5th International Conference on Mass Customization and Personalization in Central Europe (MCP-CE 2012)
Customer Co-Creation in Central Europe
September 19-21, 2012, Novi Sad, Serbia

HYBRID CLOUD COMPUTING CHALLANGES AND MASS CUSTOMIZATION

Emilija Ristova[1], Valentina Gecevska[2], Zoran Panov[3]
[1]University "Goce Delcev" Stip, Faculty of Mechanical Engineering, Macedonia
[2]"Ss. Cyril and Methodius" University in Skopje, Faculty of Mechanical Engineering Skopje, Macedonia
[3]University "Goce Delcev" Stip, Faculty of Natural and Technical Science, Macedonia

Abstract: *Mass customization is a new trend in business. Basic concept is to increase the variety of individually tailored products/services to meet customer needs without a large increase in production costs. It requires a highly flexible production technology though. Developing such technologies can be expensive and time-consuming. Cloud computing enables delivery of mass customized services/information in the "Data to Information to Knowledge" chain. The proven success of cloud-based solutions, coupled with the promise of a less expensive and more responsive business solution infrastructure, is prompting many companies of all sizes, from micro, to the mid-market, to enterprises to give the cloud a closer look. The benefits such as including cost-effective, accelerated provisioning in protected environments can no longer be ignored. The aim of this paper is to introduce the way how the mid-market can utilize Public Cloud computing in conjunction with a secure Private Clouds and further more to propose a framework for mass customization and its collaboration in Clouds.*

Key Words: ***Hybrid Cloud Computing, Mass customization, mid market utilization, Collaboration***

1. INTRODUCTION

The magnitude of change that is affecting industries today is unprecedented. Difficult economic conditions, a broader set of business imperatives, and evolving technology requirements are presenting midsize companies with as many threats as opportunities. At the same time, fundamental shifts are taking place in the way people everywhere live, work and interact. It's becoming increasingly clear that innovative, forward thinking companies can do more than survive in this environment, they can thrive.

There is no common definition of what the mid market company is. Depends on the purposes of the survey conducted, some researches want to ensure that the IT department is large enough, without being so large as to skew issues to those of the Fortune 500 so relate on the annual revenue from the IT offerings and others relate to the number of the employees. By Stuart Morley [1], there are several indicators of mid market including: the number of employees, annual sales and market position. Mid-market companies, typically have 100-499 employees, according to a study done by Ipso in 2006 in Canada. In the US mid-market, companies are sometimes defined as having sales of $5 million to $100 million, but other US studies use a more wide range. For an instance, IBM used between 100 and 1,000 in a 2009 study of mid-sized businesses and SAP used a definition of sales of between $30 million and $500 million which represents 1% of the number of all US companies and nearly 30% of corporate revenues. In the UK, the Department of Trade and Industry defines mid-sized firms as having 50-249 employees and 16% of the annual sales. In Europe regarding mid-marked definition, the Economist Intelligence Unit conducted a survey considered firms with €200 million or less in annual revenue. In this paper we accept definition that mid-market are companies with 50 to 500 employees but can be has high as 1,000 employees that generates annual sales of somewhere between $5 million and $100 million with a few definitions stretching the range to $500 million.

In a survey [2], where selected CIO's and CFO's were involved in companies and the IT department budget ranged from $1 to $10 million per year and meanwhile they were counted as mid-market organizations, results indicated that mid market companies have unique characteristics that are causing their IT development needs to go unaddressed. Mid market companies have drastically reduced headcount and yet need to address new business requirements. In the survey was found that CIOs and CFOs are very interested in realigning business goals and IT. They have realized some of the power that IT initiatives have given them, such as more efficient and easy migration into the production phase supply chain management and integrated services.

A survey conducted by Opinion Research Corporation and information technology decision makers at midsize businesses (100-1000 employees) among 17 countries across various industries (banking, retail, healthcare, consumer products, manufacturing) state that they need a technology partner who can help them work smarter, build an infrastructure to support their growing business, and identify ways to use the information they have to make better business decisions. The study reveals distinct mindsets that are actively shaping the business strategy and related IT priorities at midsize companies [3]. Roughly half (53%) of surveyed companies are concentrating their efforts on increasing efficiency and lowering costs-strategic imperatives that can be

supported by virtualization, energy efficiency, process optimization, IT standardization and other initiatives focused on reducing complexity and expense [3].

In this paper, an attempt has been made to introduce the way how the mid market can utilize Public Cloud computing in conjunction with a secure Private Clouds, or so-called Hybrid Cloud Computing as a new IT paradigm within the testing and demo phases of business cycles at vastly information system software packages and its easy migration into the production phase. Cloud Computing can play an important role among mass customization and its collaboration in Clouds, driven by preference of funding sources, sharing of resources and expertise, division of labor/separation of concerns and it is enabled by advances in communication and collaboration technologies [4].

2. MASS CUSTOMIZATION

Mass customization is the capability, realized by companies, to offer individually tailored products or services on a large scale. Mass customization systems have three key capabilities: elicitation, process flexibility, and logistics. Any company considering a mass customization strategy should carefully analyze its ability to deliver on the three key capabilities: elicitation (a mechanism for interacting with the customer and obtaining specific information); process flexibility (production technology that fabricates the product according to the information); and logistics (subsequent processing stages and distribution that are able to maintain the identity of each item and to deliver the right one to the right customer) [5]. Mass customization systems have three those elements that are connected by powerful communications links and thereby integrated into a seamless whole.

Elicitation. Elicitation is hard, customers often have trouble deciding what they want and then communicating influence on their decisions. That creates problems for any company aiming to serve those customers. There are situations in which customers clearly articulate their requirements. More commonly, however, customers are unsure. They are easily overwhelmed by too many selections on a store shelf or a Web page. Any elicitation process is an artful means of leading customers through the process of identifying exactly what they want. The difficulty of eliciting customer-specific information varies with the information required. Deeper levels of customization, however, require more information. Thus mass customization often requires an elaborate enabling mechanism (sometimes called a configuration). Improvements will no doubt be aided by progress in customer relationship management (CRM). CRM collects information about customers, aims to predict their individual desires and behaviors, and targets marketing messages accordingly. Although a targeted marketing message is different from a physical product or a customized service, the goals and technologies of CRM are somewhat similar to those of mass customization. *And again, the question of IT deployment model arises. What about CRM deployment models, what about different sizes of companies and sensitivity of data they managed? What is the role of Cloud computing model?*

2.1 Mass customization and its collaboration in Clouds

The core capabilities is to provide full product space for customers with low cost and high efficiency in customized manufacturers, and ultimately to meet the individual demand of customers [6]. A cloud based platform for mass customization, as a framework given bellow for an instance, by advantages of Clouds might effectively achieve the company's core capabilities and integration of resources and meet the supply and demand between the fluctuation in orders and the long lasting manufacturing capabilities.

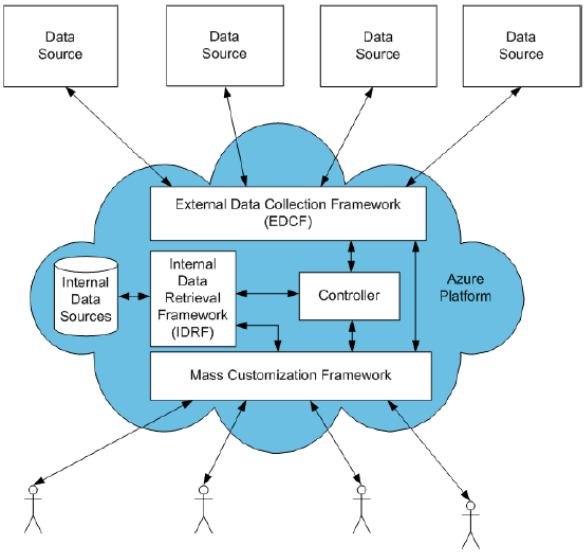

Fig. 1. A framework for mass customization and its collaboration in Clouds [4]

3. HYBRID CLOUD COMPUTING

The evolution of Cloud Computing over the past few years is potentially one of the major advances in the history of computing. Cloud Computing might be one of the alternatives for strategic investments in information technology and infrastructure due to the information systems adoption having in mind the following: companies have to increase innovation and flexibility in meeting the requirements of the market/customers (so they should focus on innovation, not solving problems associated with the infrastructure implementation and its maintenance), „start-up" companies as well as small and medium enterprises cannot afford large investments in information technology and infrastructure, greater flexibility and speed up launching new products on the market offering the opportunity to access and use of already defined data, etc. [7,8,9].

The basic notion of the Cloud computing refers to the technology infrastructure model that enables several types of computing tasks to be performed over a network. The network can be a local area network or a wide area network like the Internet. As mentioned before, the Cloud computing model promotes availability and it is composed of five essential characteristics, three

service models, and three deployment models – Private, Public or Hybrid Cloud computing service.

Private cloud services enable IT departments to do more with the infrastructure that they already have. In a typical private cloud deployment, companies undertake the consolidation of distributed IT resources and apply virtualization to those resources in the data center. This enables IT to provide more cost-effective management while spinning up services faster. However, private cloud deployments can put significant strain on existing resources and work processes. As IT departments consolidate resources, applications and data are typically moved further away from many end users. Branch office employees and mobile workers now are required to go further across the wide-area network (WAN) to get the information they need. The resulting latency can often dramatically reduce performance, and make the business less productive overall. At the same time, the consolidation will put more strain on the available bandwidth connecting branch offices to the data center. With consolidated resources, many more user requests will go back to the data center. The WAN will be responsible for carrying significantly more traffic, which could lead to bandwidth congestion, or even force the enterprise to purchase more bandwidth.

Utilizing a service provider's infrastructure or platform allows companies to integrate the public cloud into their IT infrastructure. A public cloud service allows the company to rent compute power and storage, and is usually billed on a discrete basis. Public cloud services are compelling because of scale and elasticity – a service provider supporting thousands of businesses can drive lower costs than any one business alone, and can provide adaptability for changing workloads as an operating expense rather than a capital expense. One of the major challenges with the adoption of public clouds is performance. Moving services to a public cloud means that companies must accept that their applications can potentially be run from anywhere in the world – wherever the data center of the service provider happens to be. Most public cloud services do not specify data center locations in their terms of service, maximizing their freedom to migrate work to reduce their operating costs. In essence, the distance (and latency) in accessing applications may significantly increase for everyone in the company. More surprisingly, those distances may change unpredictably.

Concerns about privacy and security of data have contributed to many companies' interest in developing private cloud environments, where company data remains inside the firewall or to consider hybrid cloud environments, which incorporate some elements of a private cloud and some elements of a public cloud [10].

While many business executives are attracted to the idea of the public cloud, just as many are interested in achieving the benefits of the cloud but on an internal basis. There are different reasons why companies investigating a cloud might want a private cloud instead of using a public one. The most obvious reason is privacy and security of data. Another reason that some companies are considering the private cloud is that they have already invested in a lot of hardware, software, and space and would like to be able to leverage their investments, but in a more efficient manner.

In most situations, a hybrid environment will satisfy many business needs. Here are some examples:

- A company likes a SaaS application and wants to use it as a standard throughout the company; top management of the company it is concerned about security. To solve this problem, the SaaS vendor creates a private cloud just for the company's needs inside their firewall. They provide the company with a virtual private network (VPN) for additional security. In this manner, the company has both public and private cloud ingredients.
- A company offers services that are tailored for different markets. For an example, a company might offer to handle claims payments for insurance agents, shipping services for manufacturers, or similar. The company may want to use a public cloud to create an online environment so each of the company's customers can send the requests and review their account status. However, the company might want to keep the data that they manage for these customers within their own private cloud.

4. AN APPROACH TO THE MID MARKET UTILIZATION OF HYBRID CLOUD COMUTING

Despite its critics, cloud computing technology has successfully transitioned from a "trend" to a trusted technology source relied upon by company's of all sizes, from start-up's, to the mid-market, to enterprises. Its proven benefits such as including cost-effective, accelerated provisioning in protected environments, etc., can no longer be ignored.

4.1 Eliminating Cloud Computing confusion

Cloud computing has been driven to the forefront of technology and business by companies such as Amazon.com, Salesforce.com and Rack space. Although these large-scale cloud providers are leading the way in this space, their approaches are fundamentally identical: they offer the same public cloud solution to all of their customers. While this solution is favorable for some cost conscious businesses, it is not tailored for the business processes and unique needs of the mid market. Every company maintains vastly different IT infrastructures.

Therefore, it is important for implementers to understand the distinction between these cloud infrastructures, known as public clouds, and the solutions and services that comprise a private cloud model, a custom configuration built from the ground up with dedicated hardware including clusters of servers, storage area networks, firewalls, databases and load balancers.

While the public cloud is highly economical and can be utilized to meet company utility computing needs, the option a "one size fits all" approach, often introducing risks such as reduced availability of critical applications, or potential data compromises. These weaknesses are among the most common concerns cited by cloud computing cynics who are quick to overlook its overwhelming benefits.

As mentioned before, private clouds offer the counterpart. In the private cloud, computing resources

and applications can be provisioned on-demand using virtualization and workload balancing, while simultaneously providing a secure environment for proprietary data and software.

While both have their benefits, we tout that the hybrid cloud, a combination of public and private, is the best solution for the mid market. For an example, by utilizing public clouds, service providers can create demo environments for multiple customers in a matter of hours, rather than weeks. From there, customers can easily be accommodated by quickly moving them from a demo environment into development, quality assurance and testing, and finally production with a private cloud. This entire process can be managed in a secure environment, backed by zero down-time.

4.2 Reliability in the Private Cloud

Virtualization is an easy solution for limiting expansive growth of physical IT infrastructure, which often wastes vital resources due to vast server sprawl. Installing applications on virtual machines greatly reduces the amount of physical assets needed, which introduces significant cost savings and eliminates unnecessarily complex IT infrastructures. Additionally, applications running on virtual machines are protected from downtime and disruption via scalable, high-class enterprise servers, enabling to company to increase their ability to maintain data integrity security controls. These solutions have all of the logging, auditing, and prevention mechanisms of traditional operating models to determine who has access to information, and how that information is stored, processed, or transferred.

A new approach can be preconfigured within hybrid cloud solution that is tailored to the client's business needs. In that way, the full visibility into operational and development areas and the power to control availability at all times through dynamic resource scheduling, as well as workload balancing (a capability especially key for multi-tenant environments) is available.

Data, applications, and development projects can be monitored constantly (24/7), migrated from one virtual machine to another without downtime, or automatically re-allocated according to your business needs.

4.3 Scalability in a Hybrid Cloud Computing

It is evident that the time consuming process of procuring hardware, testing and securing it, then rolling it out, can delay sales. Typically, when conducting demos and navigating clients through an application lifecycle, companies can be restricted to a equal ratio between applications layers and servers (an expensive setup that impedes the ability to swiftly prepare services for customers). Once up and running, these dynamic testing environments can often become inactive, posing additional challenges for users.

The cloud solves each of these issues by eliminating hardware dependency, allowing service providers to manage multiple customers in one environment at any given time. Service providers can quickly and easily provision new stand alone test environments on demand for themselves, current clients, and prospective clients with little fuss.

Those challenges aside, developers struggle with additional obstacles after clients move forward with the next phase for a project, ranging from burdensome, data intensive applications that are difficult to migrate, to real time operations, to evolving project requirements.

However, within a virtualized cloud environment, resource intensive applications can be easily moved, enabling users to move clients from development to production, and meet the demands of projects that are constantly in flux.

4.4 Customized Private Clouds depend on the vendor

As businesses continue to move toward on-demand service models to operate their IT infrastructures, infrastructure providers must evolve with them. Finding the perfect fit to support a developer's IT needs depends on operational environments that enable companies to develop and test comprehensive, turnkey services that can be managed or handed over to clients.

Hosted at multiple top tiers, world class data center facilities, vendor's hybrid cloud solutions should be protected by the highest levels of security.

What do these partnerships mean for company's business? To surpass competitors, vendor's public cloud features a group of pre-defined virtual machines, allowing service providers to create a grouping of custom virtual machines that mimic any given test or demo environment being pushed out. By replicating a pre-configured VMware Apps, rather than a cluster of applications, deployments are made faster and more efficient, saving hours of time and eliminating manual tasks.

How to overcome dependability? Vendor's private clouds ensure that data and resources are protected by completely redundant servers, providing high-availability and 100% uptime; all supported by customizable file level backup and restoration capabilities.

What about security issue? Vendors of the cloud solutions should offer the ability to conduct development within a segregated environment. In this way, separation provides a secure area that can be used for demonstration, training, development, and testing purposes without jeopardizing enterprise information resources.

New approach created to help meet company's growing business demands, the unified management portal can seamlessly shift workloads to and from the private cloud to the vendor public clouds without reloading data, changing IP addresses, or encountering DNS (Domain Name System) issues.

5. CONCLUSION

When it comes to information systems (for an instance, Product Lifecycle Management software packages or CRM systems), in today's complex business environment, companies are beginning to focus more and more on the individual productivity, application productivity and IT productivity. These three factors must be balanced and optimized at moderate cost. This is

particularly challenging for small and medium sized companies who don't want to tie up their investment resources in major IT systems particularly within the testing and demo phases of business cycles.

The benefits of using on demand solutions for SME's means:

- Improved cost efficiency, lower TCO (by using standardized applications, the costs of rollout, service and operation, user training and ordering and billing processes can be reduced significantly. This is the basis for ensuring a much lower „time to value" and total cost of ownership (TCO) [11])
- Flexibility trough the "pay-per-use" model
- Improved service quality through standardization
- Faster implementation (on average less than three months following kick-off in a typical user environment)
- No implementation risks
- Higher reliability thanks to the limited need for fine-tuning
- Higher reliability thanks to the limited need for fine-tuning.

As businesses continue to move toward on-demand service models to operate their IT infrastructures, many providers of on-demand and custom cloud solutions are paving the way for companies to better serve customers by combining the reliability, scalability and flexibility of the cloud. The burden of short scheduling requirements within the testing and demo phases of business cycles at vastly information systems is eliminated through swift provisioning of resources. The expensive hassles of dealing with aging hardware, server refresh, and the need to quickly adapt to unexpected frequent changes can all be offloaded and managed by cloud services. By relegating these tasks to the private cloud, businesses can focus on innovation, rather than keeping the lights on.

In that manner, reliability in Private Clouds as well as scalability that Public Clouds offer, ensure the future of Hybrid Cloud Computing in conjunction with SME's. As previously emphasized, Cloud computing can play an important role among mass customization and its collaboration in Clouds, the most driven by preference of funding sources, sharing of resources and expertise, division of labor/separation of concerns and it is enabled by advances in communication and collaboration technologies. The service platform architecture and the core technology can improve the service capacity of mass customization business through the integration of resources, demand integration and optimal configuration.

6. REFERENCES

[1] Stuart Morley, *The unique challenges of mid market companies*, Stabilize and grow business, JUMP, 2007.

[2] David Jakopac, *Survey Reveals Needs of Mid-Market Companies*, Lisle Technology Partners, LLC, 2003.

[3] IBM Worldwide Study, *Inside the Midmarket: A 2009 Perspective, An environment like no other*, IBM General Business, USA, 2009.

[4] Kwa-Sur Tam, *Cloud Computing as a Cyber-Infrastructure for Mass Customization and Collaboration*, VirginiaTech, Invent the Future, 2012.

[5] Zipkin, Paul, *The Limits of Mass Customization*, MIT Sloan Management Review; Spring 2001, Vol. 42 Issue 3, p81, 7p, 1 cartoon.

[6] Wenzhe Chen, Pinqiang Dai, Yonglu Chen, Qianting Wang, Zhengyi Jiang, *Study on Cloud-Based Service Platform for Mass Customization*, Jun Hua Che et al., Advanced Materials Research, 479-481, 98, 2012.

[7] Ahmed Patel, Ali Seyfi, Yiqi Tew, Ayman Jaradat: *Comparative study and review of grid, cloud, utility computing and software as a service for use by libraries*, Library Hi Tech News Number 3, 2011, 25-32.

[8] Sean Marston, Zhi Li, Subhajyoti Bandyopadhyay, Juheng Zhang, Anand Ghalsasi: *Cloud computing — The business perspective*, Decision Support Systems 51, pp. 176–189, 2011.

[9] Emilija Ristova, Valentina Gecevska: *AHP methodology and selection of an advanced information technology due to PLM software adoption*, Proceedings of XV International Scientific Conference on Industrial Systems, ISBN 978-86-7892-341-8, COBISS.SR-ID 266010119, pp. 588-562, Novi Sad, Serbia, 2011.

[10] Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, *Cloud Computing for Dummies*, Wiley Publishing Inc., 2010.

[11] Case study: *Siemens IT Solutions and Services*, Fujitsu Technology Solutions GmbH, 2010, www.siemens.com/it-solutions.

CORRESPONDENCE

MSc Emilija Ristova, Assistant
University "Goce Delcev" Stip, Faculty of Mechanical Engineering, Stip, Macedonia
emilija.ristova@ugd.edu.mk

Dr Valentina Gecevska, Prof.
"Ss. Cyril and Methodius" University in Skopje, Faculty of Mechanical Engineering – Skopje, Macedonia
valentina.gecevska@mf.edu.mk