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A Quantitative Study on Migration Path of Legacy Systems to Contemporary Systems

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Abstract—*Fast pace of business-driven changes. The changes lead to the need for increasing business agility. The legacy systems tend to lack in designed structures, logic, coding and documentation which needs to be migrated to contemporary systems. Contemporary systems such as SOA, Cloud computing etc are available for system migration. In this paper migration path has been completely analysed from the user's perspective parameter considered. Several techniques and tools are available for migration but the path they get transformed was not analyzed till yet .The results shows up a best migration path legacy systems to contemporary systems.*

Keywords*: legacy, contemporary, SOA, Cloud Computing*

1. INTRODUCTION

Growing competition and globalization, tighter regulation and increasing merger and acquisition are accelerating changes in business requirements, demands newer architecture and technologies. For the current scenario there are several technologies available such as cloud computing, SOA, etc.

SOA is an architectural style that uses loosely coupled services, having separated concerns, as main components to build new solutions as compositions of services. Web services technology allows interoperability of services located/accessible in/from the Web. A systematic way of realizing SOA with Web services would challenge these changes in business requirements. SOA with Web services can leverage software systems to become more efficient and responsive to change. However, moving to SOA with Web services would not be possible without taking into account the existing enterprise assets, such as legacy applications and databases, for several reasons, namely (1) SOA is mainly about reuse of assets ;in this regard, legacy applications are running smoothly and performing critical tasks, (2) most of the business functions are locked within them (3) legacy applications were built at high cost, and we need to preserve these investments, and (4) migration to SOA can give new life to legacy applications. Yet, the legacy applications were built without taking into account the advent of SOA and Web services and are incompatible with these environments. Therefore, modernization techniques of these legacy applications are necessary. However, there exist several modernization techniques, including replacement, redevelopment, migration, reengineering, and extension surrounding, and wrapping, which requires an understanding of both the applications and the changes, in business and technology, since these applications were developed. One of the solutions, we discuss in this work, is to extend the critical business logic of the legacy applications while preserving the investments, through their wrapping to Web services and SOA environments, making them loosely coupled, interoperable, discoverable, and (re)usable within and across the boundaries of the enterprise. Indeed, Web services technology provides a standard way for legacy applications to expose their functionalities over the Web or communicate and integrate with other applications, regardless of the application programming language or the running platform. This solution has several benefits as it:

(1) extends the life of the legacy applications by making them reusable in SOA, (2) abstracts their logic and data, (3) leverages the investment by taking advantage of their capabilities, (4) minimizes the risks and costs involved as they stay intact and reusable in SOA.

A critical aspect of this solution concerns with guidance process that assists IT department teams to select an appropriate solution among several potential, yet confusing, modernization techniques and tools. Indeed, constructing services from existing legacy applications to obtain the benefits of SOA is not an easy task. It requires a complex task, particularly when the services are expected to execute within a tightly constrained environment. Moreover, there is a risk, even if it is minimized in the wrapping solution, that the migration process does not succeed. Numerous projects and automated tools exist to wrap legacy applications and expose them as Web services as detailed in the related work section. Each tool has several features to wrap parts of the legacy application (interface, logic, or data). Yet, these tools do not provide the necessary guidance on which feature is most suitable for the target legacy applications to wrap as Web services.

1.1 Service Oriented Architecture

Service-oriented architecture (SOA) can be viewed as an architectural construct for flexible connection of separate components in response to changes in business. SOA focuses on the exchange of information among major software components and on the reusability of the components by separating the interface from the internal implementation. There are several features of SOA that make legacy system modernization appealing in today's world, including loose coupling, abstraction of underlying logic, agility, flexibility, reusability, autonomy, statelessness, discoverability and reduced costs. The primary purpose for the adoption of SOA is to improve business communication so that the goals of the enterprise can be more readily realized.

Chatarji provides a summary of the business advantages of migration to SOA. Short-term benefits include improving reliability, reducing hardware costs, leveraging existing development skills and moving to a standards-based server and applications. An important advantage is providing a data bridge between incompatible technologies. The long-term benefits are reduced management costs and the collection of unified information taxonomy.

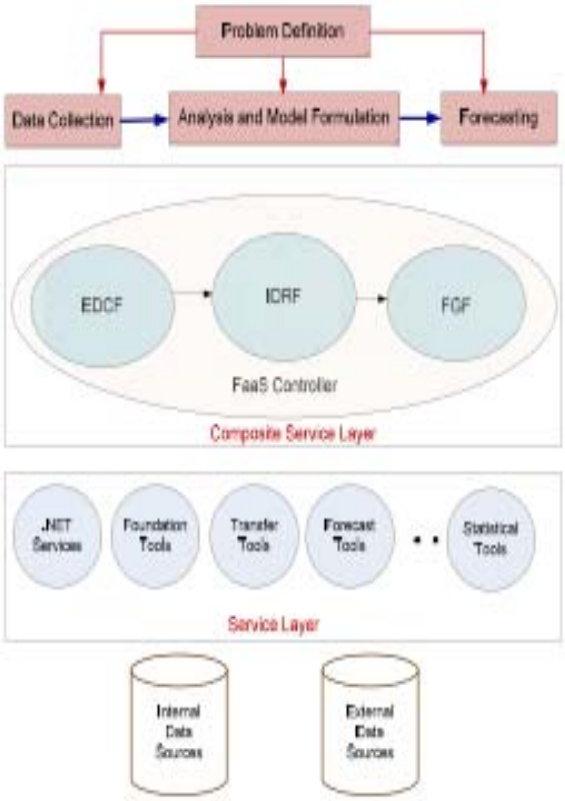

Fig. 1: Layered Architecture of SOA

Fig.1 shows the layered organization of the services, composite services and workflows in the framework. Services in the Service Layer consist of the fundamental and agnostic services that are not coupled to any specific application. They perform tasks such as data transfer over the Internet (Transfer Tools services), statistical analysis (Statistical Tools services), forecasting (Forecast Tools services), etc.

1.2 Cloud Computing

While SOA is for service development and building applications, cloud computing provides the infrastructure for the deployment of these services. SOA and cloud computing are complementary to each other and together they provide agile software solutions to many problems. There is a number of cloud computing service providers such as Amazon, Google, Microsoft, Rackspace, etc. The Microsoft Azure cloud computing platform has been chosen for this project for the following reasons. Azure, as well as compatible software such as the Windows Communication Foundation and the .NET technologies supports the design principles and implementation of SOA in the cloud. The development environment for Azure is integrated into Visual Studio and provides a simulated runtime for Azure for local desktop based development and unit testing. Azure has a "staging" environment where an application can be deployed to the cloud, but will not be made live until the developer is happy with how it works.

1.3 Role and Place of Legacy Applications within Web Services Architecture

The term ‘legacy application’ was used to describe old applications that are running on outdated hardware or software and continue to be used only because the costs and risks involved in replacing or redeveloping them are high. Nevertheless, today this term has been extended to include any application that was built and deployed without incorporating new business needs, architectures, or technologies. or instance, applications that are meeting the organization requirements, IT investment preserving, reliable, secure, yet do encounter reusability within newer architectures, specifically SOA. Indeed, SOA embodies many old as well as new enterprise applications that collectively need to conform to SOA principles. The challenges facing IT organizations require re-architecting the IT infrastructure in order to reflect business concepts and requirements, namely business processes, rather than low-level technical concepts (APIs, data types, and platforms). Actually, several business drivers are leading IT management teams to engage in modernization projects tightly coupled business functions should be transformed into loosely coupled, flexible reusable building blocks to integrate within the modern enterprise architecture. This means that applications should communicate regardless of their language, platform, and network configurations. IT infrastructures that were initially built for performance purposes should now encounter reusability, integration, and security. However, a range of questions arise as mentioned by and we can summarize in ‘What kind of guidance stakeholders are provided with’ to select the applications (or parts of the

applications), the modernization techniques, and specifically the tools.

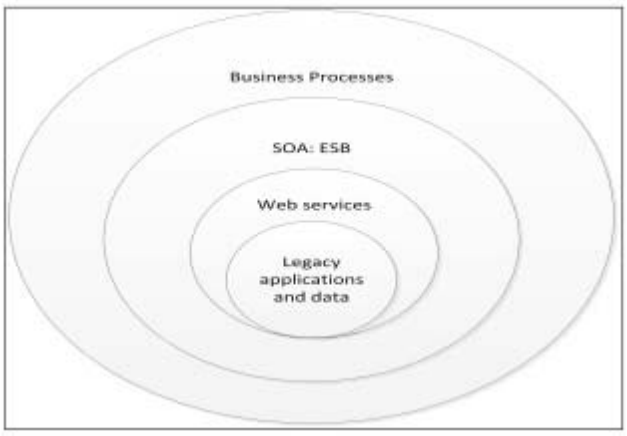

Fig. 2: wrapping legacy applications to Web services for SOA

If one decides to integrate these applications by using wrapping techniques, Web services technologies constitute the most modernization technique of legacy applications

Yet, to enable legacy applications to participate in SOA, we first need to position them within a comprehensive Web services stack that provides guidance toward SOA development, where modernizing, by using wrapping techniques, legacy applications and databases is a crucial and essential phase . As SOA aims at making business processes more agile and responsive, it is mostly about reuse, integration, and composition, and rarely about new development. Therefore, the existing assets that are legacy applications and databases are central, as they constitute the main reusable components of SOA that supports responsive business processes as shown Fig. 1. This development would consider four perspectives: Wrapping, specification validation, deployment, and reuse. First, legacy applications and databases are wrapped (wrapping perspective), next their specification as Web services is checked with respect to service orientation design principle (requirement specification and description perspective), then they are deployed and managed within a SOA auxiliary service such as a registry (deployment perspective), and finally they are reused in different business processes (composition perspective).

Therefore, we first need an understanding of how to deal with legacy applications when we rationally decide to keep them intact but workable in Web services and SOA environment and then guidance process for wrapping them into Web services with respect to SOA.

2. PROPOSED SYSTEM

Fig. 3 depicts about the proposed architecture which involves migration path of legacy system to contemporary system ways in detail manner. The contemporary system in the sense cloud computing here. Migration has been taken place in the following manner, such as 1) Architecture Migration Planning

2) Architecture Recovery and consistency 3) Architecture Transformation 4) Architecture Based Development

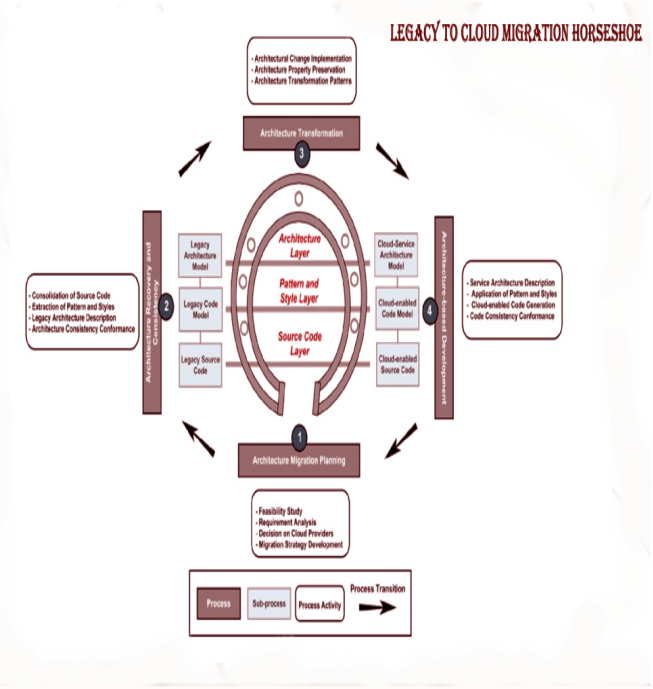

Fig. 3: Legacy to Cloud Migration Architecture

2.1 Architecture Planning

Fig.4 shows the planning of architecture for migration process. In this step, Feasibility Analysis, Requirement analysis, migration strategies, various cloud providers has been taken into consideration for the planning process.

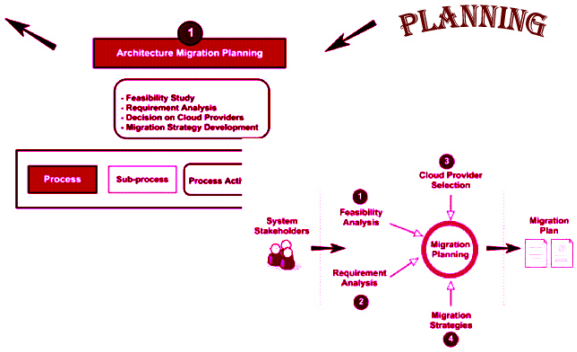

Fig. 4: Architecture Planning

2.2 Architecture Recovery and consistency

It is necessary to carry over some of the best features of the legacy architecture to the newly migrated system architecture. After the migration plan, a code model is developed which

transforms the legacy architecture to new one based on pattern defined. Once the code is migrated to new one it will be checked for its consistency since the legacy system which was developed was based upon the particular organization constraints. The following figure shows up the process involved in recovery and consistency. The processes involved in this step are as consolidation of source code which consolidates code of legacy architecture.

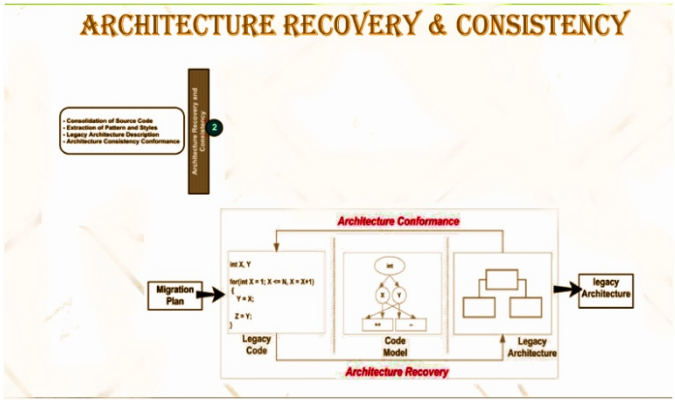

Fig. 5: Architecture recovery and consistency

The pattern and styles which are involved in development of the legacy application should be extracted for the purpose of ease in handling the code transformation. Though it is migrated to contemporary system, it is necessary to maintain and add the description of the legacy architecture. Finally with the help of migration testing, the conformance will assured that, legacy architecture pattern has been maintained in the new system. Fig .5 depicts about the recovery and consistency process of migration.

2.3 Architecture Transformation

An important step where the actual conversion has been taken place.

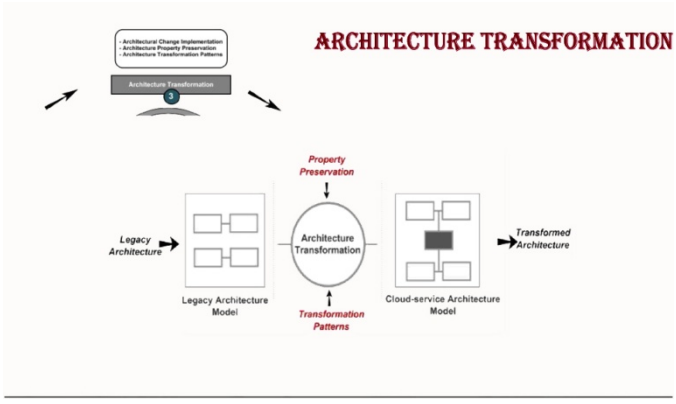

Fig. 6: Architecture Transformation

With the help of the transformation patterns defined, the migration of legacy to cloud system will be done. Here the consideration will be mainly given for the property of the legacy system which will be carried in the new developed system with some added features included.

Added features in the sense, the mixation of legacy system pattern and the cloud system patterns will be extracting the new systems owned features.

2.4 Architecture –Based Development

With the help of system code description and by defining certain standards and patterns for transformation, the architecture based migration can be done. The following Fig. 7. Shows up the migration process for architecture based development.

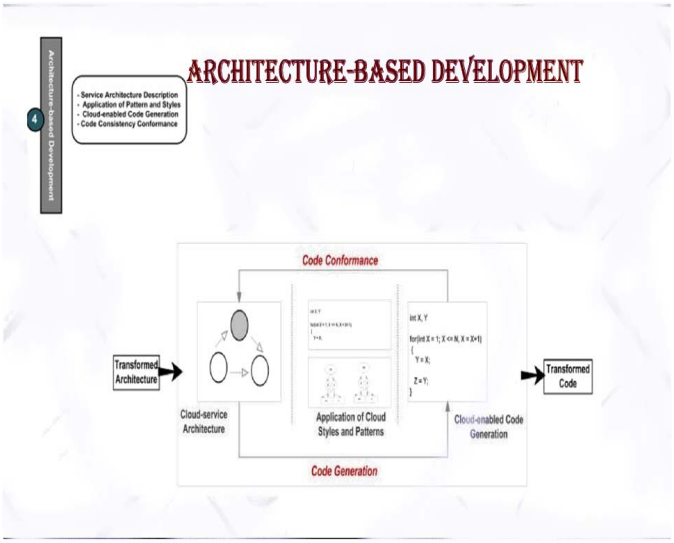

Fig. 7: Architecture based development

3. STAKEHOLDER IMPACT ANALYSIS

Analysis of the interview data suggests that the proposed cloud migration would have a positive net benefit from the perspective of the business development functions of the enterprise and the more junior levels of the IT support functions. A perceived zero net benefit was perceived by the project management and support management functions of the enterprise. A negative net benefit was perceived by the technical manager and the support engineer functions of the enterprise. Stakeholder impact analysis data suggests that there are numerous potential benefits but also risks associated with the migration of the system to the cloud. Tables 2 and 3 summarize the benefits and risks of the migration as identified by the stakeholder impact analysis. The second column in Tables 1 and 2 refers to the number of specific benefits/risks identified, and hence indicates the distribution of benefit or risk across different areas. Twelve specific benefits were identified in contrast to eighteen specific risks. According to the analysis the largest source of benefit to be derived from the cloud providing an opportunity to manage income and

outgoings in a new way, followed by the opportunities to offer new products/service, improved job status and removal of tedious work. The largest source of risk will be derived from the potential deterioration of 'customer care and service quality', 'increased dependence on 3 parties', decrease in satisfying work and increases of workload.

Table I: Sources of benefit identified by stakeholder impact analysis

Benefits	#
Opportunity to manage income & outgoings	3
Opportunity to offer new products/services	2
Improved status	2
Removal of tedious work	2
Improve satisfaction of work	1
Opportunity to develop new skills	1
Opportunity for organizational growth	1

Table 2: Sources of risk identified by stakeholder impact analysis

Risks	#
Deterioration of customer care & service quality	3
Increased dependence on external 3rd party	3
Decrease of satisfying work	3
Departmental downsizing	2
Uncertainty with new technology	2
Lack of supporting resources	1
Lack of understanding of the cloud	1

4. BENEFITS

1. Opportunity to manage income & outgoings

Introducing third party cloud infrastructure solutions presents itself as an opportunity to improve the management of income and outgoings for both finance staff and customers. Third party cloud infrastructure solutions facilitate the easing of cash-flow management for finance staff as the cloud pricing model has minimal upfront cost and monthly billing, and it also minimizes variability of expenditure on electricity. These are a benefit, in contrast to in-house data centre, as upfront costs of buying hardware are high and clients can be slow to pay, resulting in cash-flow difficulties. Additionally energy costs are a significant outgoing and by using an external provider they would benefit from providers ability to negotiate whole-sale energy prices. Third party cloud infrastructure solutions also surface many opportunities for managing income for customers, sales and marketing staff, as new pricing models can be offered to them. This is a benefit, in contrast to internal data centres which require a pricing to model comprising of a large upfront fee plus monthly support costs (due to cash-flow issues), as customers can be offered more choice over how they want pay or alternatively the finance department can choose to get the infra-structure outsourcer to bill their customers directly reducing the finance departments' administrative burden.

2. Improved status

Introducing third party cloud infrastructure solutions present an opportunity for support management and support engineers to improve their status. Support managers can improve their status in the organisation by successfully championing the high profile migration that has strategic implications. This is a benefit to the support manager as by working with new and potentially prestigious technology it may lead to career progression and increased job satisfaction. Support engineers would also benefit by improving their status within their industry by developing sought after cloud administration skills and experience.

3. Improve satisfaction of work

Third party cloud infrastructure solutions present an opportunity for support engineers, sales and marketing staff to improve the satisfaction of their work. It is an opportunity for support engineers to shed unsatisfying routine and potentially time consuming work such as performance of hardware support, network support and switching backup tapes as well as being offered new challenges in terms of cloud administration. This is a benefit as support engineers can focus on more satisfying and value-adding work such as resolving customers' software support requests. This benefit is enabled by the switch to cloud infrastructure as the third party cloud provider would be responsible for the more routine maintenance. Technical developers could also benefit from the migration as they can be involved in systems support (e.g. performing regular system health checks), which are sometimes viewed as a chore. In small organizations, there is not usually a clear distinction between the roles of system administrators and technical developers, and different people have to be involved when there is a problem. Third party cloud infrastructure solutions present an opportunity for sales and marketing staff to create new product/service offerings that better fit the customers need in terms of scalability and cost effectiveness in contrast to an in-house data centre. This is a benefit as this provides staff with new and potentially satisfying challenges that would not have existed without the migration to cloud infrastructure.

4. Opportunity to develop new skills

Third party cloud infrastructure solutions present an opportunity for support managers, engineers, sales and marketing staff to develop new skills. For support managers and engineers it is an opportunity to develop new skills in cloud computing administration. This is a benefit as the support engineers will expand their existing skill sets and experience with knowledge of managing a technology that will be in demand throughout the IT industry for years to come. For sales and marketing staff it presents an opportunity to develop skills is product/service creation and launching. This is a benefit to sales and marketing staff as it will expand their existing skill sets and experience enabling their career progression.

5. CONCLUSION

Contemporary systems are disruptive technologies that are set to migrate how IT systems are deployed because of its apparently cheap, simple and scalable in nature. The finding in this paper shows that there are also some technical issues that have to be considered for migration of legacy systems. Furthermore the implementation of contemporary systems in any organization leads to efficient way of project development and also coping up with the complexity of the system, which also increases the scalability.

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