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Challenges in Software Development on Cloud Platform

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ABSTRACT

Enterprise application development with traditional software has always been too complex, too slow, and too expensive. A new model called cloud computing has emerged over the last decade to address these problems. Applications that run in the "cloud" are delivered as a service so companies don't have to buy and maintain hardware and software to run them—or huge IT teams to manage and maintain complicated deployments. More recently, Most Software Industry opened up cloud infrastructure so everyone can use it for custom application development. With cloud platform, you can build any business application and run it on cloud servers. The application development world is beating a path to the cloud platform and its unlimited power to innovate. This paper analyzes challenges of software development process on cloud computing platform to develop quality software (SW).

KEYWORDS: Application Development, Cloud Computing, Cloud Provider, Quality Software.

Introduction

Cloud computing generally describes a method to supplement, consume and deliver IT services over the Internet [2]-[3]. Web-based network resources, software and data services are shared under multi-tenancy and provided on-demand to customers. It is this central tenet of sharing –and the standardization it implies – that is the enabler of cloud computing core benefits. Cloud computing providers can amortize their costs across many clients and pass these savings on to them. This paradigm shift in computing infrastructure was a logical by product and consequence of the ease-of-access to remote and virtual computing sites provided by the Internet. Cloud computing may also be able to resolve the traditional tensions created by software development projects – governance versus agility, consistency versus rapid adoption, and quality versus time to-market – by delivering the flexible infrastructure required to get development projects off the ground quickly, and the tools to enable constructive interaction between in-house

Stakeholders and the outsourced development team. Building Applications on Cloud Platforms is much faster compared to Traditional On-Premise

Applications. Cloud Platforms have Built-In Database, security, workflow, user interface, and other tools that help in building powerful business apps, mobile apps, and Web sites. Since the entire Application is hosted on cloud, customers need not worry about IT Infrastructure, Upgrades, updates, uptime and backups. Cloud Computing has been envisioned as the next generation architecture of IT Enterprise. In contrast to traditional solutions, where the IT services are under proper physical, logical and personnel controls, Cloud Computing moves the application software and databases to the large data canters, where the management of the data and services may not be fully trustworthy.
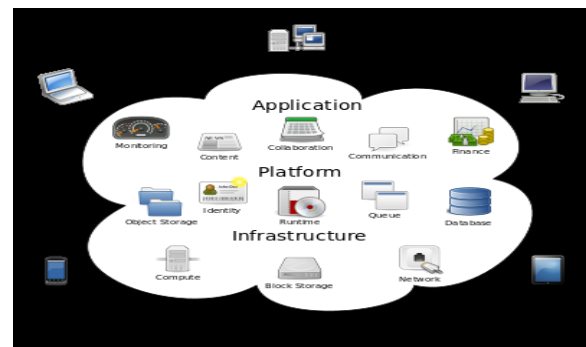

Fig. 1 Cloud Computing

Cloud computing differs from the classic client-server model by providing applications from a server that are executed and managed by a client's web browser, with no installed client version of an application required. Centralization gives cloud service providers complete control over the versions of the browser-based applications provided to clients, which removes the need for version Any computer or web-friendly device connected to the Internet may access the same pool of computing power, applications, and files in a cloud-computing environment as shown in figure 1. Users may remotely store and access personal files such as music, pictures, videos, and bookmarks; play games; or do word processing on a remote server. Data is centrally stored, so the user does not need to carry a storage medium such as a DVD or thumb drive. Desktop applications that connect to internet-host email providers may be considered cloud applications, including web-based Gmail, Hotmail, or Yahoo! email services. Cloud computing technologies are regarded by some analysts as a technological evolution.This paper analyzes impact of cloud computing platform on software development process to develop quality software (SW). Economies of all software industries depend on quality SW and SW cost is more than hardware (HW) cost. Moreover because of the involvement of many parties, SW development is inherently a complex process and most of the SW project fails because of lack of communication and coordination between all the parties involved.

The main theme of this paper is that the prevalent SW development process models should involve the cloud provider in every steps of decision making in software development life cycle to make the software project a success In Section II, background literature on software engineering with cloud computing is surveyed. How the software developer is coping with the changing trend of application development with Web 2.0 protocols and application deployment over the cloud is reported. In Section III, challenges of cloud computing platform for software engineering is analyzed. In Section IV a process model which incorporates interaction with cloud provider is proposed and analyzed. Section V concludes the paper.

Literature Survey
Enterprise Application Development Old and New
The old way: application-building that's slow and inefficient.
Over the years, the traditional way of creating and running business applications has become overly complex and umbersome. There are too many

moving parts to buy, install, configure, and maintain—including hardware and software. Plus, the entire infrastructure requires constant maintenance to keep it working smoothly. This overhead burden creates barriers to productivity in custom application development. Computing environment complexity means that every little change can trigger repercussions throughout the organization. That setup significantly reduces overall IT responsiveness, impairing the ability of a company to address constantly changing business needs. Instead, enterprise application development precedes at a glacial pace, with long backlogs a fact of life. The end result is that business managers don't get the applications they need to run their business. Instead, they end up with a welter of unintegrated, homegrown systems on spreadsheets, personal databases, or other unsupported platforms.

The new way: application development productivity in the cloud.
Enter cloud computing platform [11]. Cloud computing is easy to understand: Application development takes place—and all applications run—entirely on the Web. All you need to access them is a Web browser. With just an Internet connection, your developers gain access to an application development environment with all the tools and resources they need. This way, they can develop complete enterprise applications without the cost and complexity of buying and maintaining an on-premises development infrastructure. Developers can be instantly added anywhere in the world, with full access to application development resources. And they can quickly build and instantly deploy solutions, reducing application development cycle time, speeding the response to user requests, and delivering the IT agility required to take advantage of fast-breaking business opportunities. Custom Application Development with Cloud Cloud offers an extremely powerful, scalable, and secure platform for application development. It delivers a complete technology stack covering the ground from database and security to workflow and user interface—so you can focus on assembling, building, and instantly deploying solutions. As a result, custom application development is possible without the headaches and expense of buying, configuring, and managing development hardware and software. Unlike separately designed hardware and software products, Force.com speeds innovation through a powerful yet easy to- use application development and deployment model. You can easily develop and then immediately deploy your solutions to the cloud-based infrastructure lets you implement business logic with workflow rules, approval processes, and custom

code. You can store structured data, support Web browsers and mobile devices, integrate with other applications, do reporting and analytics, and scale up or down—all with the sub-second response time, high availability, and security you need to run your business applications.

Analysis

Impact of Cloud Computing on Software Development
Process:

In the rapidly changing computing environment with web 1014 *2011 World Congress on Information and Communication Technologies* services and cloud platform, SW development is going to be very challenging. SW development process does involve heterogeneous platforms, distributed web services, multiple Enterprises geographically dispersed all over the world. Existing software process models and framework activities are not going to be adequate unless interaction with cloud providers is included Requirements gathering phase so far included customers, users and software engineers. Because Requirement changes of a SW are the major cause of increased complexity, schedule and budget slippage [4]. Incorporating changes at a later stage of the software development life cycle (SDLC) [12]-[13] increases cost of the project exponentially. Adding more number of programmers at a later stage does not solve the schedule problem as increased coordination requirement slows down the project further. It is very important that requirements gathering, planning and design of the SW is done involving all the parties from the beginning. Now it has to include the cloud providers as well, as they will be supplying the computing infrastructure and maintain them too. As the cloud providers only will know the size, architectural details, virtualization strategy and resource utilization % of the infrastructure, planning and design phases of SW development also have to include the cloud providers. The cloud providers can help in answering these questions on: 1) How many developers are needed, 2) Component Reuse, 3) Cost estimation, 4) Schedule Estimation, 5) Risk Management, 6) Configuration Management, 7) Change Management, and 8) Quality Assurance. Because of the component reuse of web services the size of the software in number of kilo- lines of code (KLOC) or number of function points (FP) to be newly developed by the SW engineer will reduce but complexity of the project will increase many folds because of lack of documentations of implementation details of web services and their integration requirements. Only description that will be available online is the meta

data information of the web services to be processed by the computers automatically. Only coding and testing phases can be done independently by the software engineers. Coding and testing can be done on the cloud platform which is a huge benefit as everybody will have easy access to the software being built. This will reduce the cost and time for testing and validation. But software developers have to use the web services and open-source software freely available from the cloud instead of procuring them. Software developers should have more expertise in building software from readily available components than writing it all and building a monolithic application. Refactoring of existing application is required to best utilize the cloud infrastructure architecture in a cost effective way. In latest hardware technology the computers are multi-core and networked and the SW engineers should train themselves in parallel and distributed computing to complement this advances of HW and network technology. SW engineers should train themselves in internet protocols, XML, web service standards and layered separation of concerns of SOA architecture of internet to leverage all the benefits of Web 2.0. Cloud providers will insists that software should be as modular as possible for occasional migration from one server to another for load balancing as required by the cloud provider [9]. Maintenance phase also should include the cloud providers. There is a complete shift of responsibility of maintenance of the infrastructure from software developers to cloud providers. Now because of the involvement of the cloud provider the customer has to sign contract with them as well so that the ―Software Engineering code of ethics‖ are not violated by the cloud provider. In addition, protection and security of the data is of utmost importance which is under the jurisdiction of the cloud provider now. Also occasional demand of higher resource usage of CPU time or network from applications may thwart the pay-by use model of cloud computing into jeopardy as multiple applications may need higher resource usage all at the same time not anticipated by the cloud provider in the beginning. Especially when applications are deployed as ―Software-asa-Service‖ or ―SaaS‖ model, they may have occasional workload surge not anticipated in advance. Cloud provider uses virtualization of resources technique to cater many customers on demand in an efficient way[12]. For higher resource utilization occasional migration of application from one server to another or from one storage to another may be required by the cloud provider. This may be a conflict of interest with the customer as they want dedicated resources with high availability and reliability of their applications. To

avoid this conflict cloud providers need to introduce quality of service provisions for high priority tenants. Now we analyze how difficult will be the interaction between cloud providers and the software engineers? The amount of interactions between software engineers and cloud providers will depend on type of cloud like public, private and hybrid cloud involvements. In private cloud 2011 World Congress on Information and Communication Technologies 1015 there is more control or self governance by the customer than in public cloud. Customer should also consider using private cloud instead of using public cloud to assure availability and reliability of their high priority applications. Benefits of private cloud will be less interaction with cloud

provider, self governance, high security, reliability, availability of data. But cheaper computing on public cloud will always outweigh the benefits of less complexity of SW development on private cloud platform and is going to be more attractive Cloud computing practitioners cite two fundamental benefits:Adaptability: An enterprise can get computing resources implemented in record time, for a fraction of the cost of an on-premise solution, and then shut them off just as easily. IT departments are free to scale capacity up and down as usage demands at will, with no up-front network, hardware or storage investment required. Users can access information wherever they are, rather than having to remain at their desks[3]-[14]. Cost Reduction: Cloud computing follows a model in which service costs are based on consumption and make use of highly shared infrastructure. Companies pay for only what they use and providers can spread their costs across multiple customers. In addition to deferring additional infrastructure investment, IT can scale its budget spend up and down just as flexibly. This leads to an order of magnitude cost savings that wasn't possible with 100% proprietary infrastructure.

Proposed SW Process Model

Innovative software engineering is required to leverage all the benefits of cloud computing and mitigate its challenges strategically to push forward its advances. Use a new software development life cycle (SDLC) model that integrates the particular challenges of a cloud computing deployment environment throughout its processes. Here we propose an extended version of agile process model for cloud computing platform and name it extended agile model [Figure 2]. All the phases like planning, design, construction, testing and deployment need interaction with

the representatives from cloud provider. The roles or

activities by the cloud provider and SW developers are separated and listed in Table 1. A design team should ensure that major conceptual elements of the design (omissions, ambiguity, and inconsistency) [7]. Resource accounting on cloud platform will be done by the cloud provider in the requirement gathering phase. Software architecture, software architecture to hardware architecture mapping, interface design, data types design, cost estimation and schedule estimation of the project all should be done in collaboration with the cloud provider.
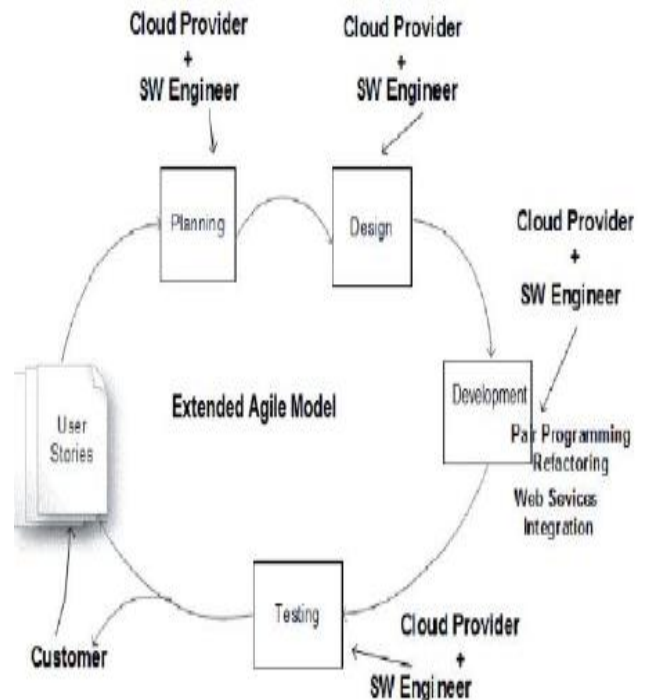

Fig. 3 Extended Agile Model

During the construction phase of the application if web services are integrated where many different enterprises are involved then error should be mitigated with the mediation of the cloud provider. Maintenance contract with cloud provider will be according to the Quality of Service agreement.

TABLE I
SW Engineering- Role Separation

Activity	Roles	
	SW Provider	Cloud Provider
Requirement Gathering	Elicitation	Resource Accounting Virtual Machine
Analysis	SW Modules	SW/HW Architecture
Design	Interface Design Data Types Cost Estimation Schedule Estimation	Component Reuse
Construction	Coding Integration of Web Services	Implementation Details
Testing	Unit Test Integration Test	Integration Test
Deployment		Operation & Maintenance

Conclusion

Cloud computing is a paradigm shift over traditional way of developing and deploying of software. This will make software engineering more difficult as they have to interact with a third party called the ―cloud provider‖. The amount of work required for developing software will reduce but there will be added communication and coordination requirement with the cloud provider which makes software development project more complex. The main thesis of this paper is that the prevalent SW process models should incorporate this new dimension of interaction with the cloud provider and separate roles of SW engineers and cloud providers. A new agile process model is proposed in this paper which includes the anticipated interaction requirement with the cloud provider which will mitigate all the challenges of software development on cloud computing platform and make it more advantageous to develop and deploy software on the cloud computing platform.

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