2.2.1.2 CONS

Of course, there are also potential pitfalls associated with SaaS, which is why the world hasn't yet gone completely cloud-software-crazy. These include:

a)   Security
The number-one concern for businesses considering SaaS is often security: if sensitive company data and business processes are to be entrusted to a third-party service provider, then issues such as identity and access management -- particularly from mobile devices -- need to be addressed. And if your company uses multiple cloud services, be aware that deprovisioning an ex-employee can become a security headache.

b)   Outages
Despite cloud providers' best-laid plans, outages do happen, with causes ranging from acts of nature to human error and many points in between. Any downtime is irritating, but a lengthy outage of a mission-critical app could prove disastrous. You'll need to scrutinize your service provider's SLA (Service Level Agreement) and historical performance very carefully before outsourcing mission-critical applications to the public cloud. Tools such as Compuware's Outage

Analyzer and Is It Down Right Now? let you monitor ongoing cloud outages.

c)   Compliance

When your business data resides in a service provider's datacenters, ensuring that you comply with the relevant government data-protection regulations can be a problem. You'll need to determine which regulations apply to your business, ask the right questions of your SaaS vendor and implement a solution to address any failings. Alternatively, you can investigate a Compliance-as-a-Service product such as that from Niu Solutions.

d)   Performance

A browser-based application hosted in a remote datacenter and accessed via an internet connection is likely to cause worries about performance when compared to software running on a local machine or over the company LAN. Obviously, some tasks will be better suited than others to the SaaS model -- at least until internet connection speed is no longer an issue. In the meantime, application performance management tools can help businesses and service providers keep tabs on how their apps are running.

e)   Data mobility

The SaaS market is awash with start-ups, and some will inevitably fail. What happens to your data and your carefully orchestrated business processes if your service provider goes under -- or if you need to change your SaaS vendor for some other reason? When choosing a SaaS vendor, you'd be wise to ensure you avoid lock-in by preparing an exit strategy.

Integration Businesses that adopt multiple SaaS applications, or wish to connect hosted software with existing on premise apps, face the problem of software integration. If it's not possible to handle the relevant APIs and data structures in-house, there's a relatively new breed of Integration-as-a-Service products available, including Boomi (a Dell-owned company), Cloud Switch and Informatics.

2.3 Review of OPMaS

OPMaS is an optimized software that integrates different software's and make sure they operate more rapidly with less memory and resources allocated. OPMaS is set to run as a service (subscribe to by different clients) rather than being purchased by clients as a standalone software. OPMaS is divided into six modules which will be reviewed individually.

The first module being the parent module on which all others depend on is the employee information management system. Employees are the most valuable and dynamic assets of any organization. An Employee Management System is an extensive and comprehensive system that maintains and tracks information pertaining to all employees in the organization. Within the digital era, the use of a digital employee data management is increasingly demanded because it the quickest, safest and easiest way to access employee data. These digital employee data management is mostly run through a user-friendly web based platform. Information is retrieved and stored on this system. This includes items such as Personal information, Contact information, Educational information, past work experience and others as desired by the organization.

Second is the leave management system module. This module consists of system that can be accessed throughout a department that manages leave related information of

employees. It helps employees apply for a leave and create a process flow to which applied leaves can be approved or denied guided by the organizations leave policy.

Third is the performance management system. This module is set to have a system that will appraise employee performance and generally help in the boost of an employee's performance culture. This module display set of increasing/decreasing productivity of an employee in the organization.

Next is the staff training management system. This module creates a system that centralize the institution's training data, giving a feedback of each employee's scheduled training and completion status and most importantly help the institution plan for future trainings to provide more effective training and save cost.

Next is the promotion and salary system which create a system that will use the results from the performance module and help institutions determine employee promotion and salary increase. This also involves payroll management and is expected to run real time.

Lastly is the chat and collaboration system which is set to create an avenue where employees can share data, information and work collaboratively.

3.   METHODOLOGY

OPMaS was developed with Bingham University in mind and to reduce the slow and inconvenient movement of paper files, missing data and high cost of operation of employee data on yearly basis. The development team adopted agile software development model.Agile model was used because of the need to aligned development with the changing business needs and environment.The Microsoft Azure cloud services was used for hosting OPMaS as shown in fig 1. The choice of Azure was to utilize the openness and flexibility of the cloud platform most especially for operational efficiency and data security. Themethodology used are discussed from 2.1 to 2.8.
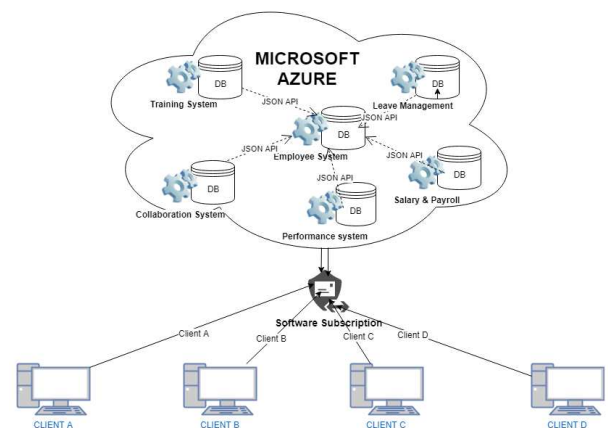

Fig 1 Architecture of OPMaS

3.1 Development Components

a) Language – ASP.NET C#:

Because of it open source web framework for building modern web apps and services with .NET. it was easy to creates websites based on HTML5, CSS, and JavaScript that are simple, fast accommodate multiple users.

b) Language Framework – ASP.NET MVC:

Asp.Net MVC is a .Net framework that uses the idea of model view controller mechanism. This tool was chosen because it exhibits an organized style of development, separating your models from your user interfaces and the controllers as well.

c) Data Management Framework – Entity Framework:

These are object-relational mapper that enables .NET developers to work with relational data using domain-specific objects. It eliminates the need for most of the data-access code that developers usually need to write.

d) IDE – Visual Studio 2015

Visual Studio is the official .Net IDE and is said to be one of the most powerful IDE's. It has tons of libraries that support the .NET framework.

e) Code Optimizer – Reshape

Reshape is a code optimizing application developed by jebrains that helps developers code faster and better and much more efficient. It helps developer's refractor their codes and most times suggest better ways of writing statements.

f) Database/Data Source - SQL server

SQL Server is a relational database management system (RDBMS) developed by Microsoft that is designed for the enterprise development of software's. SQL Server runs on T-SQL (Transact -SQL), a set of programming extensions from Sybase and Microsoft that incorporates several more features to the standard SQL, including transaction control, exception and error handling, row processing, model diagrams and declared variables.

3.1 Iteration/Construction

The agile development life cycle is dominated by the iterative processes. Each iterative process is the next piece of the software development puzzle-working software and supporting elements such as documentation, available for use by customers/developers until the final product is complete.

The iteration process flow consists of

a) Requirements: This consists of the functional and non-functional requirements.
b) Development: This involves writing of source code complimented by a database.
c) Testing: This involves testing of each unit to find errors or bugs. Once bugs are found we move back to b).

d) Delivery: This involves program delivery to project manager and review for any more requirements, if there are new requirements we move back to a).
e) Feedback: This involves a report that states items to be fix, add, and removed and other corrections.

3.2 Development

a)   User Interface

This consists of the web pages that were deployed on the browser. They were built using:
  i. HTML-Razor Syntax
  ii. CSS -Bootstrap
  iii. JAVASCRIPT – Mainly JQuery

b)   Controller

This were classes that consist of all methods related objects.

c)   Data Context

This was connection of each object to its related table in the database.

3.3 Testing

This was carried out all the teams involving developers and selected employees of Bingham University to make sure the developed meets the requirements.

3.4 Delivery

Deployment of the project to a production server for appropriate evaluation

3.5 Feedback

Feedback from selected key employees of Bingham University as they operate the system. All new and addition requirement were taken note and accommodated in the next face of the system development.

3.6 Release

This entails question and answers related to testing, internal and external training, documentation development and final release of iteration into production.

4.   IMPLEMENTATION AND EVALUATION

The application was developed and deployed. It evaluation was done with other existing software platform with similar functionalities. The result is shown in table 1.

Table 1: General features of performance evaluation method used.

System	Target Domain	Software Category	Information Collection	Accuracy	Flexibility	Overall Rating
OPMAS	A, B, C, D, E	SaaS	High	High	High	High
Intoweb [13]	A	Standalone	Good	High	Good	High
Beehive[16]	A	Standalone	Average	Good	Good	Good
Texas[14]	A, C	Standalone	High	Good	Average	Good
PlanMyLeave [12]	C	SaaS	High	High	High	High
Employease[15]	C	SaaS	High	High	High	High
Beehive[16]	D	Standalone	High	High	High	High
Pittsburgh[17]	D	Standalone	High	High	High	High

Reviewsnap[18]	D	SaaS	High	High	High	High
Intelex[19]	B	SaaS	Good	High	Good	Good
Marine Corps[20]	B	Standalone	Good	High	High	High
SalaryPayroll[21]	E	SaaS	High	High	High	High

Target domain legend: A: Employer Information System   Rating score legend: Poor: 0% – 45%
B: Training Information System   Average: 46% – 55%
C: Leave Information System   Good: 57% - 70%
D: Performance Management System   High: 71% - 100%
E: Payment Management System

5. RECOMMENDATIONS

Whenever a business implements a new technology, whether this is a hardware based technology or in this case a software service based technology, there is always a reason (or number of reasons) exactly why a business is implementing this new technology. There are several reasons why businesses would want to implement SaaS. Some business might want to improve the efficiency of their business-related process by being able to concentrate more on business related processes rather than on software management processes, while other businesses may want to improve the collaboration of several different business sites of theirs, which are geographically separated.

No matter what reason a business has for wanting to implement SaaS, they should be clear about exactly what this reason is. A business should also have a very good understanding about how their existing processes and infrastructure work. This information is required so that SaaS software services can be integrated into their existing infrastructure at a later stage but with an absolute minimum of problems.

6. CONCLUSION

As we have noted throughout this paper, cloud computing has the potential to be a disruptive force by affecting the deployment and use of technology. The cloud could be the next evolution in the history of computing, following in the footsteps of mainframes, minicomputers, PCs, servers, smart phones, and so on, and radically changing the way enterprises manage IT. Yes, plenty of questions are still left to be answered regarding security within the cloud and how customers and cloud service providers (CSPs) will manage issues and expectations, but it would be a severe understatement to say simply that cloud computing has generated interest in the marketplace.

The hype regarding cloud computing is unavoidable. It has caught the imagination of consumers, businesses, financial analysts, and of course, the CSPs themselves. Search for "cloud computing" on the Internet and you will uncover thousands of articles defining it, praising it, ridiculing it, and selling it.

SaaS is without a doubt gaining momentum, and is clearly changing the way software companies deliver their products. Large enterprises are looking at the technology to reduce operating costs and deployment times, and small businesses are looking at it to reduce their upfront software expenditures. While SaaS has certainly been around for a while, new and innovative technologies AJAX are allowing developers to provide a more desktop-like experience over the web. These technologies are already blurring the line between the Internet and the desktop, which is why we will continue to see a growing trend towards moving applications to the web. As more people utilize Internet-enabled mobile devices, they will expect to have access to the same tools that they would normally have with their desktop computers.

Although there are some technical and financial concerns that must be looked at before organizations decide to utilize SaaS, the long-term benefits gained from the technology far outweigh the risks. Organizations can significantly reduce their risk by involving IT in their purchasing decisions, and carefully choosing a SaaS vendor that has a proven track record for delivering the product they are looking for. Within the next few years we will undoubtedly see more vendors offering SaaS solutions, and more enterprises adopting it as the technology matures.

7. REFERENCES

[1] Jae Y. L., Jung W. L., Du W. C. and Soo D. K. (2009). A Quality Model for Evaluating Software-as-a-Service in Cloud Computing. Published by IEEE in 2009 as Proceeding Seventh ACIS International Conference on Software Engineering Research, Management and Applications, page 1. Print ISBN: 978-0-7695-3903-4, INSPEC Accession Number: 11073557DOI: 10.1109/SERA.2009.43

[2] Deltek (2013). Evaluating SaaS and Cloud Solutions: Guidance for Organizations on Selecting an Effective Solution. Accessed on 14 June, 2018. Via https://www.stambaughness.com/wp-content/uploads/2017/12/Evaluating_SaaS_and_Cloud_Solutions_WP.pdf

[3] Chekfoung T., Kecheng L, Lily S. (2013). A design of evaluation method for SaaS in cloud computing. Published by Journal of Industrial Engineering and Management JIEM, 2013 – 6(1):50-72 – Online ISSN: 2013-0953 – Print ISSN: 2013-8423 http://dx.doi.org/10.3926/jiem.661

[4] Ahmed S. & Maria S. (2014). *Inter-cooperative Collective Intelligence*: Techniques and Applications, Studies in Computational Intelligence. DOI: 10.1007/978-3-642-35016-0_2, _ Springer-Verlag Berlin Heidelberg

[5] Mahesh K. (2014). Software as a service for efficient cloud computing. *International Journal of Research in Engineering and Technology,* 3(1), pp 178 – 181.

[6] Jayade, K. G. &GaikwadC. J (2013). Cloud computing for agricultural information management in India, *International Journal of Software and Web Sciences*, 6(1), pp. 38–42

[7] Jose M. & David H.(2013).Review and analysis of networkingchallengesin cloud computing, Article partly funded bythe European Union Seventh Framework Programme (FP7/2007-13), grant agreement no. 312758: the SECCRIT project.

[8] Andreas M. Kleopatra K., Juncal A., Leire O., Jesus G., George K., Christina S., Hugo B., Bram P., Peter S., Oliver S., Tatiana S. & Theodora V (2014). Software modernization and cloudification using the artist migration methodology and framework, Scalable Computing: Practice and Experience, 15(2), pp 131–152

[9] Sophia M. (2016). Saas, PaaS, and IaaS: Understanding the Three Cloud Computing Service Models, DoubleHorn, Data Driven: Cloud Optimized, Available on https://doublehorn.com/saas-paas-and-iaas-understanding/, Retrieved 23rd April, 2018.

[10] Vijayalakshmi, C. (2013). An exploration of cloud service delivery models in a hybrid environment –A new depiction to corporate Computing, Proceeding. of World Conference on Multimedia and Computer Science, ACEEE, 2013.

[11] Keith B. (2013). Business Intelligence SaaS Pros and Cons, A DMG Federal eBook, March.

[12] PlanMyLeave. (2017). Leave Management System. Retrieved from http://www.planmyleave.com/

[13] Limited, I. C. (2017). WHAT IS SAAS? Retrieved from http://www.interoute.com/what-saas

[14] Texas, T. U. o. (2017). Welcome to Human Resources. Retrieved from https://hr.utexas.edu/

[15] Employease (2017) Retrieved from https://employease.com.au/

[16] Beehive (2016) Retrieved from http://beehiveschool.com.ng/

[17] Pittsburgh (2018): Retrieved from https://www.hr.pitt.edu/employee-resources

[18] Reviewsnap (2018): Retrieved from https://www.reviewsnap.com/

[19] Intelex (2018): Retrieved from https://www.intelex.com/landing/training-management-software

[20] Marine Corps (2018): Retrieved from http://www.candp.marines.mil/Programs/Focus-Area-2-Training-Simulation/Programs/Training-and-Education-Enablers/Marine-Corps-Training-Information-Management-System-MCTIMS/

[21] SalaryPayroll (2013 - 2018): Retrieved from http://paybooks.in/payroll-management-system-features/