International Journal of Advance Research and Innovation
Vol. 5(2), Apr-Jun 2017, pp. 45-50
Doi: 10.51976/ijari.521708

Article Info
Received: 02 Jan 2017 | Revised Submission: 20 Feb 2017 | Accepted: 28 Feb 2017 | Available Online: 15 Jun 2017

A Systematic Review of Strategies and Methods for Cloud Migration

*Krishan Tuli**

ABSTRACT

By leveraging cloud services, organizations can arrange their software systems over a pool of resources. However, organizations heavily depend on their business-critical systems, which have been developed more than long period. These inheritance applications are usually deployed on-premise. In recent years, research in cloud migration has been carried out. However, there is no derivative study to consolidate this research. This paper aims to identify, taxonomically catalog and methodically compare existing research on cloud migration. By analyzing the research achievements, we split the presented migration methods into three strategies according to the cloud service models integrally. Unusual processes need to be painstaking for different migration strategies, and different tasks will be implicated accordingly. We conducted a systematic literature review (SLR) of 23 selected studies, published from 2010 to 2013. We classify and compare the selected studies based on a characterization framework that we also introduce in this paper. The research blend results in a facts base of current solutions. This review also identifies research gaps and commands for future research. This review reveals that cloud migration research is still in premature stages, but is advancing. It identifies the requirements for a migration framework to help improving the maturity level and consequently trust into cloud migration. This review shows a need of tool support to computerize migration tasks. This study also identifies needs for architectural version and self-adaptive cloud-enabled systems.

Keywords: *Cloud Computing; Cloud Migration; Legacy System; Migration Strategies; Systematic Literature Review.*

1.0 Introduction

Clouds are a outsized pool of easily serviceable and accessible virtualized resources such as hardware, development platforms, and software. These resources can be dynamically re-configured to bend to a variable load, allowing for optimal resource utilization. According to the virtualization of resources, there are three cloud service models emerged: Infrastructure as a service (IaaS), Platform as a service (PaaS) and Software as a service (SaaS). The industry model of the cloud is pay-as-you-go, so enterprises can diminish capital expenditure by leveraging the cloud service. Based on these uniqueness, cloud computing provides many benefits needed by endeavor, such as no up-front investment, lower functioning cost, high scalability, and so on. Software migration is the procedure of switching from one operating environment to another so as in most cases is considered to be better. A legacy system is an obsolete computer system that remains in utilize even after more existing technology has emerged either because the organization may have invested significant time and money in it or the legacy system holds precious data. In order to take benefit of cloud computing and protect the existing investment to legacy system, endeavor are eager to migrate legacy systems to the cloud. Consequence, the study in academia and carry out in diligence on migrating legacy systems to cloud computing are very widespread today. Aggravated by the promised benefits of cloud environments, there has been considerable investigate on cloud enabled software and facilitating the resettlement of legacy on-premise software to the cloud. These approaches mainly focus on obtainable methods, techniques, processes and frameworks directly enabling migration or in some way contributing towards justifying the decision of migrating to the cloud. The assumption for each of the approaches is that in its early state, the software

**Department of Computer Science, Chandigarh Group of Colleges, Landran-Kharar Highway, Sector 112, Landran, Sahibzada Ajit Singh Nagar, Punjab (E-mail: mca.krishantuli@gmail.com)*

function is hosted on premise in a non-cloud environment, e.g., on a restricted server, before the migration is pertaining to it. As a result, migration between cloud providers, deployment models and virtual resources branded as live migration is outside the scope of this work. Thus far, there has not been a systematic literature review (SLR) of delve into onto cloud migration, making it hard to assess the maturity in general and identifying trends, research gaps, and future proportions of cloud migration in particular. In addition, considering the growing demand for migration towards cloud, we need to inspect a research agenda for cloud migration. A SLR identifies, classifies and synthesizes a proportional overview of state-of-the-research and enables knowledge transfer in the research community.

2.0 Migration Strategy

With gaze at the migration classification, there subsist different classification cases in different literature. There are three type of migration Binz et al. has classified: Standardized Format Migration, Component Format Migration and Holistic Migration. The format of the individual component transformed into an additional format in the second type, for example, transforming a virtual machine image or else enabling the execution of scripting languages on PaaS. Holistic migration aims toward realize migration to complete application built out of several components by migrating each component separately. In the direction of holistic migration, the authors projected the cloud motion framework that could leverage existing application models and make available support to migrate composite applications to cloud. Reference recognized four migration types that could cloud-enable applications by variation. The first kind replaces components with cloud offerings, which is the least persistent type of migration. The second kind describes the case with the intention of migrates some of the application functionality to the cloud. The third kind is the classic migration case where the entire software stack of the application is migrated to the cloud. The last kind is complete migration of the application. Whilst Gartner suggests information technology (IT) organizations think the following five options, as they seek to move legacy systems to the cloud: re-host lying on infrastructure as a service, re-factor intended for platform as a service, revise for IaaS or PaaS, re-build on top of PaaS and re-place by means of software as service. However, Cisco believes in three application migration options including SaaS, PaaS and IaaS. They believe the migration to SaaS is no longer an application migration although more of a replacement of the existing application with a SaaS. Migration toward PaaS is an option for migrating business applications based on typical application server software such as JavaEE or .net platforms. Migration towards IaaS involves deploying the application on the cloud servers. In toting up, the criteria that are used for considering each application migration are discussed.

Cloud migration should acquire a holistic view of all the aspects concerned in meeting the business and technical goals of an organization. There are 4 Major phases involved in cloud migration:

- Definition of cloud migration
- Design of cloud migration
- Migration of cloud migration
- Management of cloud migration

2.1 Definition:

This phase is majorly critical phase as most important decisions are taken in this phase, which sets the path for the rest of the phases. The early process is evaluating the business needs as well as the potential benefits that can be expected in moving to cloud. Based on top of the identified needs along with benefits, Return of Investment (ROI) be calculated and that can begin the cost benefit analysis in an objective way. Once the benefits and ROI are checked, a cloud migration strategy will be amorphous. This strategy will include the challenges, technical risks and solution approach. Laying on the cloud approach a migration roadmap will be developed, which will offer details on the phases involved, migration approach, cloud candidate list and so on.

2.2 Design:

Definition phase be followed by the Design phases where the cloud strategy and migration roadmap are placed into action. As a first step, parameters intended for identifying the cloud vendor are recognized based on the business needs and cloud strategy. Possibly cloud vendors are subsequently rated against these parameters resulting in the best choice of cloud vendor. As part of the cloud readiness the chosen application's architecture is reviewed

intended for cloud suitability. The technology stack is too reviewed to validate it's fitment with cloud based model.

2.3 Migration:

Based on the migration arrange this section might happen in associate degree unvaried manner. As a primary step, cloud setup is completed supported the finalized cloud design. The network, security, storage and alternative base design level setup are dead 1st. Once the fundamental cloud design is setup, resources are emotional supported the known priority and additionally applying the dependency constraint. Resources will embrace storage, tools, contents and utilities. Followed by resources, applications are setup in an exceedingly similar approach by applying priority and dependency constraints.

2.4 Management:

This section focuses on putting in the flexibility aspects of the cloud setting. As a primary step, change as several steps as doable so there's terribly lowest manual intervention concerned. Automation is worn out the areas of car scaling, configuration, back-up, DR and readying. Cloud observance is another key space that's vital for cloud management. Implementation of observance at each infrastructure and application level by investment each the integral tools offered by the cloud supplier also as external observance tools like New Relic.

3.0 Migration to IAAS and PAAS

3.1 Migration to IaaS

Infrastructure as a service is a variety of hosting, which includes network access, routing services, and storage. IaaS provider usually provides hardware and administrative services used to store applications as well as a platform for running applications. A virtual machine is built in favor of an application, which is loaded with all the software with the intention of eventually run in the cloud. In that case the virtual machine is uploaded to IaaS vendors hosting environment as well as deployed to run. IaaS is the most excellent choice for moving applications to the cloud when there is no point in time to reengineer the applications for a cloud.

With reverence to migration method, cloud computing service providers, the same as Amazon and Cisco, provide the details for migrating legacy systems to their platforms. Through experiments, the installation mistakes along with configuration errors were identified as the two main sources of errors in migration. Further a migration management framework was proposed on behalf of providing the installation automation and configuration validation, which uses templates to make simpler large scale enterprise system installation process and uses policy to authenticate the configuration and monitor the configuration changes. In short, users contain full privileges on the allocated virtual machine (VM) in migration to IaaS. They might do anything to the VM, but there is something incredible need to be considered before conducting migration:

1) Dynamic resource obligation.
2) Constraint to data storage location.
3) Prerequisite of special hardware devices.
4) Quantity of data stream.

3.2 Migration to PaaS

Platform as a service be an application development along with deployment platform delivered as a service in the direction of developers, which provide the hardware and a certain amount of application software same as databases, middleware, plus development tools. Migration based on PaaS is not at all mandatory for resource management, except it is required to make the legacy system well-matched to the requirement of PaaS provider.

Microsoft, Cisco, and Solentive offer guide for migration to PaaS from technology field, except these guidelines are limited to the PaaS they provide as well as not valid to other general cases. For the wide-ranging cases, reference particularly checking steps for application migration to PaaS, along with programming language, database, restrictions as well as limitations of the selected PaaS in addition checking specific requirements related to hardware, software along with input data as discussed in migration to IaaS. Furthermore, the general solutions to solve inappropriateness issues of database migration were discussed. Tran et al. clear the scope of migration software system for the cloud. They recognized all activities in migration that start from getting familiar with the application, the aim cloud platform, and the third party tool, after that to build the environment and get equipped for migration, as well as to modify as well as to test and ensure that the application properly runs in the cloud. In brief, PaaS

provisions a complete cloud IT stack for software development plus delivery, which makes it achievable to build "true" cloud applications and release them in a scalable and elastic environment. Furthermore, it also produces plentiful restrictions at every technology layer of the application stack:

- Programming language.
- Database.
- Middleware.
- Third party library.
- Restriction of the selected PaaS.

4.0 Related Development Tools

MoDisco is a general and extensible open source overturns engineering solution, which intensively uses MDE principles and techniques to get better approaches for reverse engineering. In contrast to many development tools that focus on UML generation from a precise technology and vice versa. MoDisco provides standard support for different target meta models as well as extensibility to other technologies.

MoDisco supports four use-cases of offered software modernization. The primary use-case is quality assurance which focuses at verifying whether an existing system meets the requisite qualities. Next is documentation which focuses on the withdrawal of information from an existing system to help recognize one aspect of the system. The third is upgrading which concentrates on transformation of an existing system to put together better coding norms or design patterns.

Lastly, migration which gears transformation toward the component, the framework, the language, or the architecture of legacy system. In every case, modernizing an obtainable software system includes three phases.

Initially the information should be extracted out of the artifacts of the scheme. After that the extracted information will be understood in order to get good modernization decisions. Lastly the information is transformed to new artifacts which might be metrics, document, code and so on. Blu Age is one more agile key for application modernization that focuses on extracting legacy architecture into a PIM arrangement and regenerates it to a modernized scheme using MDA approach.

Blu Age application is based on three harmonizing products. Blu Age reverse model extracts the business code of legacy application and transforms it into UML2 model which is self-governing related to any technology.

Blu Age database modernization migrates database technologies by means of modernizing forward engineering initiate applications by compiling UML2 models. Blu Age engineering automates data and strengthening their integrity.

Modelio is an open source modeling environment that supports SoaML, SOA architecture modeling standard, by means of specific editors dedicated to SOA architecture modeling as well as architecture implementation model generation. Modelio's core architecture is primarily concerned with meta-meta infrastructure. The core architecture supports extensibility mechanisms, particularly for UML profile definition, as well as provides the concept of modules, which package extensions and be able to dynamically applied to or withdrawn from an existing model.

Modisco and Blu Age both ADM compliant case tools that can remove architecture model from legacy system. The extracted model will be the start point of the subsequent forward engineering. Modelio imports the improved system model and generates SOA models from side to side componentization and refactoring. SOFTTEAM developed a sequence of migration tools based Modelio environment. Currently the link between Blu Age and Modelio is completely functional.

5.0 Challenges

Based on the above comparison as well as analysis, we identified the subsequent challenges that could be research topics in the future.

5.1 Holistic methodology

Till date, the existing research typically focused on the consideration of a particular migration approach. A holistic methodology of migrating legacy systems to the cloud is desired. Primarily, the migration of legacy systems to the cloud must be divided into realistic types, the Cloud providers and legacy systems must be classified, too. Then, according to a detailed kind of legacy system, the variety of Cloud providers, the migration type to be functional, and the required adaption for the migration must be made.

5.2 Scalability in IaaS

For the migration to IaaS, if the quantity of resources required by the application is steady, it is unnecessary to become accustomed for migration. However, for a number of applications, resource requirements might differ considerably from time to time, organization have to implement a new resource management component so as resources might be acquired and released automatically on demands.

5.3 Usage of essential cloud characteristics

For the migration to PaaS, in adding together to the adaption to programming languages, databases and third-party components, organization desires to consider redesigning some business processes in order to develop essential cloud characteristics.

For instance PaaS provides MapReduce programming model which is a easy data-parallel programming model designed for scalability as well as fault-tolerance. MapReduce can automatically parallelize and carry out the program on a large cluster of commodity machines.

5.4 Architecture refactoring

To reengineer legacy system to SaaS, the architecture of obtainable legacy applications need to be re-factored by design patterns for SOA and cloud computing. SOA in addition to cloud computing technologies complement both. SOA enables software architecture better scalability as well as reuse of application components.

5.5 Integrated development environment

Intended for the migration to SaaS, it refers to an integral reengineering. High-quality tools are prerequisite to successful execution of a job.

An incorporated development environment can promote migration efficiency, which must include model recovery tool, migration process tool, component recovery tool, pattern composition tool as well as service generation tool.

Model recovery tool is used to extract model as of the legacy system.

5.6 Other research topics

Besides migrating legacy system from conventional environments to cloud platforms, application migration flanked by cloud platforms may be necessary in the future.

5.7 Our ongoing work

At the moment we are focusing on migrating a workflow running system to cloud platform Aneka. From beginning to end, the existing workflow management system operation in the inhouse data center would be provided as SaaS to end users. The end workflow system will concentrate on methodical computing on large data, which can take full benefit of the virtue of the cloud.

6.0 Conclusions

Since cloud has been hastily gaining pace it's extremely significant the solution provider to be aware of the most recent happenings and trends in cloud, so that the answer proposed is in-line through the future changes in cloud technologies. Software migration is the procedure of moving legacy systems from one process environment to another that is, in mainly cases, thought to be better. Migrating legacy scheme to cloud computing can efficiently protect software assets and take benefit of cloud computing. Many research projects have been carried out, and some inventive methods and tools have been proposed so far. Through investigating the existing literature, we classify the migration into five strategies, after that review and compare the related researches on each migration strategy. In addition, associated development tools are surveyed. Based on the existing research achievements as well as application status, a number of future works are identified including holistic methodology, redesign plus adaption to application designed for special migration, architecture refactoring, integrated development environment, and so on. Besides, we become aware of the most sophisticated research in migration of legacy software to cloud computing has been performed in REMICS, consequently some further work in this research field should be carried out based on the achievement obtained in this project.

References

[1] LM Vaquero, L Rodero-Merino, J Caceres, M Lindner. A break in the clouds: Towards a cloud definition. ACM Sigcomm Computer Communication Review, 39(1), 2008, 50–55.

[2] J Geelan. Twenty Experts Define Cloud Computing, [Online], Available:

http://cloudcomputing.syscon.com, July 18, 2008.

[3] M Armbrust, A Fox, R Griffith, AD Joseph, RH Katz, A Konwinski, G Lee, DA Patterson, A Rabkin, I Stoica, M Zaharia. Above the Clouds: A Berkeley View of Cloud Computing, Technical Report, Department of Electrical Engineering and Computer Sciences, University of California, Berkeley, 2009.

[4] R Buyya, CS Yeo, S Venugopal. Market-oriented cloud computing: Vision, hype, and reality for delivering it services as computing utilities. In Proceedings of the 10th IEEE International Conference on High Performance Computing and Communications, IEEE, Dalian, China, 2008, 5–13.

[5] CY Low, Y Chen, MC Wu. Understanding the determinants of cloud computing adoption. Industrial Management & Data Systems, 111(7), 2011, 1006–1023.

[6] G Gruman, E Knorr. What cloud computing really means, http://www.infoworld.com, July 18, 2013.

[7] Roy Bragg. Cloud Computing: When Computers Really Do Rule, http://www.technewsworld.com, July 16, 2008.

[8] P Watson, P Lord, F Gibson, P Periorellis, G Pitsilis. Cloud computing for e-science with Carmen. In Proceedings of the 2nd Iberian Grid Infrastructure Conference Proceedings, Porto, Portugal, 2008, 3–14.

[9] Q Zhang, L Cheng, R Boutaba. Cloud computing: Stateof-the-art and research challenges. Journal of Internet Services and Applications, 1(1), 2010, 7–18.

[10] Definition Migration, http://searchcio. techtarget.com, July 17, 2013.

[11] A Khajeh-Hosseini, I Sommerville, J Bogaerts, P Teregowda. Decision support tools for cloud migration in the enterprise. In Proceedings of the 2011 IEEE International Conference on Cloud Computing (Cloud), IEEE, Washington, DC, USA, 2011, 541–548.

[12] A. Khajeh-Hosseini, D. Greenwood, J. W. Smith, L. Sommerville. The cloud adoption toolkit: Supporting cloud adoption decisions in the enterprise. Software: Practice and Experience, vol. 42, no. 4, pp. 447–465, 2012.

[13] C Ward, N Aravamudan, K Bhattacharya, K Cheng. Workload migration into clouds challenges, experiences, opportunities. In Proceedings of the 2010 IEEE International Conference on Cloud Computing (Cloud), IEEE, Miami, FL, USA, 2010, 164–171.

[14] Cloud Adoption Assessment. http://www.eduserv.org.uk, July 20, 2013.

[15] M Menzel, R Ranjan. CloudGenius: decision support for web server cloud migration. In Proceedings of the 21st International Conference on World Wide Web, ACM, New York, NY, USA, 2012, 979–988.

[16] A Khajeh-Hosseini, D Greenwood, I Sommerville. Cloud migration: A case study of migrating an enterprise IT system to IaaS. In Proceedings of the 2010 IEEE International Conference on Cloud Computing (CLOUD), IEEE, Miami, FL, USA, 2010, 450–457.

[17] T Binz, F Leymann, DSchumm. CMotion: A framework for migration of applications into and between clouds. In Proceedings of the 2011 IEEE International Conference on Service-Oriented Computing and Applications, IEEE, Irvine, CA, USA, 2011, 1–4.