Business Integration as a Service: Computational risk analysis for small and medium enterprises adopting SAP

VICTOR CHANG [1,2]
SCHOOL OF COMPUTING AND CREATIVE TECHNOLOGIES, LEEDS METROPOLITAN UNIVERSITY, LEEDS, UK.
ELECTRONICS AND COMPUTER SCIENCE, UNIVERSITY OF SOUTHAMPTON, SOUTHAMPTON, UK.
V.I.CHANG@LEEDSMET.AC.UK

This paper presents Business Integration as a Service (BIaaS) which enables connections between services operating in the Cloud. BIaaS integrates different services and business activities to achieve a streamline process. We illustrate this integration using two services; Return on Investment (ROI) Measurement as a Service (RMaaS) and Risk Analysis as a Service (RAaaS) including small and medium enterprises (SMEs) that use SAP. The SAP case study demonstrates the cost-savings and the risk analysis achieved, so two services can work as a single service. The case study confirms that SMEs can manage their loss in downturn between -1% and 1%. The risks are managed and kept low under 0.76%. The SAP case study confirms the benefits of BIaaS adoption, including cost reduction and improvements in efficiency and risk analysis. Implementation of BIaaS in other organizations is also discussed. Important data arising from the integration of RMaaS and RAaaS are useful for management of SMEs adopting SAP.

Additional Key Words and Phrases: Business Integration as a Service (BIaaS); ROI Measurement as a Service (RMaaS); Risk Analysis as a Service (RAaaS); BIaaS Case Studies.

1. INTRODUCTION

Cloud Computing transforms the way many organizations work and offers added values for operation management and service computing. Researchers have demonstrated the positive impacts it can offer for business engineering and service level management [Schubert et al., 2010; Chang et al., 2011 a; 2010 b; 2011 a; 2011 b; Chang et al., 2013 a] In addition, Cloud Computing offers a variety of other benefits including agility, resource consolidation, business opportunities and green IT [Birgo et al; 2007; Buyya et al, 2010; Chang et al., 2011 b; 2011 c; 2011 d; 2013 a; 2013 b; 2013 c]. Integrating different business activities together into the same environment can improve efficiency, reduce costs and improve collaboration rather than using a number of standalone services. Businesses can achieve long-term sustainability by using Business Process as a Service (BPaaS) to improve business connectivity and streamline the essential process. Höing et al. (2009) use Grid Computing and WS-BPEL to demonstrate BPaaS as an Orchestration as a Service Infrastructure. However, BPaaS is process dependent and focused on a particular process at a time, and does not always connect different business activities.

There are different cloud services developed by different vendors. There are services provided by research centers focused on billing and pay as you go models [Ambrust et al., 2009; Buyya et al., 2009; 2010], Return on Investment (ROI) calculations [Chang et al., 2011 b; 2011 c; 2012 a] and validation supported by experiments or simulations. Each service is self-contained, since each contains a series of proven hypotheses and methods supported by case studies and/or experimental results. There is no interaction or collaborative work between different models and services, resulting in no connection between different types of Cloud services such as quantitative (described earlier) or qualitative services (business requirement collection and customer requirement). However, this is essential for Business Integration as a Service (BIaaS), as the business requirements collected by qualitative services need to transform to quantitative Cloud analysis. Traditionally, many organizations employ business analysts to bridge the gap between quantitative and qualitative services/requirements. Similarly, there are few connections between different quantitative services such as integration between cost-saving services and risk analysis services.

Although vendors' lock-in is a technical challenge [Ambrust et al., 2009; Chang et al., 2010 a; 2010 b] integration of different services is another challenge. Here is an example. An organization needs to use Cloud service provider A for measuring and analyzing business performance and Cloud service provider B for identifying and quantifying risk analysis. Both services are managed and offered by different providers and have different requirements and technical solutions. Costs can be nearly double compared to an integrated service that would provide both these services [Papazoglou and Georgakopoulos, 2003; Chang et al., 2011 d; 2012 b]. This motivated us to propose Business Integration as a Service (BIaaS). The objective of which is to allow two or more activities/services at any level (IaaS, PaaS, or SaaS) that are traditionally separate services to be integrate as a single service. This saves costs, improves efficiency, serves more purposes and provides more added values for businesses.

This paper describes our own flavor of Business Integration as a Service (BIaaS) and a case study confirming its benefits for organizations adopting cloud. In our demonstration of integration, we are connecting two different services to allow a user request to be performed as thought they were one service rather than two separate services. The structure for this paper is as follows. Section 2 describes selected literature related to BIaaS and Section 3 explains the system architecture. Section 4 presents SAP case study and the first service. Section 5 demonstrates the second service. Section 6 presents three topics for discussion and Section 7 is the Conclusion and Future Work.

2. BUSINESS INTEGRATIONM LITERATURE

As pioneers in business integration, Krippaehne et al. [1992] proposed a strategy matrix for vertical integration to present strategies, goals and factors influencing successful business integration. Business Integration (BI) then started from the concept the Business-to-Business (B2B) e-commerce. Bhaskaran et al. [2001] describe their B2B architecture which is divided by into technological frameworks. Vojdani [2003] identifies six application groups for utility companies in his business integration platform and explains how these components work. Until 2005, BI was introduced in Java and SOA, where Vinosk [2005] proposes Java Business Integration (JBI) by the use of enterprise application integration (EAI). Iyengar et al. [2007] introduce BI using IBM WebSphere Business Integration (WBI) technology which consists of Service Component Architecture (SCA), basic business processes and workflows. They use business process management (BPM), SOA BI scenarios, architecture, patterns and WS-BPEL related technologies to demonstrate BI. Chrisdutas [2008] consolidates the proposal from Vinosk [2005] and presents SOA Java BI. He explains the operation of JBI including each component and the interactions between different JBI containers.

Papazoglou and van den Heuvel [2011] present two models related to BI. The first is cloud delivery model in which they explain interactions between virtualized applications, clients and a stack comprising IaaS, PaaS and SaaS suitable for BPaaS. Their second model, the blueprint model, is proposed to allow BPaaS or SaaS applications to run dynamically on virtualized clouds to enable service virtualization. They also explain an architectural scenario showing how blueprint support for the cloud service life cycle can work. However, their approach is at the system design level without details of implementation, testing or use cases. Ring et al. [2009] explain the integration of Grid and Cloud systems using two approaches. Their first is to redesign architectures of different Grid systems and their second is to implement interoperability, which includes re-implementations of Unicore 6, Globus 4, GLite, OMII Grid and so on which also contain other components such as security, standardization and service discovery. However, that is interoperability and includes re-implementations of existing systems and components. That method is suitable for Grid but not for Cloud due to the following reasons:

- Use of Virtual Machines (VMs) is not a pre-requisite
- There is no pay-as-you-go characteristic
- It does not have a good scalability like what Cloud does.

2.1 Motivation to propose Business Integration as a Service (BIaaS)

Often each Cloud service is independent. Some even involve multiple steps. Each service request has to be handled separately and there is a lack of communication between services leading to the following problems:

1. There is no communication between services. Each time two types of service requests and activities have to done at different periods of time.
2. Creation of additional work and cost. It also costs more to pay two service providers.
3. It is difficult to check consistency of computational results from different service providers.

Integration between different types of services is required and all services need to be carried out within the same framework without communications and technological barriers (such as BPEL to BPMN). This motivates us to propose and demonstrate Business Integration as a Service (BIaaS), which aims to offer the following:

- To allow two or more different services to work together where traditionally each service would be separate from the others.
- To permit the outcome of one service to be used as input for another; integrating two or more services into one.

Business Integration as a Service (BIaaS) is an important area to resolve this. It is both a good software engineering process and an algorithmic method to link Service A and B together.

2.2 Two Services involved in Business Integration as a Service (BIaaS)

There are two different Cloud services within BIaaS and each plays its own role. Their descriptions are as follows:

- ROI Measurement as a Service (RMaaS): The aim is to compute Cloud business performance. It is developed based on Organizational Sustainability Modeling (OSM), which can compute thousands of datasets and presents results for statistics and 3D Visualization. There are two "mini services" associated with OSM. It starts as a PaaS-based statistical service to compute and analyze key statistical data. It then gets to the second step of RMaaS, which is a SaaS-based service to present key analysis in a 3D Visualization. The third step of RMaaS is a Quality Assurance (QA) SaaS-based service to ensure that the 3D data has a high quality and to further analyze the implications of data.
- Risk Analysis as a Service (RAaaS): This service is aimed to calculate risks and evaluate its impact on an organization. RAaaS starts with a SaaS-based risk

analysis offered by Variance-Gamma Process (VGP) which reduces inconsistencies and errors and calculates the risk pricing. It then moves to second step of RAaaS, another SaaS-based service based on Least Square Method (LSM) that computes high-performing simulations and to calculate the most expected risk pricing and its most likely range. Risk pricing means the expected risks involved and can be quantified as a numeric number (used in financial options: European or American) or a percentage (such as presenting percentage of loss) [Waters et al, 2008; Hull, 2009; Lee et al., 2010]. If a risk pricing is 20%, it means it will cause 20% of undesirable impacts such as loss of revenues.

We first present how each service works and then how the two services can work together in the BIaaS framework.

2.3 Details in System Design and Architecture

IaaS provides linkage between different types of services which in turn leads to efficiency improvement and time reduction in business processes. Services in BIaaS can work within the same framework without barriers in communications by connecting all services and ensuring (interim) service output formats are acceptable input for the next. BIaaS can offer services and connect services together to save businesses time and resources for analysis. It also allows them to compute complex models while keeping easy to use concepts and features [Krippaehne et al., 1992; Chang et al., 2011 d; 2012 b].

Our System Design and Architecture is similar to Papazoglou and van den Heuvel's [2011] cloud delivery model except we avoid using a new language. A number of technologies are used for each step of the service. The major advantage being that each step has a preference for certain technologies or platforms due to its functionality. For example, a statistical computing service favors statistical languages or packages.

Service 1 is RMaaS which includes three steps. It requires completion of at least the first two steps before presenting results. Each step in RMaaS is considered as a sub-service as follows:

1. Statistical service: This computes Cloud business performance with key statistical data offered by SAS, a statistical program.
2. Visualization service: Results from statistical service pass onto this step which presents key data using 3D Visualization enabled by Mathematica. Completion of this step is the minimum requirement for RMaaS.
3. Quality Assurance service: This is an optional step required when connecting to another service. It ensures data quality and performs further analysis of the implications of data.

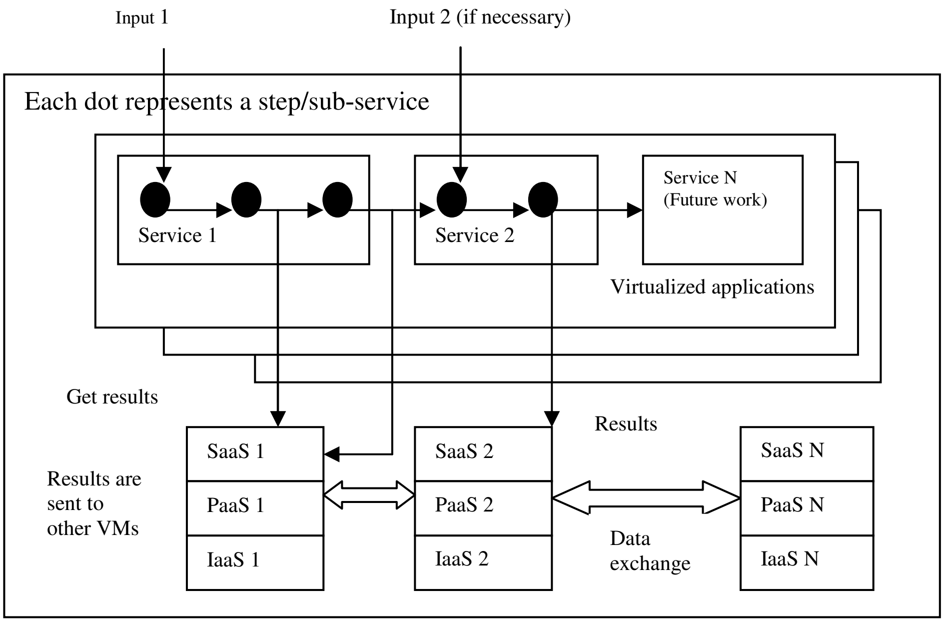


Fig. 1. System Design and Architecture for BIaaS in Private Cloud

Results are saved in text formats readable by each service and then passed onto the next step. Service 2 is RAaaS which is itself comprised of two steps. Results from the last step of RMaaS are passed onto the first step of RAaaS. Similar to RMaaS, each step in RAaaS is a sub-service and the two steps are:

1. VGP risk analysis service: This reduces inconsistencies and errors and calculates the risk pricing. It computes results showing frequency of occurrence and risk pricing.
2. LSM risk analysis service: This computes high-performing simulations and calculates the most likely risk pricing and its upper and lower bounds.

Integrating RMaaS and RAaaS requires the following:

- Results from the end of RAaaS and the end of each step need to be saved as text and passed to the next step, allowing results from each service to be assessed onto the next.
- Use requests (ROI measurement and risk analysis) are completed in one rather than as two separate services.

3. BIAAS CASE STUDY FOR SMES USING SAP

SAP aims to focus on Small and Medium enterprises (SMEs) in cloud strategies with two cases presented here. The first case is Piaggio, an Italian motor firm using SAP-HR, and 5 SAP/R3 instances where the largest instance has 13,000 SAP roles and more than

140,000 user/role assignments. They use Identity and Access Management (IAM) particularly workflow in the virtualized environments to improve their security and service (Chang et al., 2011 c). The second example is BearingPoint, which builds a system called iGRC to consolidate SAP's single sign-on such as SAP Business Object Access Control and SAP ERP. Their iGRC system components include key SAP products and allow data exchange between different SAP components where Chang et al. [2011 c] did a case study to interview a number of SMEs and obtain data.

3.1 Organizational Sustainability Modeling (OSM), the Model behind the ROI Measurement as a Service (RMaaS)

Organizational Sustainability Modeling (OSM) is a model to process thousands of datasets and uses SAS for statistical analysis and Mathematica for 3D Visualization, of which SAS is more suitable than others since it can compute more in-depth analysis [Chang et al., 2010 a; 2010 b; 2011 b; 2011 c]. The objective of ROI Measurement as a Service (RMaaS) is to calculate cloud business performance, so that the organization can be aware of their ROI and can help stake-holders to make the right business decisions. This involves with two mini steps. The first step is a PaaS service analyzing business performance by computational statistics and the second step is a SaaS which involves computing statistics and presenting them into 3D Visualization.

Before discussing RMaaS, introduction for OSM is useful. Rationale for OSM is as follows. Return on Investment (ROI) needs to consider the input and output of Cloud adoption and risks associated with adoption [Khajeh-Hosseini et al, 2010, 2011]. The formula (3) shows three metrics are required for the input: the expected CBP value, the actual CBP value and the risk-free rate (or risk-occurring rate). The OSM formula can compute output which can present the ROI as a whole and demonstrate that Cloud adoption can achieve the following:

- Meet the expected target.
- Present the actual performance (or actual return).
- Present the risk-free rate (or risk-occurring rate) for manageable risk and uncontrolled risk (beta).

Based on the improvement of Capital Asset Pricing Model (Chang et al., 2011 b; 2011 c), the OSM formula is presented as

$$a = r_f + (\beta \times (e - r_f)) \qquad (1)$$

where a is the actual return (or performance) of a Cloud project or investment, the actual CBP value

r_f is the risk free rate (1- r_f is the risk-occurring rate)

e is the expected return (or performance) of a Cloud project or investment, the expected CBP value, and β is the beta value to represent risk measure or uncontrolled risk. These are unpredictable events which cannot be managed and have a direct impact to Cloud adoption.

The uncontrolled risk, beta, can be calculated once when the expected value, the actual value and risk-free rate in each dataset are available. A good approach is to calculate all beta values and average them out. Another approach for calculating beta is to perform linear regression, where the gradient of the slope is the value for beta [Sharpe, 1990]. So the formula becomes

$$\beta = (a - r_f) / (e - r_f) \qquad (2)$$

The steps above require the following input:

- Actual CBP values (a): the actual values obtained from the measurement.
- Expected CBP values (e): using the previous data (or previous measurement) as the benchmark, or using computation technique to model the expected values.
- Risk-free rate (r_f, sometimes risk-occurring rate, 1- r_f): the percentage that does not affect Cloud Business Performance (CBP) if targets are not met.

After collecting at least several hundred of metrics, these data can use OSM to calculate beta, and compute the overall Cloud Business Performance (CBP) values to present to stakeholders.

3.2 OSM Output Results

Computational modeling of OSM will use a, e, r_f (or 1- r_f) as the input to compute CBP. Output should contain the following.

1. Beta (β) is a value to determine the risk measure (or the extent of the volatility), which is the uncontrolled risk that may affect the Cloud project.
2. Standard Error (SE) of the mean is the range of the mean that the experimental results fall into for OSM. The smaller the standard error, the smaller the difference between expected and actual CBP results [Hull, 2009; Lee et al; 2010].
3. Durban-Watson (DW) is a test used to detect the presence of autocorrelation (a relationship between values separated from each other by a given time lag) in the residuals (prediction errors) from a regression analysis. The result of Durban-Watson (DW) should be above 1 [Hull, 2009; Lee et al; 2010]. Durban-Watson is used to test regression computed by OSM and accuracy of the output, and also the statistical behaviours. The value for Pr > DW corresponds to the negative autocorrelation test

(residuals eventually wither off) and is a preferred method in the OSM approach, and the value of Pr > DW should ideally get as close as to 1 to reflect the accuracy of the OSM regression.

Additional OSM outputs are presented as follows.

- Mean Square Error (MSE) is an estimator to quantify the difference between estimated and actual values. A low MSE value means there is a high correlation between actual and expected CBP values.
- R-squared value is used to determine how the regression fits in a line. Both 95 and 99.99 Confidence intervals (CI) are computed. In this context, it is referred as "R-squared value for firm", a term that is commonly used in econometrics to describe the percentage of risks in proportion to the external or internal organizations or factors [Lee et al., 2009; Teoh et al., 2009]. For example, if an organization has an R-squared value (99.99 C.I) of 0.4, this means 40% of risks are from external bodies or the market, and 60% of risks come from the organization such as poor adoption decision, overspending, poor selection of equipment (resulting in accidents). Cloud adoption also introduces risks and the R-squared value provides a good indication for the percentage and sources of beta risks. The results for OSM regression is as follows. See Table I.

Table I: OSM key statistics for calculating SAP case study for SMEs

Beta **13.99% of risks: external and 86.01% of risks: internal**	0.42815	**Durbin-Watson** **Pr > DW (negative autocorrelation: maximum of 1 in favour of OSM)**	1.4029 0.9996
Standard Error	0.09772	Regress R-Square (99.99 C.I)	0.1399
Mean Square Error (MSE)	0.19970	Regress R-Square (95 C.I)	0.5243

The data is carefully calculated and examined with data consistency and coding algorithms. Thirty two months of in-depth data can best represent sustainability from the initial phase to establishment. The SAS program for the OSM is coded to plot required data with a suitable regression method. Table 1 presents the result of auto linear regression summary with Ordinary Least Squares used (OLS). Interpretations of results are as follows.

Beta is 0.42815, which is considered a medium-low value since it is below 0.5. Standard error is very low which means the variance between expected CBP and actual CBP values are small. Durbian Watson test is above 1, and Pr > DW value is very close to 1, which is in favoured of OSM regression. R-square (99 CI) indicate the percentage of risks, where 13.99% of risks are from the external and 86.01% of risks are the internal. The internal risks may include the followings:

- While SAP can help SMEs to achieve cost-saving and decision planning, internal risks arise due to plans by cost-saving such as redundancy, loss of resources and skills associated with cost-saving.
- SAP can help SMEs to organize their IT and business plans. Although the majority of SMEs have the benefits of adopting SAP Cloud, it does not provide long-term solutions for lowering operational risks.

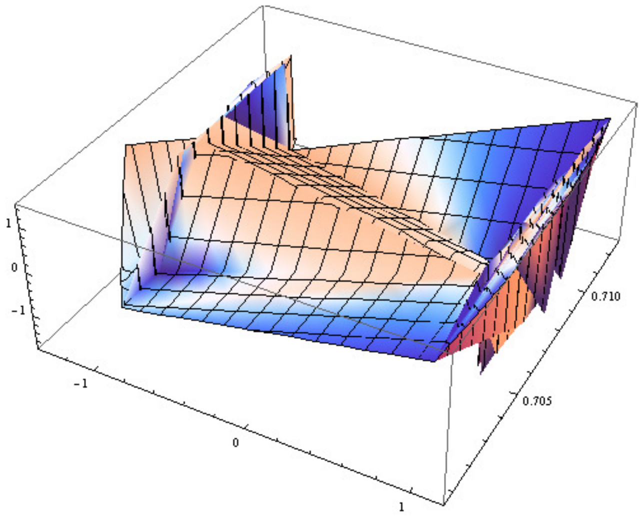
As a result, calculating operational risks for SAP Cloud adoption and the analysis for the business in the long term is essential to maintain a healthy CBP. Operational risks will be calculated in the second service, RAaaS, and will be presented in Section 4.2.

3.3 3D Visualization within ROI Measurement as a Service

Further statistical analysis can be computed. However, this often requires those with relevant training to perform such tasks. Our major contribution in this project is to present complex statistical analysis using 3D Visualization, which is a SaaS service enabled by Mathematica. The benefit is to ensure no data is missed for analysis, and also those without advanced statistical backgrounds can understand. This is useful for many decision-makers and directors who need to know business analytic results quickly but need not spend too much time to understand them.

The 3D visualization models are presented in Figure 2, which is the default 3D model that indicates a return of cost-saving between 1 % and -1% on the y axis, which is significant reduction in operational costs. It also shows the expected cost-saving between 1 and -1% on x-axis. The z-axis presents risk-free rate (0.7-0.715 %), which means minimum expenses to keep operation running (including staffing costs). This percentage range can guarantee cost-savings. With Cloud Computing, statistics can analyze the cost-saving from consumption and resources required. But the 3D calculation takes hidden areas such as staffing costs into consideration; fewer people are required to do the same amount of work. Similarly, Buyya et al. [2010] and Chang et al. [2011 a; 2011 c; 2012 a; 2013 a; 2013 b] use 3D Visualization to present Cloud Computing analysis and challenges. The 3D result suggest that (i) SMEs use SAP as a cautious cloud tactic or/and (ii) SMEs prefer to use more predictable or familiar ways to maintain their cloud business sustainability.

The use of 3D Visualization allows stakeholders to understand the CBP results easily and quickly without the need to know the details in statistical analysis. This is a significant contribution as stakeholders (CEOs, CIOs and investors) of those SMEs adopting SAP Cloud, have reported that Visualization services in BIaaS can reduce the time and complexity to understand advanced business performance reports and analytics.



- x-axis: the actual operational loss managed by SAP (-1 and 1%)
- y-axis: the expected operational loss managed by SAP (-1 and 1%)
- z-axis: the risk-free rate (0.7 to 0.715%)

Groups (without redundancies) that use SAP for cost-saving, have a greater influence in this 3D model.

Fig. 2. 3D visualization for SMEs adopting SAP during downturn

4. RISK ANALYSIS AS A SERVICE

Results from RMaaS are passed onto the second phase focusing on Risk. Simulations in Risk Analysis become more popular in organizations investing in new technologies and new areas. Risk Analysis as a Service (RAaaS) is a specialized area to present. Chang et al. (2011 a) describe how Financial Software as a Service (FSaaS), which is close to RAaaS, can work in the context of Clouds. This includes Monte Carlo Methods (MCM) and Black Scholes Models (BSM) are used to calculate pricing and risk, and present some selected results for visualization particularly risk analysis. This ensures there is no hidden or missing data for risk analysis, and visualization allows stake holders to understand the impacts of risk more easily. FSaaS can be used as a stand alone solution. Similarly, RAaaS can be used in the BIaaS and to allow results from RMaaS to be used and presented as an integrated solution. RAaaS development is made up of the following sequence.

- Variance-Gamma Process (VGP) in MCM, focusing on error corrections.
- Least Square Method (LSM) in MCM, focusing on fast and reliable calculations with an excellent performance.

Chang et al. (2011 a) describe financial models they use for risk and pricing analysis, in which they have adopted Monte Carlo Methods (MCM) for advanced risk calculations and Black Scholes Model (BSM) for 3D risk modeling. In this case, the ECS cost-saving is used for risk modeling, where the Least Square Methods (LSM) can be used to compute up to 100,000 simulations in one go to ensure a high level of accuracy.

4.1 First RAaaS Step: Variance-Gamma Process (VGP)

Ribeiro and Webber (2004) demonstrate improved calculation techniques based on Monte Carlo Methods (MCM) on top of the Variance-Gamma Process (VGP), which has been a subject of a number of studies [Carr et al., 2002; Ribeiro and Webber, 2004]. Brigo et al. (2007) demonstrate their risk modeling process and explains how VGP reduces inconsistency with coding algorithm presented. Error corrections in financial modeling are important and when errors are identified, rectifications need to be found and applied automatically wherever possible [Zimmermann, 2006]. The reason is that slight discrepancies in financial analysis can lead to adverse impacts such as financial loss. VGP is a technique of MCM used for error corrections and offers two benefits:

- It simulates the pricing and risk analysis using raw data which includes good and out of range data.
- It removes out of range of data, re-computes simulations and presents the improved simulations.

Results from RMaaS are passed onto RAaaS as the key variables for VGP, the first step of RAaaS. Referring to Figure 3, the top half shows original variables following gamma distribution. The lower half shows the stratifying variables from gamma distribution. The stratifying model eliminates infrequent variables and also concentrates on more frequently seen results, giving more accurate results than the original modeling by MCM. The code can facilitate similar tests for different variances for volatility, maturity and risk free rate.

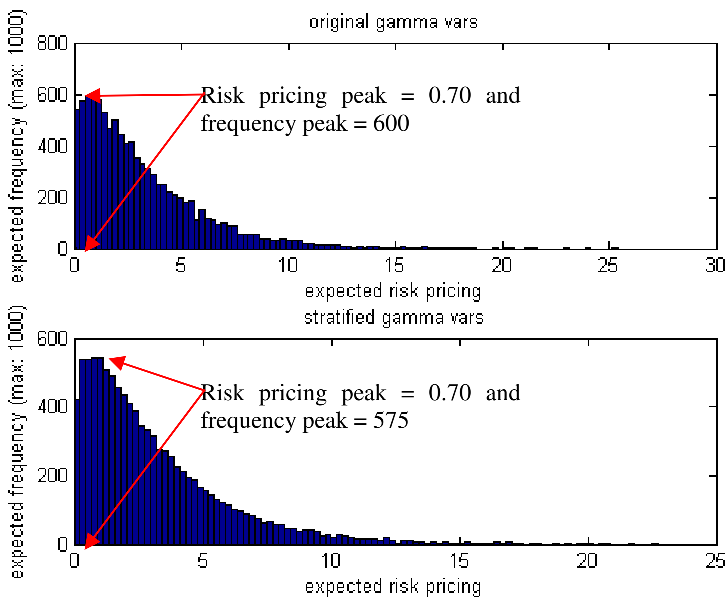


Fig. 3. Error correction by VGP: Risk pricing and frequency of occurrence

Figure 3 shows the improved data for risk analysis with VGP gamma distribution where the expected frequency of occurrence is 575 instead of 600 before correction takes place. Expected risk pricing means the expected measurement of risk which has implications for costs and sometimes it can be expressed in terms of percentage (Hull, 2009; Lee et al., 2010). In other words, it can be interpreted that an expected risk pricing of 0.70 means the risk will cost 0.70% of your total operation. Here is an example. A project suffers from delays and need to hire additional employees and resources to ensure the project progresses. The highest frequency of occurrence corresponds to 0.70% of expected risk pricing, which means it cost 0.70% of the total expenditure when such an incident happen. Referring to Figure 3, the expected frequency of occurrence is 575 out of 1000. Although it has a lower frequency of occurrence, it still poses risk. The purpose is for us to identify the likelihood for higher risks which is crucial for risk management.

4.2 Second RAaaS Step: Least Square Method (LSM)

Risk analysis is useful for organization to understand the extent of business and operational risks, which can be varied form time to time. To perform risk modeling, American and European options are used, as both models are popular choices within MCM for financial risk analysis. American option is an option that can be exercised anytime during its life. The majority of exchange-traded options are American. A European option may be exercised only at the expiry date of the option, which means at a single pre-defined point in time (Hull, 2009; Lee et al., 2010). Adopting both options are suitable because American option can calculate the average performance, and European option can calculate the best pricing or risk at the time that research work takes place.

LSM is well-known for making accurate and high-performing simulations to compute reliable results [Moreno et al., 2001]. LSM is chosen because of the following advantages. Firstly, LSM provides a direct method for problem solving, and is extremely useful for linear regressions. LSM only needs a short starting time, and is therefore a good choice. Secondly, LSM can be used in the Clouds, because often jobs that require high computations in the Clouds, need extensive resources and computational powers to run. LSM is suitable if a large problem is divided into several sections where each section can be calculated swiftly and independently. This also allows improvements in efficiency [Longstaff et al., 2001; Choudhury et al., 2008; Chang et al., 2011 a].

Chang et al. [2011 a] explain how 100,000 simulations on Clouds can be achieved by adopting LSM in MATALAB. This makes simulations to be completed in 4 seconds if the time step (a variable in LSM and MCM) is equal to 10. MATLAB (primary language) is written at the backend and C# is written for frontend to facilitate a large number of simulations. Core MATLAB code algorithm has been explained by Chang et al. [2011 a]. The following is the result of running LSM to calculate the expected risk price out of 100.

MCAmericanPrice = 0.7533

MCEuropeanPrice = 0.7326

Both American and European options can be converted to percentage, which can represent the percentage of getting this risk analysis (Hull, 2009; Lee et al., 2010). This means the risks of SAP adoption should have operational risks (financial management, project management and unexpected costs) will be 0.7533% and 0.7326% respectively.

Operational risks can be divided for internal and external uses. Their explanation is as follows.

- Internal: Calculate the operational risk for Cloud adoption, which meets the interests of the operational staff.
- External: Calculate the operational risk for clients. In this case, the type of operational risk is not Cloud but the clients' investments, which meets the business analysts' interests.

Section 3.2 presents that where most of risks are from the internal. According to Khajeh-Hosseini [2010; 2011], risks in Cloud adoption in the early stage are from the internal because organizations are exploring new approaches; errors are made in the early stage; finding ways to improve co-ordination and efficiency between different departments.

5. DISCUSSIONS

Two topics for discussions are presented as follows.

5.1 Summary of the SAP Case Study and results contribute to part of the framework

This case study is about managing Cloud and utility computing to minimize costs and risks, and demonstrates how to integrate two services, RMaaS and RAaaS, so they can be viewed as a single service. RMaaS service includes two steps in this SAP case study. The first step involves statistical service to compute several key data and variables, which are passed onto the second step, 3D Visualization service, to present its cost-return analysis visually with actual loss (in downturn) between -1 and 1% against expected loss between -1 and 1%. Selected output from RMaaS together with management's data is passed on the first step of RAaaS, which offers VGP service to reduce errors and calculate the risk price. The outcome is passed to the second step of RAaaS, which offers LSM service to calculate the exact risk pricing in American and European options. LSM also can compute 100,000 simulations per service to ensure an accurate and reliable result. This data is useful for management board. Our analysis confirm those SMEs manage to lower their loss while lowering their risk. The benefits of BIaaS allow calculating different key results which are connected to each other, and thus the efficiency is improved.

BIaaS is part of a framework, Cloud Computing Adoption Framework (CCAF), to help organizations to achieve good Cloud design, deployment and services. CCAF has been demonstrated in several organizations such as GSTT, KCL, Universities of Greenwich, Southampton, Oxford, VMware, Vodafone/Apple, Salesforce, IBM. Contributions from BIaaS and CCAF will and have positively impacted some of e-Research, Cloud, Grid, Health, Finance and Education Communities.

5.2 The Uncontrolled risks and Controlled Risks

According to Sharpe (1990), there are two types of risks: uncontrolled and controlled risks. Uncontrolled risks are unplanned events beyond human interventions such as earth quakes and financial crisis, which include the beta risk. The controlled risks can be managed and minimized with the human interventions, which include operational risks. In this paper, RMaaS compute the beta risk and RAaaS compute operational risks. However, a challenge is to calculate the accurate beta risk and new method needs to be in place to ensure the probability of calculating the beta risk is as close to the reality as possible. The Quality Assurance service together with the algorithm adopted by OSM can compute a higher accuracy of beta risk calculations. Apart from identifying the beta risks belongs to the internal or external sources with the respective percentages, R-squared value is commonly used to determine how fit a regression is, including the data points of all beta risk values. Hence, the task is to focus on performing regression on all beta values, and computes results with both statistical analysis and visualization presentations, so that both stakeholders and data analysts can all understand the implications offered by the beta risk, and also determine the accuracy of beta risk calculations. The use of BIaaS applications can compute both uncontrolled and controlled risks altogether at once without using two different services, thus there is an improvement in efficiency. Cost-saving is achieved to pay one service per request without paying to two service providers.

6. CONCLUSION

This paper presents Business Integration as a Service (BIaaS). Its objective is to connect different services from different clouds together into an integrated environment, with the output of one service being used as input to the next bringing business activities together. The combined use of Risk Analysis and Quality Assurance also allows risk control and data quality to be reviewed and monitored which helps management to make precise and informed decisions.

The SAP case study in this paper shows BIaaS in action integrating RMaaS with RAaaS for selected organizations, in this case a SME. The SAP case study demonstrates the cost-savings and the risk analysis achieved, so two services can work as a single service. The case study confirms that SME can manage their loss in downturn between -1% and 1%, which is demonstrated by RMaaS in the form of statistical services and visualization services. RAaaS then reduces errors and uses 100,000 simulations to compute the risk pricing for using SAP. Both American and European options are computed, which are 0.7533% and 0.7326% respectively. The SAP case study confirms the benefits of BIaaS adoption, including cost reduction and improvements in efficiency and risk analysis. Those SME manage low risk and low return strategy in economic downturn well. Discussions about risk management for both uncontrolled and controlled risks are presented, where RMaaS and RAaaS can calculate beta and operational risks accurately.

The key advantage of adopting BIaaS is to allow different services to be performed, computed and managed in one platform. This saves time and resources compared with performing activities at different times and locations. It improves efficiency, and consolidates streamlining of processes and communications between different departments of large organizations.

REFERENCES

ARMBRUST, M., FOX, A., GRIFFITH, R., JOSEPH, A. D., KATZ, R. H., KOWNWINSKI, A., LEE, G., PATTERSON, D., RABKIN, A., STOICA, I. AND ZAHARIA, M. 2009, Above the Clouds: A Berkeley View of Cloud computing. Technical Report, No. UCB/EECS-2009-28, UC Berkeley, February.

BHASKARAN, K., CHUNG, J.Y., DAS, R., HEATH, T., KUMARAN, S. AND NANDI 2001, P., An e-business integration and collaboration platform for B2B e-commerce, Third International Workshop on Advanced Issues of E-Commerce and Web-Based Information Systems, WECWIS 2001, San Juan, CA , USA , 21 - 22 Jun.

BRIGO, D., DALESSANDRO, A., NEUGEBAUER, M. and TRIKI, F. 2007, A Stochastic Processes Toolkit for Risk Management", Working Paper, King's College London, November 2007.

BUYYA, R., YEO, C. S., VENUGOPAL, S., BROBERG, J. AND BRANDIC, I. 2009, Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility, Journal of Future Generation Computer Systems, 25(6), June 2009, Pages 559-616.

BUYYA, R., RANJAN, R. AND CALHEIROS, R. N., InterCloud 2010: Utility-Oriented Federation of Cloud Computing Environments for Scaling of Application Services, Algorithm and Architectures for Parallel Processing, Lecture Notes in Computer Science, 2010, Volume 6081/2010, 13-31.

CARR, P., GEMAN, H., MADAN, D., and YOR, M. 2002, The fine structure of asset returns: An empirical investigation, Journal of Business, 75 (2), 305-332, 2002.

CHANG, V., BACIGALUPO, D., WILLS, G. AND DE ROURE, D. 2010, A Categorisation of Cloud Computing Business Models. At CCGrid 2010, The 10th IEEE/ACM International Symposium on Cluster, Cloud and Grid Computing, Melbourne, Australia, 17 - 20 May 2010, 509-512 (2010 a).

CHANG, V., WILLS, G. AND DE ROURE, D. 2010, "A Review of Cloud Business Models and Sustainability", IEEE Cloud 2010, the third International Conference on Cloud Computing, 5-10 July 2010, Miami, USA (2010 b).

CHANG, V., LI, C.S, DE ROURE, D., WILLS, G., WALTERS, R. AND CHEE, C. 2011, "The Financial Clouds Review", International Journal of Cloud Applications and Computing, 1 (2). pp. 41-63. ISSN 2156-1834, (2011 a).

CHANG, V., DE ROURE, D., WALTERS, R. AND WILLS, G. 2011, "Organisational Sustainability Modelling for Return on Investment: Case Studies presented by a National Health Service (NHS) Trust UK". Journal of Computing and Information Technology, 19 (3). ISSN Print ISSN 1330-1136 (2011 b)

CHANG, V., DE ROURE, D., WILLS, G. AND WALTERS, R. 2011, Case Studies and Organisational Sustainability Modelling presented by Cloud Computing Business Framework, International Journal of Web Services Research, 8 (3). pp. 26-53. ISSN 1545-7362 (2011 c)

CHANG, V., WILLS, G. AND WALTERS, R. 2011, Towards Business Integration as a Service 2.0 (BIaaS 2.0), In: IEEE International Conference on e-Business Engineering, The 3rd International Workshop on Cloud Services - Platform Accelerating e-Business , 19-21 October, 2011, Beijing, China (2011 d).

CHANG, V., WILLS, G., WALTERS, R. AND CURRIE, W. 2012, Towards a structured Cloud ROI 2012: The University of Southampton cost-saving and user satisfaction case studies, Sustainable Green Computing: Practices, Methodologies and Technologies (2012 a).

CHANG, V., WALTERS, R. J. AND WILLS, G. 2012, Business Integration as a Service, International Journal of Cloud Applications and Computing, 2, (1), 16-40 (2012 b).

CHANG, V., WALTERS, R. J. AND WILLS, G. 2012, Cloud Storage in a private cloud deployment: Lessons for Data Intensive research (Best student paper). In, The second international conference on Cloud Computing and Service Sciences (CLOSER 2012), Porto, Portugal (2012 c).

CHANG, V., WALTERS, R. J. AND WILLS, G 2013, The development that leads to the Cloud Computing Business Framework, International Journal of Information Management, February (2013 a).

CHANG, V. AND WILLS, G., A University of Greenwich Case Study of Cloud Computing 2013 – Education as a Service. In, E-Logistics and E-Supply Chain Management: Applications for Evolving Business, IGI Global, April (2013 b).

CHANG, V., WALTERS, R. J. AND WILLS, G. 2013, Cloud Storage and Bioinformatics in a private cloud deployment: Lessons for Data Intensive research. In, Cloud Computing and Service Science, Springer Lecture Notes Series, Springer Book, 2013 (2013 c).

CHOUDHURY, A.R., KING, A., KUMAR, S. AND SABHARWAL, Y. 2008, Optimisations in Financial Engineering: the Least-Squares Monte Carlo method of Longstaff and Schwarts, IEEE International Parallel and Distributed Computing, IPDPS 2008.

CHRISTUDAS, B. D. 2008, Service Oriented Java Business Integration, Book, published by Packt, ISBN: 978-1847194404, February 2008.

HOING, A., SCHERP, G., GUDENKAUF, S., MEISTER, D., AND BRINKMANN, A. 2009, An Orchestration as a Service Infrastructure Using Grid Technologies and WS-BPEL, Service-Oriented Computing, Lecture Notes in Computer Science, 2009, Volume 5900/2009, 301-315.

HULL, J.C. 2009, Options, Futures, and Other Derivatives, Seventh Edition, Pearson, Prentice Hall, 2009.

IYENGAR, A., JESSANI, V. and CHILANTI, M. 2007, WebSphere Business Integration Primer: Process Server, BPEL, SCA, and SOA, Book, ISBN :013224831X 9780132248310, 2007.

KHAJEH-HOSSEINI, A., GREENWOOD, D., and SOMMERVILLE, I. 2010, Cloud Migration: A Case Study of Migrating an Enterprise IT System to IaaS, 3rd IEEE International conference on Cloud Computing, Cloud 2010, 5-10 July 2010; Miami, USA.

KHAJEH-HOSSEINI A., SOMMERVILLE I., BOGAERTS J., TEREGOWDA P. 2011, Decision Support Tools for Cloud Migration in the Enterprise. IEEE 4th Int. Conf. on Cloud Computing (CLOUD 2011), Washington DC, USA, 2011.

KRIPPAEHNE, R. C., MCCULLOUCH, B. G., and VANEGAS, J. A. 1992, Vertical Business Integration Strategies for Construction", Journal of Management in Engineering, 1992.

LEE, J., WANG, J., and ZHANG, J. 2009, The Relationship between Average Asset Correlation and Default Probability, technical paper, Moody's, July 2009.

LEE, C.F., LEE, A.C. and LEE, J. (Editors on behalf of 30 authors) 2010, Handbook of Quantitative Finance and Risk Management, Volume 1, Springer publisher, ISBN 978-0-387-77116-8, 2010.

LONGSTAFF, F.A., and SCHWARTZE, E.S., Valuing American Options by Simulations: A Simple Least-Squares Approach. Review of Financial Studies, 14, 1, 113–147, 2001.

MORENO, M. and NAVAS, J.F. 2001, On the Robustness of Least-Square Monte Carlo (LSM) for Pricing American Derivatives, Journal of Economic Literature Classification, April 2001.

PAPAZOGLOU M. P. and van den HEUVEL, W-J. 2011, Blueprinting the Cloud, IEEE Internet Computing, Vol. 15 No. 6, November/December 2011.

PAPAZOGLOU, M.P., and GEORGAKOPOULOS, D. 2003, Service Oriented Computing, Communications of the ACM, Vol. 46, No. 10, October 2003.

RIBEIRO, C. and WEBBER, N. 2004, Valuing path-dependent options in the variance-gamma model by Monte Carlo with a gamma bridge, The Journal of Computational Finance 7 (2):81–100, 2004.

RINGS, T., CARYER, G., GALLOP, J., GRABOWSKI, J., KOWACIKOVA, T., SCHULZ, S. and STOKES-REES, I. 2009, Grid and Cloud Computing: Opportunities for Integration with the Next Generation Network, Journal of Grid Computing, August 2009.

SCHUBERT, H., JEFFERY, K. and NEIDECKER-LUTZ, B. 2010, The Future for Cloud Computing: Opportunities for European Cloud Computing Beyond 2010, Expert Group report, version 1.0, January 2010.

TEOH, S, H., YANG, Y. G. and ZHANG, Y. 2009, R-Square and Market Efficiency, Social Science Research Network, July.

VOJDANI, A. F. 2003, Tools for Real-Time Business Integration and Collaboration 2003, IEEE Transactions on Power Systems.

VINOSKI, S., Java business integration 2005, IEEE Internet Engineering, Vol. 9, Issue 4, August 2005.

WATERS, D. 2008, Quantitative Methods for Business, Fourth Edition, Prentice Hall, Financial Times, 2008.

ZIMMERMANN, H. G., NEUNEIER, R. and GROTHMANN, R. 2006, Active Portfolio-Management based on Error Correction Neural Networks, Working Paper, Siemens AG, 2006.