Utilisation of virtual infrastructures to assist SOA for efficient realisation of SaaS

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Abstract: SOA (Service Oriented Architecture) has become a well-known, elusive acronym in ICT. Many conflicting definitions of SOA among the business and development communities have evolved due to the significant attention it has received [1] since Alexander Pasik coined SOA in 1994. An abstract framework, the reference model for SOA is published to clarify this misconceives by OASIS recently.[1]. However, beside this complexity, SOA has assisted few businesses to increase business competitive advantage by utilising the ICT more meaningfully to provide faster throughput. Many recent surveys by Gartner, BEA, etc. given the companies confidence to invest in accelerated spending and aggressive adaptation of SOA within the business models. The recent European survey sponsored by BEA, found that many companies (55%) view SOA as "the best way to support the use of social networking and 'Web 2.0' development techniques in their IT infrastructure". This points to the illusion that companies comprehend 'web services' or 'xbXML' as SOA or vice versa, although these are only specialised implementations of SOA.[2]. Regardless of the implementation technique the focus of utilising SOA is to realise; development of collaborative environments, on-demand business application services provision, viable business applications delivery through Software as a Service (SaaS) model, 'Mashups' and composite applications enabled to be driven by end-users, etc. SaaS is relatively a new term coined by Webex offering 'Webex meeting hosting' on-demand service, in 1999, which then began to be more widely used since the SaaS Conference held in Santa Clara, March 2005.[3]. It has provided a new meaning to the previous terms; Application Services Provision, on-demand and utility computing. In general delivering the software functionalities (or services) via the Internet technologies are called SaaS and the ability of using the Internet, Web as a platform, to read and write rich content collaboratively are called 'Web 2.0'.[4]. The convergence of SOA, SaaS and Web 2.0 has given the ability to interconnect service components offered by various providers to create Enterprise Mashups that serve Business Processes of each organisation.[5]. The overall Total Cost of Ownership can be decreased by the internal implementation of SOA and it can further decreased by connecting organisation's SOA to SaaS providers. Such implementations facilitate quick realisation of the associated benefits. The utilisation of Enterprise Mashups and automation of Business Processes are strong drivers to reduce TCO, advancement in operational efficiencies and acquiring new business opportunities.[5][6]. It is becoming more evident that in order to achieve this realisation providers as well as consumers of above technologies are required to integrate Virtualisation Technologies [13] within their Enterprise Service Bus (ESB). This paper put forward this important notion and details how organisations and developers should execute their next move in achieving the 'spontaneous enterprise'.

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Introduction

SOA (Service Oriented Architecture) has become a well-known, elusive acronym in ICT. Many conflicting definitions of SOA among the business and development communities have evolved due to the significant attention it has received since Alexander Pasik coined SOA in 1994. An abstract framework, the reference model for SOA is published to clarify this misconceives by OASIS recently.[1].

Let's look at a couple of definitions of SOA from generic to specific manner.

SOA in genetic terms

"SOA is an integration architecture approach based on the concept of a service. The business and infrastructure functions that are required to build distributed systems are provided as services that collectively, or individually, deliver application functionality to either end-user applications or other services. SOA specifies that within any given architecture, there should be a consistent mechanism for services to communicate. That mechanism should be loosely coupled and support the use of explicit interfaces. SOA brings the benefits of loose coupling and encapsulation to integration at an enterprise level. It applies successful concepts proved by Object Oriented development, Component Based Design, and Enterprise Application Integration technology to an architectural approach for IT system integration."

IBM Redbook (2005)[12]

SOA as applies into banking sector

"There is much focus in the market currently on Service-Oriented Architecture (SOA) – especially among the larger banks. What does this mean? It means transforming the core systems into a series of plug and play components, with the ability to move to a component-based architecture. It means standardisation. It provides ease of integration. Most importantly, it offers a migration path to allow large, complex retail banking organisations to migrate to next-generation functionality in a risk-averse fashion."

*James Buckley, Director Product Strategy, **T**EMENOS™ **C**ORE**B**ANKING (2007)* [9]

SOA is one of the hottest subjects of businesses in recent times. It has grabbed attention of many CIO's as a potential way to reduce total cost of ownership of the ICT infrastructure that also provides business improvement through reusable ICT assets called 'services'. Recent Forrester Research Inc. shows that only large enterprises are benefiting the utilisation of SOA with in organisations. Having said that, there are not enough guides available to them for the implementation of SOA within organisations, which require a proper strategy, planning and governance. This will be expanded later in the discussion.
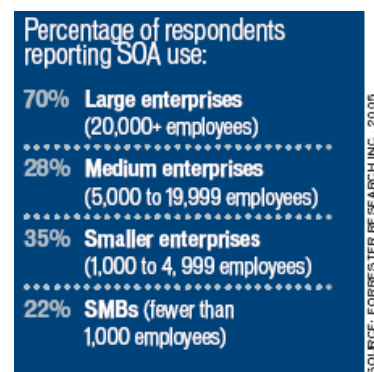

Percentage of respondents reporting SOA use:

70% **Large enterprises** (20,000+ employees)

28% **Medium enterprises** (5,000 to 19,999 employees)

35% **Smaller enterprises** (1,000 to 4,999 employees)

22% **SMBs** (fewer than 1,000 employees)

SOURCE: FORRESTER RESEARCH INC., 2005

Figure 1: Computerworld Executive Bulletin (2007)
https://store.computerworld.com [8]

However, beside this complexity, SOA has assisted few businesses to increase business competitive advantage by utilising the ICT more meaningfully to provide faster throughput. Many recent surveys by Gartner, BEA, etc. given the companies confidence to invest in accelerated spending and aggressive adaptation of SOA within the business models. The

recent European survey sponsored by BEA, found that many companies (55%) view SOA as "the best way to support the use of social networking and 'Web 2.0' development techniques in their IT infrastructure". This points to the illusion that companies comprehend 'web services' or 'xbXML' as SOA or vice versa, although these are only specialised implementations of SOA.[2].

SOA is simply a way of business functionality standardisation, giving a structure to the software applications and organising ICT infrastructure within the enterprise. The 'web services', XML, etc. are some of the latest implementations of the SOA principle. SOA requires applications to be designed as 'services' and due to many flexibilities that are associated with using the internet these services have been designed as 'web services' by many developers of applications by using the standardise internet protocols for defining user interfaces. Technically, 'web services' uses SOAP (Simple Object Access Protocol) and the WSDL (Web Services Description Language). SOA must provide; services management, services registry, services security and Enterprise Services Bus (ESB) or related messaging infrastructure as the minimal functionality. It is becoming more evident that in order to achieve this realisation providers as well as consumers of above technologies are required to integrate Virtualisation Technologies [13] within their Enterprise Service Bus (ESB). This paper put forward this important notion and details how organisations and developers should execute their next move in achieving the 'spontaneous enterprise'.

SOA, SaaS, Mashups and Web 2.0 explained
The following figure 'How SOA works' provides the simplified explanation of using web services way to reaching the business consumer.
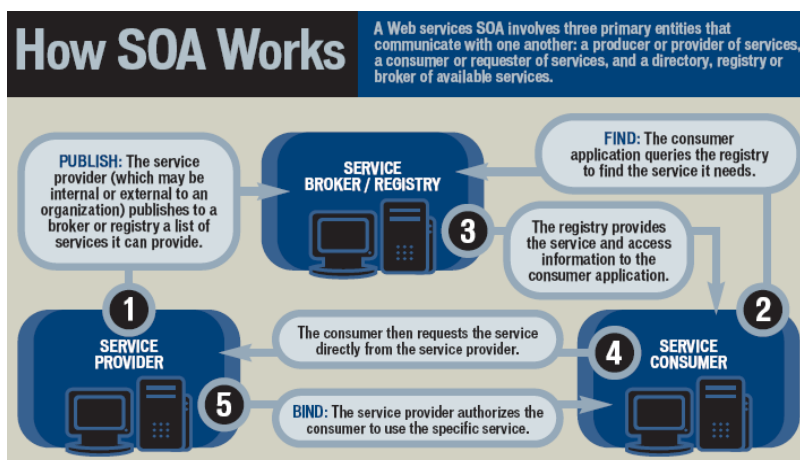

Figure 2: How SOA works, Computerworld Executive Bulletin (2007) [8]

"The good news is that SOA is an incremental architecture, so you can scale your road map to SOA project by project and yet still deliver compelling ROI that accrues as you enable more services within your SOA."
"And be sure to invest in the development of an SOA governance model and policies that can be enforced both during services design and runtime. Governance can make or break your SOA initiative. Defining and enforcing SOA governance is hard work, but it is essential for success."
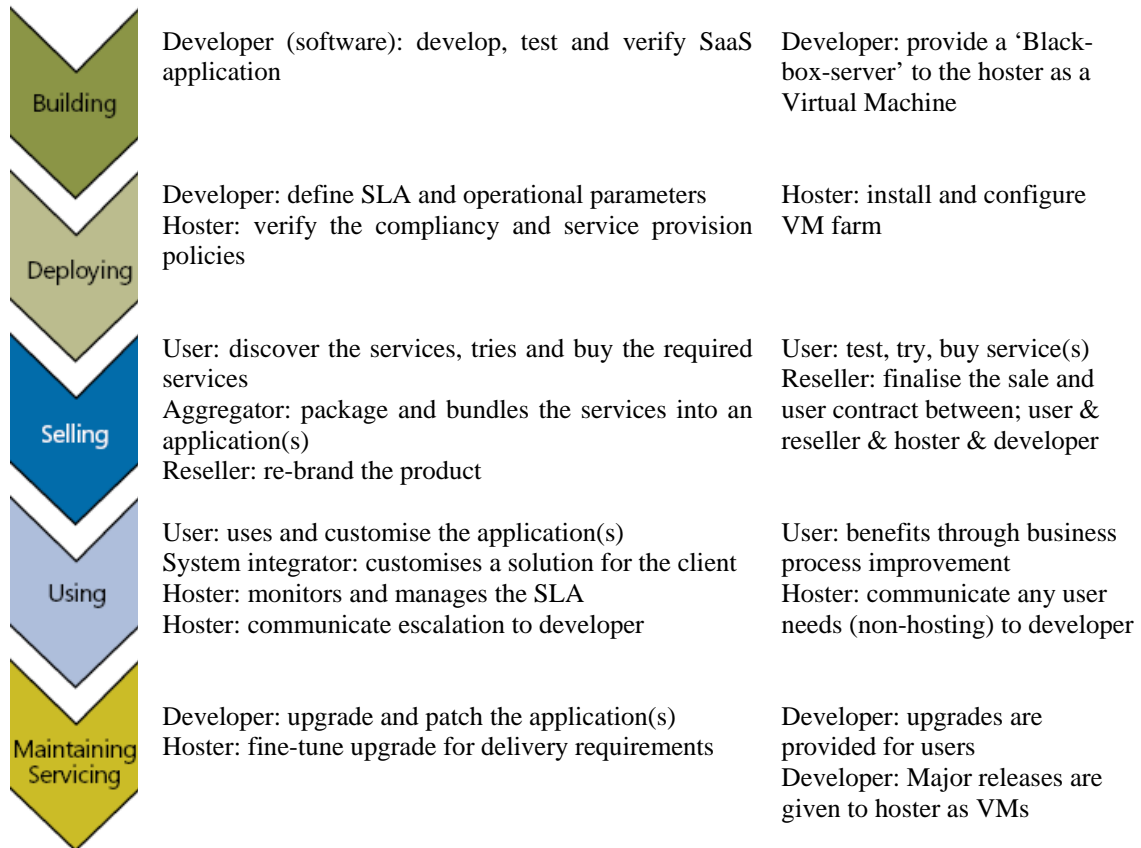*E. Marks, AgilePath Corp. CEO* [8]

Therefore, regardless of the implementation technique the focus of utilising SOA is to realise; development of collaborative environments, on-demand business application services provision, viable business applications delivery through Software as a Service (SaaS) model, 'Mashups' and composite applications enabled to be driven by end-users, etc. SaaS is relatively a new term coined by Webex offering 'Webex meeting hosting' on-demand service, in 1999, which then began to be more widely used since the SaaS Conference held in Santa Clara, March 2005.[3]. It has provided a new meaning to the previous terms; Application Services Provision, on-demand and utility computing. In general delivering the software functionalities (or services) via the Internet technologies are called SaaS and the ability of using the Internet, Web as a platform, to read and write rich content collaboratively are called 'Web 2.0'. [4].

Web 2.0 has evolved to provide a rich and immersive experience to the user through lightweight rapid programming, and flexible hosting and deployment. This could clearly be considered as another advancement of creative usage of the web for services deployment. Utilisation of lightweight programming and standardisation allows new services to be created by composing existing 'discoverable services', which called 'mashups' that more closely operate at the user interface level. More interestingly these 'discoverable services' are being created and hosted by different organisations based on their various expertises. As a simple example the Tax Office can provide a service module for tax calculation for the current year that is discoverable and hence Tax Accountant can compose their online service to calculate personal tax for clients by the utilisation of this discoverable service. When tax brackets are changed the Tax Office can change their service module such that previous clients can be benefited immediately through Tax Accountant's online service. Within the same application Tax Account may provide a module that facilitates Personal Budgeting, which utilises another 'discoverable service' from the Local Councils to receive Rates and associated calculations. If Tax Accountant offers their services discoverable then another Financial Consultants can build their online service modules by the utilisation of services offered by the Tax Accountant, etc. Although it seems as if we are heading towards a scary future, at the same time, it will be exciting for business application services suppliers. In some cases users (E.g. SME) themselves can create their in-house applications based on the 'discoverable services' from many other services providers. This provides new opportunities to new organisations that target SaaS delivery within their portfolio in one way or another. It is also important to mention those technologies discussed in this paper offer organisations to bring; Mashups, Wikis, Blogs, etc. together through Rapid Application Services Deployment Strategy (RASDS) for enabling new generation of online Knowledge Services (KS) infrastructures that are more superior to the current organisational KM infrastructures. This level of harnessing collective intelligence from other organisations will facilitate future of 'wisdom clouds' and 'spontaneous enterprises'.

Vital role of Virtualisation
The convergence of SOA, SaaS and Web 2.0 has given the ability to interconnect service components offered by various providers to create Enterprise Mashups that serve Business Processes of each organisation.[5]. This delivery model is different to the online internet based systems that providers (mainly software developers) have been offering to other businesses (B2B) and direct to consumers (B2C). The advancement of new delivery model and its processes have created new industries to participate in between the developer and the consumer. This is shown in the Table 1 below with the Services Supply Chain (SSC); developer, hoster, aggregator, system integrator, and user. The developer should clearly define hosting requirements and performance measurements so that hoster can provide the required services to them. Also the developer should document the required services selling and marketing literature such a way that it will integrate seamlessly within the hoster's marketplace. It will be more beneficial to the user when these marketplaces begin to have some standard 'look and feel' or standardisation. Much more importantly, to realise this delivery model Virtual Machine (VM) technology [13] has to be integrated to achieve the required practical flexibility. In particular the developer can not give too much of information regarding the application(s) and services to the hosting organisation, but when the configurations are carried out by the hoster in many cases unnecessary outflow of information can take place over the duration. This could also lead into inconsistencies in defining SLAs between these parties.

Table 1: Services Supply Chain of SaaS provision (Mihindu)

Building	Developer (software): develop, test and verify SaaS application	Developer: provide a 'Black-box-server' to the hoster as a Virtual Machine
Deploying	Developer: define SLA and operational parameters Hoster: verify the compliancy and service provision policies	Hoster: install and configure VM farm
Selling	User: discover the services, tries and buy the required services Aggregator: package and bundles the services into an application(s) Reseller: re-brand the product	User: test, try, buy service(s) Reseller: finalise the sale and user contract between; user & reseller & hoster & developer
Using	User: uses and customise the application(s) System integrator: customises a solution for the client Hoster: monitors and manages the SLA Hoster: communicate escalation to developer	User: benefits through business process improvement Hoster: communicate any user needs (non-hosting) to developer
Maintaining Servicing	Developer: upgrade and patch the application(s) Hoster: fine-tune upgrade for delivery requirements	Developer: upgrades are provided for users Developer: Major releases are given to hoster as VMs

Adapted from G. Carraro, F. Chong, and E. Pace (2007) [7]

VM technology can assist the developer to keep the required services configuration matters tightly controlled. Similarly, the hosting organisation can also concentrate on the hosting of the services encapsulated inside a 'VM server' (VM black-box element) somewhat independently of many installation and configuration matters. This method further assists the developer to carryout minor updates or major releases by creating new VMs, whenever, this is the most appropriate way to perform these tasks. As pointed the hoster does not have to become involved in such activities other than the hosting point of view. Readers who are new to VM technology, under these environments, should get acquainted with the overall benefits of this technology through the websites of leading virtualisation providers (E.g. Vmware VI, Citrix Xen Source, etc.) and supported virtual infrastructure environments. Within recent future hosting industry will begin facilitating and offering developers and governmental departments 'SaaS hosting provision' specialisation. On a different point the hosting organisations are required to utilise Virtual Infrastructure Management (VIM) and Business Transaction Management (BTM) systems to provide business users with the efficient business process realisation through the hosted services. Without the use of BTM systems (E.g. Choreology Cohesions, OpTier CoreFirst, etc.) hosting organisation are under equipped to facilitate complex 'requirements of services provision' and to provide the required feedback to the developers regarding BTM related aspects.

Benefits and opportunities
The overall Total Cost of Ownership (TCO) can be decreased by the internal implementation of SOA and it can further decrease by connecting organisation's SOA to SaaS providers. Such implementations facilitate quick realisation of the associated benefits. The utilisation of

Enterprise Mashups and automation of Business Processes are strong drivers to reduce TCO, advancement in operational efficiencies and acquiring new business opportunities.[5][6]. As some experts argue the Enterprise Mashups can blur the line between the enterprise and the web. However I would interpret this as an opportunity for small players in the SSC to capture much needed market share which is currently obsessed by large enterprises. The key to their success relies on two folds; full understanding of the SaaS solution development lifecycle and in depth knowledge of utilisation of SaaS model to successfully realise a specific business process or processes attached to a particular business. Therefore small players are needed to work very closely with the Business Analysts and Entrepreneurs of the businesses where they intend to provide SaaS solutions and it is a fact that this is not a new idea in Software Services Development (SSD). The complete application lifecycle management that allow further integration of development, versioning, deployment, management, operations and support of a SaaS solution require SSC to closely collaborate for the provision of specialised services based solutions of the future. Due to the fact that this level of collaboration among SSC are not easy to take place it is possible organisations to merge to provide consolidated services reducing the number of players within the SSC. Which also means this is another opportunity to merge with other small organisations strategically.

Mitigation of risks
Inevitably there are many risks involved in adaptation and utilisation of the described technologies. Although this paper does not discuss them I would like to point couple of important issues. Firstly the risk mitigation strategies must be built into the services development process in such a way risks are recognised at the pre-production stage and mitigated accordingly. Secondly in order to provide a stable and satisfying service to clients require clear knowledge of SaaS development lifecycle and the development team should identify most of the service inefficiencies at the design phase. The identification of them at the implementation or testing phases will be costly but may be inevitable in some cases. The real danger lies if these inefficiencies moved into the maintenance phase which could be sixty times expensive, according to **@Stake,** than they could be identified and fixed at the design phase and this is shown in figure 3 below. In another words vulnerabilities need to be identified prior to the services been offered is the best practice of services design. Designers also need to be aware and the necessary measures to be taken against of any indirect costs such as loss of reputation, customer attrition, legal liability, etc. which could damage the business greatly.
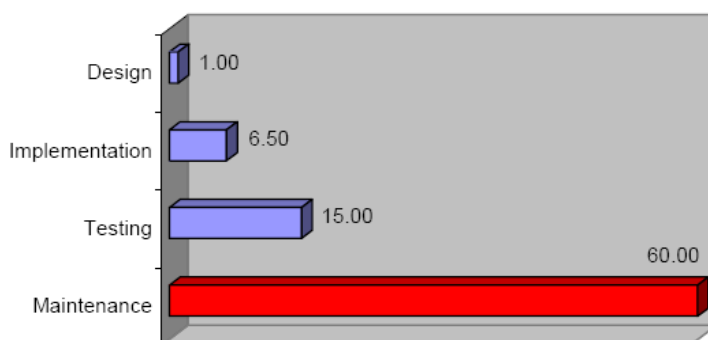

Figure 3: Cost Multiplier graph for **D**esign: **I**mplementation: **T**esting: **M**aintenance:

D:I:T:M=1:6.5:15:60

source @Stake

Summary
"Service-oriented architecture (SOA) is an approach to defining integration architectures based on the concept of a service. Applications collaborate by invoking each others services,

which in turn can be composed into larger sequences in order to implement business processes of the enterprise."

SOA is targeted for organising the 'spontaneous enterprise' that consists of solutions (dynamically organised services) which promote reuse, growth and interoperability. As one of its implementation strategies Internet Technologies have been exploited to a great detail. The utilisation of Virtualisation Technology [13] for the facilitation of SOA has become highly relevant for realising the SaaS model by every organisation. The paper promotes this notion as a timely way forward.

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The author has developed skills and experience by working for academic, research and business enterprises in Europe, and Australasia over two decades and is the founding member of UK's first 'BIM Research & Special Interest Group'. His current research interests are human-centric technology infrastructures for future workplaces (FWS), strategies of distributed knowledge and data management for community collaboration and virtual reality, virtual environments and virtual technology infrastructures. He has been leading and delivering for many European Commission projects with Information Society Technologies (IST) Programmes via University of Salford, Greater Manchester. He has recently been engaged in the design and deployment of web infrastructures for technological observatory of VR, VE and FWS, and Strategic Knowledge Management infrastructures for scientific and professional communities. In addition to this he has also written many research papers on Knowledge Engineering, Communication and Collaboration Tools and Distributed Virtual Networking infrastructures for collaboration. One of his future research goals is to establish a framework for Virtual Technology Infrastructures to support effective communication and collaboration for virtual communities. He can be contacted through the details below or via his personal e-box at; mybox@sas.mihindu.name.

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