# A New Framework
# for Cloud Business Process Management

Mohamed K. Watfa[✉], Nafez A.L. Najjar,
Jad Cheikha, and Nayef Buali

University of Wollongong in Dubai, Knowledge Village, Dubai, UAE
MohamedWatfa@uowdubai.ac.ae,
{nan926,jcc693}@uowmail.edu.au, nayefbuali@gmail.com

**Abstract.** Cloud BPM is a technology that utilizes Cloud computing offerings for running a Business Process Management System (BPMS). Both technologies are of high interest to business and technology domains and it is understood that the combination of both Business Process Management and Cloud computing will result in a higher level of business efficiency. This research paper uses both quantitative and qualitative analysis in order to have an in depth details on the Cloud Business Process Management adoption rate and the benefits it offers for end users. Since Cloud Business Process Management is a new technology trend, we propose a standard Cloud Business Process Management model which focuses on business efficiency. We were able to identify the reasons behind the lack of Cloud BPM adoption in the local market and gathered sufficient evidence to prove that there is a relation between Cloud BPM and business efficiency.

**Keywords:** Cloud computing · Business Process Management (BPM) · Cloud Business Process Management (CBPM) · Business efficiency · Cloud Business Process Management adoption

## 1 Introduction

Business Process Management (BPM) is a holistic management approach focused on aligning organizational objectives and other aspects to continuously improve business processes; i.e., is referred to as a "process improvement" process. The aim of Business Process Management is to improve the business performance of an enterprise by changing business operations to perform more effectively and efficiently. BPM as a management discipline, has its origins in previous management disciplines such as business process reengineering (BPR), as developed in the seminal works of Hammer in the 1990s [1]. Organizations are continuously subjected to internal and external challenges and threats; hence the ability to adapt to new opportunity and change in business processes is mandatory to stand out among rivals. The core advantage of BPM is to achieve efficiency by continuously improving business processes. BPM also helps organizations in being customer oriented as this is one of the most demanding goals and targets in achieving business goals. Furthermore, BPM plays a key role in product and services improvement, quality and innovation.

BPM is sometimes wrongly considered to be a means of software or application only, while in fact it consists of multiple steps and functionality within the BPM lifecycle; however a software or application is considered part of the BPM lifecycle which also includes process design, system configuration, process enactment, and diagnosis where analysis and monitoring tools, flow times, process bottlenecks, utilization are used. The Business Process Management is part of the enactment phase which consists of software suites used for process modeling, management, execution, and monitoring. The main components of a BPMS as summarized in Fig. 1 are divided into:

- The *Business Process Modeling* component aims to create a process models and is usually achieved by means of graphical notations.
- The *Business Process Environment* includes the components that trigger the initiation of the process.
- The *Business Process Model Repository* is a space where models are saved.
- The *Process Engine* is the core where the process models are executed and acts as a compiler in SW coordinating communication and interaction with service providers.
- *Service Providers* act as an Input/Output system and consists of computer systems and humans who interact with the process engine.
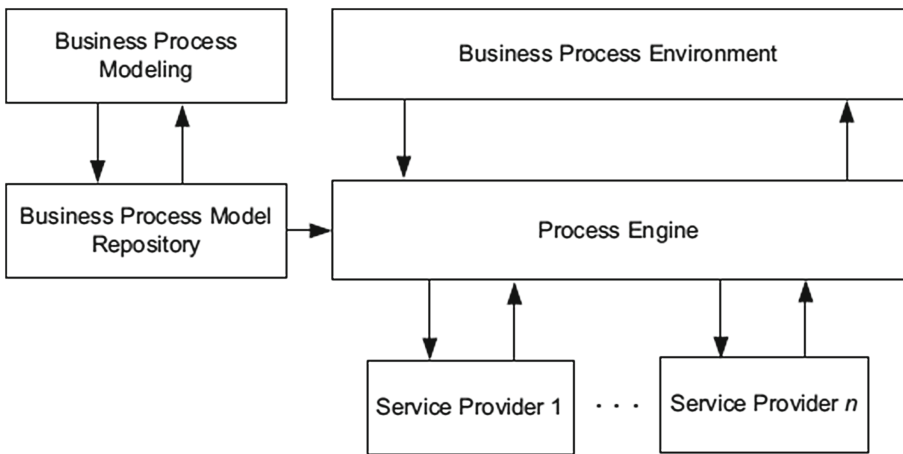


**Fig. 1.** BPMS components

According to Gartner [10], forty percent of Respondents with BPM Initiatives use Cloud Computing to Support at Least ten percent of BPM Business Processes. BPM is a proven technology with a paramount goal to improve business processes and a transformation to be cloud based is a solution already offered by many BPM providers. Cloud computing offers many advantages to the business and applications that have moved to the cloud inherit many of its wide range advantages and drawbacks as well. Cloud BPM is being implemented as PaaS or SaaS by most of the vendors. However, researches in this field indicate that Cloud BPM can be implemented as IaaS cloud offerings [2]. Furthermore most of the current vendors are offering Cloud BPM as a

public cloud type of offering. On the other hand, according to the research by Han *et al.* in [3], Cloud BPM can be offered in any of the cloud deployment models. Furthermore, a combination that includes separating components of a BPM system between multiple types and that is offered as a hybrid cloud is also suggested. BPM and Cloud independent advantages are widely recognized among organizations however what's gaining attention more and more is the collective advantages of BMP in Cloud. The economic value of a BPM in the cloud eliminates the need for an upfront capital investment as it functions on a "Pay per use" model which decreases the overall cost of the solution. With BPM in the cloud, organizations no longer need to worry about scaling their system up or down and how this scaling might affect their systems since it will be completely handled by their BPM-C Vendor upon request. Some other BPM-C advantages include continuous operational efficiency improvement, high availability and performance, increased revenue, decreased overall cost, competitive advantage and many more. These benefits combined together will offer the organizations a dynamic responsive IT infrastructure which can be continuously improved or adjusted in order to meet the business needs and keep up with the rapid changes in the market.

In this research, we focus on the BPM being shifted to the cloud in order to address the how successful this move can be for organizations in the local market. On the other hand, we provide a detailed study of the current thoughts of this technology in terms of advantages, drawbacks and adoption rates to assist current and future vendors offering cloud based BPM systems adopt, innovate and change to satisfy markets need in this context. The rest of the paper is organized as follows: Sect. 2 states the research problem and its corresponding research questions highlighting the significance of this research work. Section 3 summarizes the related research work. Section 4 summarizes our research design and methodology and results. Section 5 concludes this work.

## 2   Research Questions

Addressing the concept, models, advantages and disadvantages of cloud BPM over non Cloud based BPM are to be studied, proposed and tested furthermore. Also, the adoption factor and adoption status according to both SMB and enterprises will be extracted and analyzed to address to what extent it is acceptable and seen as an added value to enhance and improve organizations business processes.

### 2.1   Research Questions

Our research question focuses on the analysis and justifications of the lack of Business Process Management in the Cloud (BPM-C) adoption among local Enterprises and SMEs and how cloud based BPM platforms can contribute to improve the efficiency of an organization through modeling and standardizing core business processes. In this research, we will be using a non-causal correlation methodology along with a cross sectional study setting. A non-contrived methodology will also be used in order to discuss rigorously our research question.

In a nutshell, our main objectives are listed below:

- Identify the differences between cloud based BPM and BPM.
- Identify cloud BPM models and frameworks.
- Understand if and how cloud BPM can enhance organizations' efficiency.
- Study the advantages and disadvantages of cloud BPM.
- Analyze future trends relating to cloud BPM.
- Analyze local adoption behavior compared to other regions.

## 3  Related Work in Cloud BPM

Whibley [4] discusses the business benefits of having a cloud BPM and how the BPM will integrate with the cloud architecture. Moreover, he discusses the challenges and how the future of cloud BPM will transform the delivery of business processes. The author argues that the cloud adoption in packaged apps is on the rise but on the other hand the adoption of BPM to cloud is slower because BPM applications do not have the same features of packaged apps. Multiple concerns and weakness come to mind in which the author did not discuss or mention. First, he mentions the BPM as a PaaS while in reality BPM can also be offered and supported through multiple other service models. A second concern includes the challenges besides data security, for example unknown reliability of the Infrastructure which is provided by the cloud vendor and the challenges of integrating the BPM system in house and legacy systems within an organization. Moreover, there is the issue of computation vs. non computational intensive activities that might lead into increasing the cost on the user side. It also seems that the author relied on theoretical information and did not provide any statistical data to support his analysis. This short coming was somehow addressed in the next research by Railton *et al.* [5]. Railton *et al.* performed a literature review and an online survey on Cloud based BPM to propose the definition and concept of cloud BPM, identify main benefits and drawbacks of cloud based BPM, its characteristics, market trends and adoption rates.

Existing research work on cloud BPM [4–7] primarily focused on the definition, characteristics, benefits, drawbacks and market trends. However, there was a small focus on the adoption rates of Cloud BPM. Since cloud BPM inherits many of its characteristics from cloud computing and the lack of literature studies that addresses the adoption of Cloud BPM, analyzing papers on the adoption of Cloud computing [8, 9] is presumed to facilitate our goal of studying and analyzing Cloud BPM adoption. Yeboah-Boateng et al. [8] evaluates the main factors and issues that are affecting the adoption of Cloud Computing technologies within SMEs in developing economies. Cloud adoption has recently increased however the interest in these kinds of services in the developing economies is still slow and not up to the speed. Due to this, the identification of enabling and constrain adoption features arises. Some of the main enabling features are low cost, business continuity, enhanced communications and scalability. On the other hand, some of the adoption constrains are security, unconventional internet connections and lack of trust for current systems.

Moreover, some of the factors that influence the adoption of cloud computing technologies are efficiency of cloud vendors, management support and trial periods. A survey of cloud-computing adoption studies can be found in [8, 9] where a noticeable part of the published research was conducted in well-developed countries. In addition, existing studies [8, 9, 11] focus on the acceptance of services and deployment models for cloud computing while disregarding the factors that drive adoption.

## 4   Research Methodology and Analysis

In this research, we used a mixed research method that includes both qualitative and quantitative methods. The qualitative method will aim to gather in-depth information and understanding on Cloud BPM and its impact on business process efficiency. On the other hand, the quantitative method will gather statistical information which will help us analyze the information gathered. Furthermore, the findings, relationships and assumptions will be studied and tested using hypotheses testing. We also study the relationship between Cloud BPM and Business Efficiency. For that we will be using a Non-Causal investigation type. This type will be used to study, analyze and answer the correlation between Cloud BPM and Business Efficiency. In order to achieve and accurate result, the study will be conducted on real life Cloud BPM systems that are currently running in local SMEs or Enterprises. This Non-Contrived study will consist of multiple interviews, surveys from different personnel in the BPM area and an analysis of archival data. A cross sectional methodology will be used where all the data will be collected at a certain point in time. In order to get an unbiased data sample, the unit of analysis for this research will be a mixture of individuals, groups, divisions and industries.

The target population for this research is divided in to three sections. The first are BPM providers and users, second are cloud providers and users and finally the third are cloud BPM providers and users. The reason behind targeting Cloud and BPM providers is in hopes of finding difficulties with providing Cloud BPM since they do not offer this kind of service and they will have an unbiased opinion about it. With respect to the above target population, the sampling frame will consist of the following: Local Enterprises such as IBM, Oracle, Microsoft, EMC; Telecommunications and Banking industries; and Government hospitals and local IT SMEs. The following sample units will be derived out of the above sampling frame: 30 samples from Enterprises, 30 samples from Telecommunications industry, 30 Samples from the banking industry and 30 samples from local IT SMBs and SMEs. We have chosen the probability sampling technique with multi-stage sampling consisting of two stages. The sampling methodology will start by randomly selecting two to three samples from the sampling frame and assigning them into clusters. Once this is done, we will again randomly select multiple clusters in order to acquire twenty to thirty samples from each selected cluster.

In order to have accurate measurements, survey and interview questions will be worded to focus on the Cloud BPM attributes that relate to the hypotheses and research questions. Mainly the questions and interviews will focus on the areas of adoption and business efficiency attributes with regards to Cloud BPM. After a successful literature review we concluded that the following will be the main Cloud BPM attributes that we will focus on: *Adoption, Implementation, Flexibility, Reliability, Security, and Functionality.*

The survey will consist of two to three questions on each of the above attributes and the style of the questions will contain a mixture of "Closed Questions" that will be answered using the Likert Scale, Multiple Choice, Tick Box, and Open Questions. Since reliability and accuracy of the collected data are of high importance to this research, part of the questions will concentrate on collecting the personal information of the respondents. This will assist us at a later point by measure the respondent's involvement in the Cloud BPM area. Also, hypotheses based on the literature review and the studies conducted on Cloud Business Process Management were analyzed.

## 4.1 Data Collection and Sampling

An online survey was used to collect data that addresses our research framework attributes with at least two questions per attribute. Furthermore, we conducted interviews with Cloud BPM vendors. The questions are a combination of knowledge, background, experience, opinion and feeling questions. The selection of our targeted respondents was carefully done by selecting local organizations that can be but in two classifications as shown in Tables 1 and 2.

**Table 1.** Sample classification based on company size.

| Row variable | Cloud BPM | No cloud-BPM | Total |
|---|---|---|---|
| Enterprise | 84 | 24 | 108 |
| SMB | 57 | 15 | 72 |
| Total | 141 | 39 | 180 |

**Table 2.** Sample classification based on adoption of cloud computing and adoption of Cloud BPM.

| Row variable | Cloud BPM | No cloud-BPM | Total |
|---|---|---|---|
| Have cloud computing | 138 | 15 | 153 |
| Don't have cloud computing | 3 | 24 | 27 |
| Total | 141 | 39 | 180 |

## 4.2 Research Analysis and Results

Some interesting results from our data analysis included the following;

- **Cloud computing characteristics and adoption behavior effect cloud BPM**: As expected Cloud BPM would inherit many characteristics and adoption factors from Cloud computing as the framework depends on including cloud computing as a key enabler to our suggested framework. 65 % of our respondents indicate that PaaS is the most deployed cloud computing delivery model, while 70 % indicated that PaaS is the most deployed Cloud BPM model. Furthermore, hybrid deployment model is the highest adopted model among private and public models with 42 % in companies that have Cloud Computing solutions, and 41 % among companies that have Cloud BPM implementations.

- **Company size effect on Cloud BPM adoption**: Respondents from both enterprises and SMBs would have the same interest in deploying Cloud BPM.
- **Cloud BPM key advantages**: We included six questions to uncover and validate key advantages and adoption enablers in our framework; five of the questions are Likert scale based while one allows the respondents to choose the 4 most important advantages among 10. Some results included:

  – 95 % agreed that Cloud BPM would enhance the efficiency of organization utilizing it, which indicates that organizations would more likely adopt Cloud BPM to achieve their overall goal of process improvement.
  – More than 95 % agreed that applying BPM in a cloud based approach would provide higher uptime and lower downtime. This could be due to the fact that one of the main Cloud Computing characteristics is availability of the service anywhere and anytime through means of network access and is built and constructed with this key feature in mind.
  – Almost all of the respondents agreed to the potential acceleration of cloud BPM adoption among local organizations.
  – The majority of the respondents with a proportion of more than 95 % agreed that Cloud BPM can support both simple and complex business processes, hence can replace the traditional BPM.
  – All of the respondents agreed that Cloud BPM is considered flexible and can scale up and down. This can be a consequence of inheriting this key feature from cloud computing offerings which support scaling the resources as needed by the underlying applications.
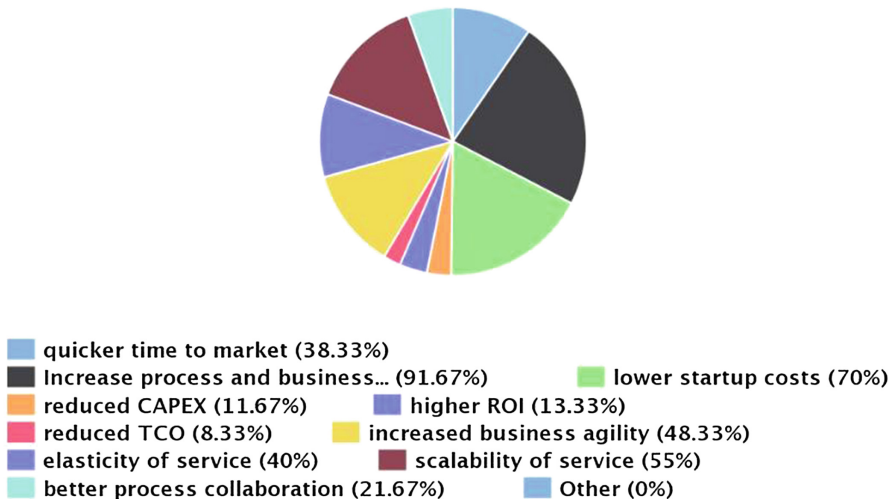


- quicker time to market (38.33%)
- Increase process and business... (91.67%)          lower startup costs (70%)
- reduced CAPEX (11.67%)          higher ROI (13.33%)
- reduced TCO (8.33%)          increased business agility (48.33%)
- elasticity of service (40%)          scalability of service (55%)
- better process collaboration (21.67%)          Other (0%)

**Fig. 2.** A pie chart depicting the different perceived advantages of cloud BPM.

- **Perceived Advantages of cloud BPM**: To analyze the advantages, a question offered the respondents to choose the most four important advantages of adopting a Cloud based BPM among a total of ten advantages extracted from our literature review. Figure 2 describes the respondents' answers. Increase process and business efficiencies was the highest selected advantages with a percentage of 91.7 %, while the second highly selected advantage was lower startup costs with almost two third of the respondents.
- Also, almost half of the organizations indicated that lower startup costs and increased business agility were evident advantages of cloud BPM.
- **Cloud Based BPM vs. On Premise Solution**: The last set of charts gathered information on the Advantages and Disadvantages of Cloud BPM. Most of the respondents consider the security is the main disadvantage of a Cloud BPM even though most of them don't consider it a show stopper if implemented correctly with the proper Cloud Models. As for the advantages of a Cloud BPM, the two options that received the most selection and stand out are the "Increase process and business efficiency" and "Lower startup cost" as depicted in Fig. 3.
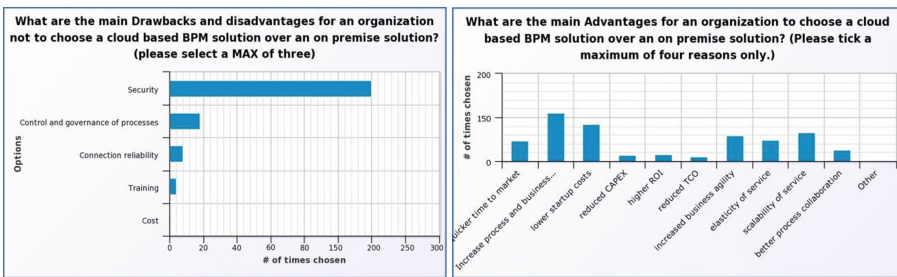


**Fig. 3.** Charts comparing cloud based BPM and on premise solutions.

Also, hypotheses based on the literature review and the data collected on Cloud Business Process Management were analyzed and associated conclusions were derived as shown below:

**$H_1$**: *The majority of local organizations are using Platform as a service (PaaS) as their main Cloud BPM service model rather than (IaaS, SaaS) service models.*

**Conclusion 1**: At 95 % confidence level, using a single population hypothesis t-test, there was sufficient evidence to conclude that the majority of local organizations are using Platform as a service (PaaS) as their main Cloud BPM service model rather than (IaaS, SaaS) service models.

**$H_2$**: *The majority of local organizations use Hybrid Cloud model for their Cloud BPM deployments compared to the international adoption rate of the same model.*

***Conclusion 2***: At 95 % confidence level, using a single population hypothesis t-test, there was sufficient evidence to say that the majority of local organizations are using Hybrid Cloud model for their Cloud BPM deployments compared to the international adoption rate of the same model (58 %).

***H₃***: *There is a relation between company size and the adoption behavior of Cloud BPM. Local Enterprises are more interested in deploying Cloud BPM Services compared to Local SMBs.*

***Conclusion 3***: Using a Chi-Square Test Statistic for dependency, we failed to reject the Null Hypothesis and conclude that we do not reject H0 and conclude that there is no sufficient evidence that the two proportions are different at $\alpha = 0.05$, hence "Company size" and the "Adoption rate of Cloud based BPM" are independent.

## 5 Conclusions

Our Cloud BPM research is considered the first of its kind in the local market that provides insightful information on the lack of Cloud BPM adoption reasons and the relationship between Cloud BPM and business efficiency according to the local market. Furthermore, our survey results provide statistical information on the current state and market maturity level when it comes to Cloud BPM. Other studies conducted on Cloud BPM do not apply to the local market due to the difference in the IT maturity level between the two regions. Moreover, previous researches focus mainly on the technical aspect of cloud models and BPM components. Concisely, we were able to identify the reasons behind the lack of Cloud BPM adoption in the local market and gathered sufficient evidence to prove that there is a relation between Cloud BPM and business efficiency. We were also able to identify the advantages and disadvantages of Cloud BPM according to the local market.

Moreover, we identified the most commonly used Cloud BPM components. Extended hypothesis testing and inferential regression analysis will be provided in an extended version of this work.

## References

1. Hammer, M.: Reengineering work: don't automate, obliterate. Harvard Bus. Rev. **68**(4), 104–112 (1990)
2. Illustration of Cloud Taxonomy. http://www.cloudcontrols.org/cloud-standard-information/cloud-definitions/
3. Han, Y.-B., Sun, J.-Y., Wang, G.-L., Li, H.-F.: A cloud-based BPM architecture with user-end distribution of non-compute-intensive activities and sensitive data. Cloud Comput. 11 (2010)
4. Whibley, P.: Transforming the business case for process improvement. BPM Cloud 8 (2012)
5. Railton, J., Karakostas, B.: Cloud based Business Process Management systems. Cloud BPM 126 (2011)

6. Fang, Z., Yin, C.: BPM architecture design based on cloud computing. Intell. Inf. Manage. **2**(5), 329–333 (2010)
7. Duipmans, E.F., Pires, L.F., da Silva Santos, L.O.B.: A transformation-based approach to Business Process Management in the cloud. J. Grid Comput. 29 (2013)
8. Yeboah-Boateng, E.O., Essandoh, K.A.: Factors influencing the adoption of cloud computing by small and medium enterprises in developing economies. Cloud Comput. Adoption **2**(4), 8 (2014)
9. Rath, A., Mohapatra, S., Kumar, S., Thakurta, R.: Decision points for adoption cloud computing in Small, Medium Enterprises (SMEs). Cloud Comput. Adoption 22 (2012)
10. Market, 2011, Gartner, 2011. http://www.gartner.com/newsroom/id/1550514
11. Cloud Computing Trends: 2014 State of the Cloud Survey (2014). http://www.rightscale.com/blog/cloud-industry-insights/cloud-computing-trends-2014-state-cloud-survey