A Cloud Computing Methodology Study of Platform-as-a-Service (PaaS) in the Financial Industry

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Abstract

The financial industry is a frequent client of cloud computing systems. Firms in this industry are gradually implementing more of Platform-as-a-Service (PaaS) as a new paradigm of this technology. In this study, the authors evaluate business, procedural and technical factors in the implementation of PaaS, as to their significance on projects and on a larger strategy. The authors learn from financial firms innovating in PaaS that procedural and business factors manifested more significance on PaaS projects than technical factors, which may facilitate an optimal strategy with this technology if the firms pursue such a strategy. The findings and the methodology of this study benefit educators enhancing curricula of information systems for current evolutions of cloud computing systems in the financial industry and in generic industry.

Keywords: cloud computing, financial industry, information systems, platform-as-a-service (PaaS), strategy

1. DEFINITION OF PLATFORM-AS-A-SERVICE (PaaS)

Platform-as-a-Service (PaaS) "is a broad collection of application infrastructure (middleware services including application platform, business process management, database and integration) … [consisting largely] of application PaaS (aPaaS) …" (Gartner, Inc., 2013) and an operating system (Zhang, Cheng, and Boutaba, 2010). Essentially PaaS is a platform on which firms deploy or develop projects and software solutions without having to buy, or having the complexity of hosting, the infrastructure technology (Marston, Li, Bandyopadhyay, Zhang, and Ghalsasi, 2011, and Murphy, 2013). Firms may have mainframe (Acquia, Inc., 2011) and mobile systems (Sartain, 2013) managed on PaaS by a cloud service provider (CSP) - the extent of providers (Emison, 2013a) is depicted in Figure 1 in the Appendix of this paper. PaaS CSPs include Amazon Database Service, Google App Engine, IBM Smart Cloud, Microsoft Azure Services and

Salesforce Force.com (Butler, 2013, Cloud Connect – Information Week, 2013, and Emison, 2013b). Literature forecasts global growth to be $27 billion or 5.3 zettabytes in PaaS by the end of 2016 (Sartain, 2013) and $241 billion in cloud computing overall by 2020 (Engineyard, 2013).

The benefits, especially for financial firms (Zimmerman, 2013), are in accessibility of agile development environments and in agility, efficiency and flexibility of infrastructure performance (McCaffrey, 2013). The fast provisioning of resources and scalability of services are considered critical features of infrastructure PaaS (Pearlson and Saunders, 2013). Financial firms are enabled to immediately implement innovations in products and services from hosted hardware and software for mainframe and mobile systems and for network operations systems. Financial firms are further interested in the cloud because of cost pressures (Crosman, 2014) and in outsourced PaaS because of infrastructure investment savings (Crosman, 2013b) in shared technology. Literature indicates 80% of firms leveraging cloud computing, such as PaaS, in 2014 (Thibodeau, 2013).

The benefits of PaaS are accompanied by concerns however. The control of customized resources by a CSP inevitably inhibits instant migration of services to a different CSP in the event of issues, such as non-fulfillment of services (Gonzalez, Miers, Redigolo, Simplicio, Carvalho, Naslund, and Pourzandi, 2012) or non-interoperability of non-CSP systems (Kress, 2014). The outages in the performance of PaaS resources inhibits proper response of services (Addis, Ardagna, Panicucci, Squillante, and Zhang, 2013) – an issue negative to that which is strategic about this technology (Distefano, Puliafito, and Trivedi, K., 2013). The perceived problems as to proper protection, risk management, and security of the systems are frequently indicated in the financial firm (Lipman, 2013a) and generic (Nanavati, 2014) literature. The PaaS may not realize savings (The Economist, 2013). These problems of PaaS pose a risk to financial firms and to generic industry (Vignos, Kim, and Metzer, 2013), such that the implementation of PaaS projects may be initiated slowly without a strategy. For financial firms, the risk may be managed with a methodology for a PaaS strategy. Given PaaS as the last segment of cloud computing to be initiated by industry (McAfee, 2011), a methodology may offer optimal potential with the technology.

2. INTRODUCTION TO PAPER

In the study, the authors apply a cloud computing methodology model to evaluate dimensions of business, procedural and technical factors on the implementation of PaaS projects in financial firms. The model is customized from earlier studies on Infrastructure-as-a-Service (IaaS) and Software-as-a-Service (SaaS) in financial firms by the authors (Howell-Barber, Lawler, Joseph & Narula, 2013, and Howell-Barber, Lawler, Desai, & Joseph, 2013). The emphasis of this holistic model in this study is on the factors, or the impacts, on the implementation of PaaS projects and on significance on strategy. This methodology is important to financial firms in the management of PaaS (and IaaS and SaaS) projects and strategy, inasmuch as increased investment in the technology in 2014 - 2016 is indicated in the literature (Camhi, 2013, Crosman, 2013a, and Stine, 2013). Though financial firms may be increasing investment in the technology, few may have a methodology model for business professionals and cloud technologists on projects that might proceed in a productive strategy.
The methodology model of the study is enhanced from the models on the IaaS and Saas studies by the authors (Howell-Barber, Lawler, Joseph, & Narula, 2013, and Howell-Barber, Lawler, Desai &, Joseph, 2013), but is essentially homogenous in the hosted similarity of the technologies.

Business Factors of Model
The business factors on the implementation of PaaS projects are below:

Agility and Competitiveness – Extent to which improved agility in initiating new products and services and increased competitiveness in the industry market were significant on the PaaS project;

Cost Benefits – Extent to which expense savings were significant on the PaaS project;

Executive Involvement of Business Organization – Extent to which participation of senior managers from the internal business client organization was significant on the PaaS project;

Executive Involvement of Information Systems Organization – Extent to which participation of senior managers from the internal information systems organization was significant on the PaaS project;

Globalization – Extent to which international impacts were significant on the PaaS project;

Organizational Change Management – Extent to which internal organizational change management processes were significant on the PaaS project;

Participation of Business Client Organization – Extent to which participation of internal business client organizational staff were significant on the Paas project;

Regulatory Requirements – Extent to which governmental or industry regulatory rules were significant on the PaaS project; and

Strategic Planning and Cloud Computing – Extent to which integration of overall strategic planning was significant on the project.

Procedural Factors of Model
The procedural factors on the projects are below:

Education and Training – Extent to which internal PaaS training was significant on the project;

Estimation of Expense and Planning and Procurement – Extent to which internal expense planning and procurement techniques were significant on the PaaS project;

Process Management – Extent to which internal process improvement responsibilities and tasks were significant on the PaaS project;

Program and Project Management – Extent to which internal program and project management teams, in partnership with the external cloud service provider (CSP) teams, were significant on the PaaS project;

Risk Management – Extent to which the CSP service level agreements (SLAs) integrated into internal risk management techniques were significant on the PaaS project;

Service-Oriented Architecture (SOA) – Extent to which purchased services of SOA were significant on the PaaS project;

Standards – Extent to which open standards, participation in standard organizations or processes of standards were significant on the project; and

Technology Change Management – Extent to which technology change management including CSP selection were significant on the project.

Technical Factors of Model
The technical factors are below:

Cloud Computing Center of Excellence – Extent to which a designated internal information systems team knowledgeable in best-of-class practices of cloud technology including PaaS were significant on the project;

Cloud-to-Cloud Interoperability – Extent to which PaaS integration with other internal or external cloud systems or technologies were significant on the project;

Cloud-to-Non-Cloud Interoperability – Extent to which PaaS integration with other internal or external non-cloud systems or technologies were significant on the project;

Continuous Processing – Extent to which 365/7/24 resource availability of services were significant on the PaaS project;

Data – Extent to which data governance, including "big data" management services, were significant on the PaaS project;

Elasticity of Processing Resources – Extent to which resource synchronization with internal processing requirements were significant on the PaaS project;

Infrastructure Architecture – Extent to which PaaS integration with internal organizational processing requirements were significant on the project;

Multiple Cloud Service Providers (CSPs) – Extent to which multiple CSPs were significant on the PaaS project;

Networking Implications – Extent to which the internal networking infrastructure was significant on the PaaS project;

Platform of Cloud Service Provider (CSP) – Extent to which the CSP platform of specialized technologies was significant on the project;

Privacy and Security – Extent to which CSP and internal organizational protection and security requirements were significant on the project;

Cloud System Problem Management – Extent to which problem management monitoring tools were significant on the project; and

Tools and Utilities – Extent to which CSP lifecycle management and system utilities were significant on this project.

This methodology offers a model on Paas projects that may proceed progressively in a strategy with PaaS technology.

The study attempts to evaluate the factors of the model as to immediate implementation significance and to significance to strategy. How might financial firms be best in identifying and implementing PaaS projects with external CSPs, but also be best in concurrently implementing other projects with internal organizational staff? How might the firms be integrating PaaS projects non-disruptively with internal services, and even IaaS and SaaS projects and services? How might they be integrating private and public PaaS services? How might they be managing external CSP PaaS systems integrating with internal organizational processes and systems? How might financial firms be managing PaaS systems in a PaaS strategy, if not an integrated SaaS, PaaS and IaaS strategy, with internal staff? Few in the field of information systems furnish a methodology model to answer these questions – answers that might be helpful to instructors in information systems in informing students of industry practices with this technology.

3. FOCUS OF STUDY

The focus of the authors is to evaluate the aforementioned business, procedural and technical factors in financial firms, as to significance in implementation on PaaS projects and as to significance on a PaaS strategy. Though firms in the industry have frequently hesitated in cloud computing innovation due largely to issues of reliability and security, the perceived processing savings is inexorably pressuring them to pursue PaaS systems (Melvin, 2013). The investment in PaaS is manageable with not only a methodology to minimize project risks but also with a strategy to maximize the benefits of PaaS systems (Subramanian, 2013). The maximization of on premise systems and outsourced PaaS systems, if not of further IaaS and SaaS technologies, is probable in a strategy (Greengard, 2013a). Financial firms may benefit from the guidance of the methodology of the study, and instructors in information systems may learn new practices in the shift to PaaS technology. In short, this study of PaaS contributes insight into a striding technological trend.

4. RESEARCH METHODOLOGY

The research methodology of this study consisted of a case study of 5 financial firms, chosen by the authors from among cloud computing first-mover innovators in Platform-as-a-Service (PaaS) identified in reputed practitioner publications (e.g., *Bank & Systems Technology*, *Bank Technology News*, and *Wall Street & Technology*) in the 4-month September – December 2013 period. The projects and systems of PaaS in the firms were evaluated by the authors from a checklist definition instrument of the aforementioned business, procedural and technical factors in the 4-month January – April 2014 period. The factors were evaluated on evidence of factor project significance, and significance on strategy, on a six-point Likert-like rating scale:

5 – Very high in significance;
4 – High in significance;
3 – Intermediate in significance;
2 – Low in significance;
1 – Very low in significance; and
0 – No significance.

These evaluations were based on in-depth observation of middle-management stakeholders in the financial firms; informed perceptions of observation PaaS rationale by the third author, an industry practitioner of 35 years; and research reviews of secondary industry practitioner studies by the first author, which were filtered for hype of marketing by also the third author. The checklist instrument of this study was evaluated in the context of construct, content and face validity and content validity, measured in sample validity, by the second author.

Overall, the research methodology of this study of PaaS was consistent in creditability and proven reliability with that of the earlier original studies of the authors on cloud SaaS and IaaS technologies (Howell-Barber, Lawler, Joseph, & Narula, 2013, and Howell-Barber, Lawler, Desai, & Joseph, 2013) and on related service-oriented architecture (SOA) technology (Lawler, & Howell-Barber, 2008); and with that of information systems syllabi taught by instructors in the Seidenberg School of Pace University.

5. ANALYSIS OF DATA

From the case study of the financial firms, the authors interpreted the data from the evaluations of the factors, and of the strategies, in the MATLAB 7.10.0 Statistics Toolbox (McClave & Sincich, 2006), for the following sub-section and Tables 1 and 2 in the Appendix.

Detailed Analysis of Financial Firms*
Firm 1: **Banking Institution**
Project: **Application Processing Platform**
Type: **Public Cloud System**

Financial Firm 1 is (in revenue) a small-sized northeast banking institution that focused on an application for processing and routing of customer services initiated at its international retail offices. The objective of the project was to discontinue antiquated and disparate internal systems that were not current with executed transactions; enable faster management of the transactions, especially problematic transactions; and integrate organizational processes for faster monitoring of the transactions. The project resulted in an external public cloud, performance reporting for senior management and service staff, and full security of the system.

The business factors of *Executive Involvement of Business Organization* (5.00 / 5.00), *Executive Involvement of Information Systems Organization* (5.00) and *Participation of Business Client Organization* (5.00) were significant in ensuring that the business requirements of the retail offices were met by the CSP. The procedural factors of *Process Management* (5.00) and *Risk Management* (5.00), and the technical factors of *Data* (5.00) and *Privacy and Security* (5.00), were especially significant in ensuring that *Regulatory Requirements* (4.00) were met by the CSP. Inasmuch as the processes of the system were managed mostly by the CSP, the technical factors of *Cloud-to-Non-Cloud Interoperability* (5.00), *Continuous Processing* (5.00) and *Cloud System Problem Management* (5.00) were of further significance. The very high reliance of the firm on the CSP was evident in the internal procedural factor of *Education and Training* (1.00) and the technical factor of *Cloud Computing Center of Excellence* (0.00). The project was the first initiation of the firm into the cloud, in the context of a plan in *Strategic Planning and Cloud Computing* (4.00), with the intent of further migration of internal systems to the CSP in 2015 – 207.

Firm 1 is an example of a small-sized organization that is cautiously piloting PaaS for a few applications in a public cloud with a CSP vendor.

Firm 2: **Financial Services Institution - Domestic**
Project: **Application Infrastructure Platform**
Type: **Private Cloud System**

Firm 2 is a large-sized northeast financial services institution that focused on an application infrastructure for development systems staff. The objective of the project was to discontinue expensive and inefficient localized infrastructures; and enable a faster infrastructure institutionalized for software teams. The project resulted in a private cloud with a CSP that improved platform services and productivity of the staff for next generation systems, at a lower investment than the multiple platform services.

Though the business factor of *Agility and Competitiveness* (5.00) and *Cost Benefits* (5.00) were significant in initiating the project, the procedural factors of *Estimation of Expense and Planning and Procurement* (5.00), *Standards* (5.00) and *Technology Change Management* (5.00) were significant in managing the technology. The technical factor of *Cloud-to-Non-Cloud Interoperability* (5.00) was especially significant on this project, inasmuch as the financial firm was initiating a private cloud PaaS that was also managed by the internal information systems organization. This project was significantly technical, such that *Continuous Processing* (5.00), *Elasticity of Processing Resources* (5.00) and *Infrastructure Architecture* (5.00) were of notable significance to the internal systems staff. The reliance on internal systems teams was evident in the procedural factor of *Education and Training* (4.00) and the technical factor of *Cloud Computing Center of Excellence* (5.00). The project was migrating the firm into the cloud with informed knowledge of a strategy in *Strategic Planning and Cloud Computing* (5.00).

Firm 2 is an example of a large-sized organization that is piloting core infrastructure on PaaS in a private cloud with a CSP, in order to be competitive and efficient on projects, but the firm is limiting integration of in-house on premise systems with the vendor.

Firm 3: **Financial Services Institution - Global**

Project: **Database "Big Data" Platform**
Type: **Private Cloud System**

Firm 3 is a large-sized global proprietary services organization that initiated an enhanced database platform for international offices. The objective of this project was to enable expandable features of an existing PaaS hardware platform for predictive analytic services. The project included a few more CSPs that resulted in an improved private cloud platform that increased scalability of the services and interoperated internal legacy systems.

The business factors of *Agility and Competitiveness* (5.00) and *Cost Benefits* (5.00) were again significant, but they included more of *Participation of Business Client Organization* (5.00) on the project. The procedural factors of *Education and Training* (5.00) and *Standards* (5.00), and the technical factor of *Cloud Computing Center of Excellence* (5.00), were especially significant on this project – the inclusion of open source standards in the technical factor of *Tools and Utilities* (5.00) was notable significantly for ensuring independence of the CSP vendors. The reliance on the internal management of systems was again evident in *Executive Involvement of Information Systems Organization* (5.00). This project was mainly managed by the internal organizations, in the procedural factors of *Estimation of Expense and Planning and Procurement* (5.00) and *Technology Change Management* (5.00). In fact, the technical factors of *Cloud-to-Non-Cloud Interoperability* (5.00), *Data* (5.00), *Elasticity of Processing Resources* (5.00), *Infrastructure Architecture* (5.00) and *Multiple Cloud Service Providers* (5.00) were prominent on this project – the hosted *Multiple Cloud Service Providers* (5.00) integrating into internal processes of the organization were notably significant to project success. Interestingly, the factor of *Privacy and Security* (2.00) was not as evident in the planning of the technologists. Overall, this project was further in migrating into the PaaS platform in an incremental strategy, in *Strategic Planning and Cloud Computing* (5.00), than the projects in Firms 2 and 1.

Firm 3 is another example of a large-sized organization that is independently migrating into the PaaS paradigm, pioneering critical infrastructure on PaaS in a private cloud, but limiting the optimization of the technology in initial internal training.

Firm 4: **Global Insurance Organization**
Project: **Elastic Grid Platform**
Type: **Public Cloud System**

Firm 4 is an international medium-sized insurance organization that needed a faster and flexible data center platform for international regulatory reporting requirements. The objective was to implement a high performance platform for the processing stochastic systems of the offices of the organization. The project resulted in a new public cloud platform with a first comer CSP that increased the frequency and intelligence of the reporting and the interoperability of the systems at less expense than previous.

The business factors on this project were especially significant in European Union *Regulatory Requirements* (5.00) that involved more of *Executive Involvement of Business Client Organization* (5.00) and *Participation of Client Organizations* (5.00) than on the projects previously, though the information systems organization in *Executive Involvement of Information Systems Organization* (5.00) managed the project, again similar to the projects previously. The factor of *Cost Benefits* (5.00) was of project significance. The procedural factors of *Process Management* (5.00), *Program and Project Management* (5.00) and *Risk Management* (5.00), and also *Education and Training* (5.00), were of notable significance, inasmuch as the PaaS platform was a higher-risk public system. The technical factors of *Cloud-to-Non-Cloud Interoperability* (5.00), *Data* (5.00), *Elasticity of Processing Resources* (5.00), *Privacy and Security* (5.00) and *Tools and Utilities* (5.00) were of significance in insuring the performance and protection of the non-private technology. Overall, the project was planned in a sole strategy for the specific technology, but was not positioned for a PaaS strategy of subsequent technologies.

Firm 4 is an illustration of an organization that is leveraging a PaaS public cloud platform on a limited number of projects with a CSP vendor, but the organization will not probably pursue the technology unless perceived urgent.

Firm 5: **Customer Loan Management Organization**
Project: **Loan Management Platform**
Type: **Public Cloud System**

The final firm is a small-sized Midwest organization that needed to replace an

expensive external system hosted by a non-cloud vendor. The objective of the organization was in fully outsourcing and processing payment transactions on a less expensive public cloud system of a CSP vendor. The project resulted not only in a less expensive PaaS processing and reporting system, but also in PaaS utilities and tools furnished by the vendor that increased organizational profit margins.

The business factors of *Agility and Competitiveness* (5.00) and *Cost Benefits* (5.00) were notably significant on this project. This project was managed by the business organization in *Executive Involvement of Business Client Organization* (5.00) and *Participation of Client Organizations* (5.00), inasmuch as the firm as a small-sized organization was without a technologist team. The procedural factor of *Process Management* (5.00), in negotiating processing requirements with the CSP, was of significance. The technical factors were limited to *Data* (5.00), *Privacy and Security* (5.00) and *Tools and Utilities* (5.00) in project significance. In short, neither the organization nor the project was positioned for a PaaS *Infrastructure Architecture* (0.00) plan or strategy in *Strategic Planning and Cloud Computing* (0.00) – outsourcing of specific technologies was the pure and simple target.

Firm 5 is an illustration of small-sized organizations having few funds for internal systems that are initiating investment in limited PaaS platform technologies that are often public not private utilities.

*Financial Firms are classified as confidential due to competitive imperatives in the industry.

Summary Analysis of Financial Firms

The analysis of the data findings from the financial firm projects is disclosing business factors (3.51 summary) as essentially significant. Even though the PaaS projects were mainly managed by the information systems organizations (4.00), the justification for the projects was not merely technical. The procedural factors (3.60) were significant insofar as the organizations were managing the migration of processing requirements (4.60) to the CSP vendors. Internal technologist training (3.60) was significant in instances of interoperability of non-PaaS systems and observable performances of PaaS technologies (Stewart and Slisinger, 2012). The technical factors (3.18) frequently were manifested more and were notably significant in interoperability (4.00) of non-PaaS systems and in the performances (4.00) and protections (4.40) of PaaS technologies, especially in the large-sized organizations sharing PaaS technologies. Few of organizations were migrating systems to multiple CSP vendors (1.00). Privacy and security (4.40) was of notable significance. The large-sized organizations were migrating systems to private cloud vendors; and the small-sized organizations were migrating the systems to public cloud vendors. The organizational planning of the projects in a bona fide PaaS strategy was not positioned prominently in the study, but the potential of pursuing a strategy was strong at times. The planning of IaaS, PaaS and SaaS strategy was not a result of this study.

(The correlations of the factor ratings between pairs of the firms indicated in Table 3 that positive correlations between Firms 1 and 4 (0.5132), Firms 1 and 5 (0.5920) and Firms 4 and 5 (0.5187) were statistically significant at the $p<0.01$ level of significance. The frequency distributions of the 0 -5 ratings of each of the firms indicated in Table 4 that except for Firm 5 factor ratings across Firms 1-4 were concentrated in the 5 (very high in significance) rating. The concentrations of the 5 rating in Firms 1, 2, 3 and 4 were 43.33%, 63.33%, 66.67% and 63.33% respectively – in Firm 5 the 0 rating (no significance) had the highest concentrations of ratings of 40.00%.)

6. DISCUSSION AND IMPLICATIONS OF STUDY

The evaluations of the financial firms denote encouragingly that the PaaS projects were funded and implemented from business factor justification. Though the projects were mainly managed by the information systems organization, in partnership with the CSP PaaS staff, the internal technologists were motivated by business organizational requirements (Greengard, 2013b), not the provider technologies. The importance of internal organizational requirements as a PaaS prerequisite is an immediate implication.

The evaluations of the firms by the authors find that the PaaS projects were implemented mainly in private cloud systems by the large-sized organizations and in public cloud systems by the small-sized organizations. The management of internal non-PaaS and external PaaS metric processing and protection requirements was notable regardless of the systems. Risk and security of the external systems were notable in

the study. Though external private secure systems on the cloud will be the probable technologies of large-sized organizations (Lipman, 2013b), the risk and security of private and public systems were equivalently of prominent significance in the study. The importance of non-PaaS and PaaS processing requirements in private and public secure systems is an implication of the study.

The evaluations of the authors highlight the governance importance of integration of internal non-PaaS and external PaaS systems in mostly the large-sized organizations with the most systems. The focus on the interoperability of the systems, and even of localized so-called ready technologies (Andriole, 2014), is noted in the literature (Greengard, 2013a) and was of prominent significance in the study. The importance of interoperability and openness of the processing of non-PaaS and PaaS systems, as a required responsibility of the CSP and the internal systems organization, is another implication.

Even though the cloud model of PaaS is an outsourcing paradigm, the findings in the financial firms indicate that knowledge of cloud PaaS in the internal systems organizations is of importance in the migration of the systems to the CSP vendor. The importance of cloud knowledge in PaaS, SaaS and IaaS is noted often in the literature (Eddy, 2013, Florentine, 2013, and Kress, 2014) and was also of prominent significance in this study. Firms need professionals skilled in the business and technical perspectives of these technologies (Gabriel, 2013 and Rubin, 2013). Forward-looking instructors in information systems might enhance programs for students, in order to help them in learning these state-of-the-art technologies, in tandem with traditional theories (Linthicum, 2013). The importance of internal skilled systems teams in the interface integration and migration of on premise systems and PaaS provider technologies is a further implication.

Finally, the findings of the study indicate the locus of the financial firms to be more on PaaS projects at minimal risk (Subramanian, 2013) than on strategy. The gains of the projects were more incremental than integrated or optimized in a strategy (Greengard, 2013a). Though PaaS projects are the smallest of the cloud technologies (Butler, 2013), firms may proactively pursue a strategy if PaaS furnishes an increased edge in their industry beyond expense infrastructure savings with these technologies. PaaS may be eventually integral to the firms (Sardet, 2012), necessitating a strategy. The importance of practitioners and researchers in information systems pursuing the potential of a PaaS strategy is the last implication of this study.

7. LIMITATIONS AND OPPORTUNITIES

Implications of this study are from a limited number of financial firms, inasmuch as investment is limited in this segment of the technology. This study is exclusive of external cloud service provider (CSP) PaaS processes and is limited to internal interoperating processes of the PaaS systems and technologies of the financial firms. The methodology of this study furnishes nevertheless an opportunity for pursuing project research and significance of strategy, inasmuch as practitioner and scholarly research is limited on PaaS if not on IaaS and SaaS technologies (Zhang, Cheng, and Boutaba, 2010). The methodology may even be improved for researching CSP risks and reviewing CSP services for specialized PaaS technologies. The opportunities for PaaS study will increase as investment increases in this technology.

8. CONCLUSION OF STUDY

The authors conclude that the financial firms analyzed in this study are benefiting from Platform-as-a-Service (PaaS) projects, but not as frequently as other cloud platform technologies. Firms in this industry are concerned about risks and are generally hesitant in implementing outsourced PaaS systems. For the firms implementing PaaS private or public systems, the authors learn that business, procedural and technical factors from the framework of a management methodology model are significant on PaaS technologies.

The business factors were a definite justification for the projects, in efficiencies and savings, even though the projects were managed mostly by the information systems organizations. The procedural factors, such as risk management, were significant in the migration of processing and protection requirements to the cloud service provider (CSP) PaaS technologies. The technical factors were more manifested than the procedural and business factors and were prominent and of significance in the interoperability of non-PaaS systems and PaaS technologies in tandem.

At the same time, the findings indicate that the financial firms initiated investment in the CSP PaaS technologies separate from a strategy. Though the firms might be hesitant about further investment due to lingering issues, such as security, they might be more motivated to pursue a PaaS strategy beyond tactical once the benefits are more prevailing than the issues. In the interim period, the study contributes findings that are beneficial to instructors in information systems, in helping students learn practices in PaaS state-of-the-art technologies. The study is beneficial to practitioners, in learning of proven solutions. In conclusion, this study contributes a methodology model for instructors and practitioners that may be applied in the evolution of PaaS technologies not only in the financial industry, but also in generic industry.

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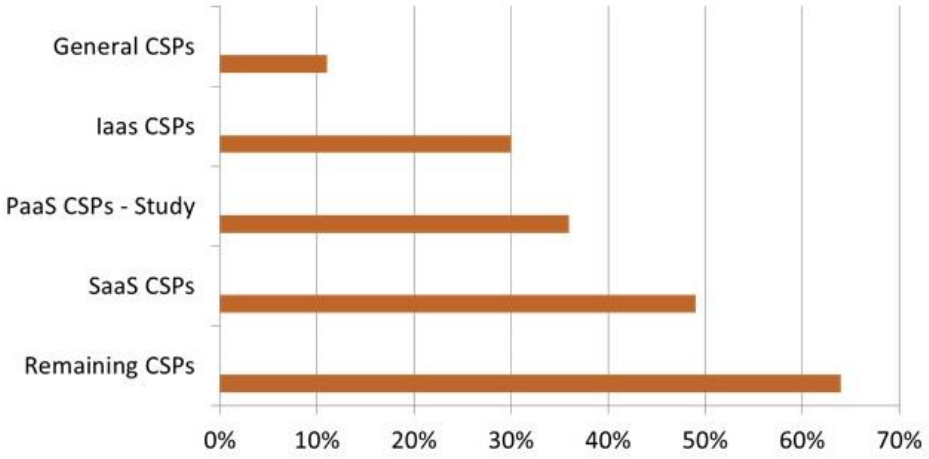
APPENDIX

Figure 1: Cloud Service Providers (CSPs) – Platform-as-a-Service (PaaS) in Industry



2013 Organizational Percentage Usage

Source: Emison, J.M. (2013a, March). PaaS buyer's guide. *Information Week*: *Reports*, 2.

Table 1: Summary Analysis of Factors of Financial Firms of PaaS Study

Categorical Factors of Methodology Model	Means	Standard Deviations
Business Factors	3.51	2.00
Procedural Factors	3.60	1.84
Technical Factors	3.18	2.14

Legend: 5 – Very High in Significance, 4 – High in Significance, 3 – Intermediate in Significance, 2 – Low in Significance, 1 – Very Low in Significance, and 0 – No Significance, on Projects of Study

Table 2: Detailed Analysis of Factors of Financial Firms of PaaS Study

	Firm 1 Means	Firm 2 Means	Firm 3 Means	Firm 4 Means	Firm 5 Means	Summary Means	Standard Deviations
Business Factors							
Agility and Competitiveness	5.00	5.00	5.00	1.00	5.00	4.20	1.79

Cost Benefits	3.00	5.00	5.00	5.00	5.00	4.60	0.89
Executive Involvement of Business Organization	5.00	0.00	3.00	5.00	5.00	3.60	2.19
Executive Involvement of Information Systems Organization	5.00	5.00	5.00	5.00	0.00	4.00	2.24
Globalization	5.00	4.00	3.00	0.00	0.00	2.40	2.30
Organizational Change Management	2.00	4.00	0.00	4.00	0.00	2.00	2.00
Participation of Business Client Organization	5.00	3.00	5.00	5.00	5.00	4.60	0.89
Regulatory Requirements	4.00	0.00	0.00	5.00	3.00	2.40	2.30
Strategic Planning and Cloud Computing	4.00	5.00	5.00	5.00	0.00	3.80	2.17
Procedural Factors							
Education and Training	1.00	4.00	5.00	5.00	3.00	3.60	1.67
Estimation of Expense and Planning and Procurement	4.00	5.00	5.00	5.00	3.00	4.40	0.89
Process Management	5.00	5.00	3.00	5.00	5.00	4.60	0.89
Program and Project Management	3.00	3.00	4.00	5.00	2.00	3.40	1.14
Risk Management	5.00	5.00	5.00	5.00	3.00	4.60	0.89
Service-Oriented Architecture (SOA)	0.00	5.00	5.00	0.00	0.00	2.00	2.74
Standards	0.00	5.00	5.00	0.00	0.00	2.00	2.74
Technology Change Management	3.00	5.00	5.00	5.00	3.00	4.20	1.10
Technical Factors							
Cloud Computing Center of Excellence	0.00	5.00	5.00	0.00	0.00	2.00	2.74
Cloud-to-Cloud Interoperability	0.00	0.00	5.00	0.00	0.00	1.00	2.24
Cloud-to-Non-	5.00	5.00	5.00	5.00	0.00	4.00	2.24

Cloud interoperability							
Continuous Processing	5.00	5.00	2.00	3.00	3.00	3.60	1.34
Data	5.00	0.00	5.00	5.00	5.00	4.00	2.24
Elasticity of Processing Resources	0.00	5.00	5.00	5.00	0.00	3.00	2.74
Infrastructure Architecture	3.00	5.00	5.00	0.00	0.00	2.60	2.51
Multiple Cloud Service Providers (CSPs)	0.00	0.00	5.00	0.00	0.00	1.00	2.24
Networking Implications	4.00	3.00	2.00	3.00	3.00	3.00	0.71
Platform of Cloud Service Provider (CSP)	2.00	5.00	5.00	5.00	2.00	3.80	1.64
Privacy and Security	5.00	5.00	2.00	5.00	5.00	4.40	1.34
Cloud System Problem Management	5.00	5.00	2.00	5.00	3.00	4.00	1.41
Tools and Utilities	5.00	5.00	5.00	5.00	5.00	5.00	0.00

Legend: Refer to Legend in Table 1

Table 3: Correlations between Pairs of Financial Firms of PaaS Study

	Firm 1	**Firm 2**	**Firm 3**	**Firm 4**
Firm 2	0.0844			
Firm 3	-0.2811	0.2019		
Firm 4	0.5132*	0.0640	-0.1584	
Firm 5	0.592*	-0.0967	-0.1404	0.5187*

*Correlations between Firms 1 and 4, between Firms 1 and 5 and between Firms 4 and 5 were significant statistically relative to zero at the 0.01 level of significance.

Table 4: Frequency of Ratings across Factors of PaaS Study

	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5
Ratings					
0	20.00%	16.67%	6.67%	23.33%	40.00%
1 – Very Low	3.33%			3.33%	
2 – Low	6.67%		13.33%		6.67%
3 – Intermediate	13.33%	10.00%	10.00%	6.67%	26.67%
4 – High	13.33%	10.00%	3.33%	3.33%	
5 – Very High in Significance	43.33%	63.33%	66.67%	63.33%	26.67%