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# Adoption of Cloud Computing in Hotel Industry as Emerging Services

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**Abstract.** The hotel industry is experiencing forces of change as a result of data explosion, social media, increased individualized expectations by customers. It is thus appealing to study the cloud computing adoption in the hotel industry to respond such changes. This paper reported an investigation on such topic by identifying the cloud computing services and summarising their benefits and challenges in organization, management and operation. The research findings were comparatively studied in reference to the results appeared in the literature. In addition, recommendations were made for both cloud service providers and hotels in strategic planning, investment, and management of cloud-oriented services.

**Keywords:** Cloud computing, cloud service adoption, hospitality

## 1 Introduction

The core requirements for a hotel to be successful were to be affiliated to a hotel group and to have a good quality product in terms of rooms and facilities before the age of computer networks and cloud services (4). This success dependency has shifted in recent years to a hotel's ability to provide customers a personalized service offering comfortable home-like environment. This need has created a very hungry hotel industry for data about customer habits, desires and preferences. To gather, analyze and make use of such data, translate this into customer services, and deliver tailor services to the finest detail in an age of increased mobility, hotel groups required to become more dynamic and efficient in the way they make use of technology.

Information technology (IT) can help in this case, which allows hotels to become globally competitive and present wherever their guests are. This is key to the success of a hotel group in a market where 1) mobile booking on travel websites are increasing at a faster rate (20% annually) than desktop bookings (2% annually), 2) 21% of bookings are originating from smart phones and tablets, and 3) 12% of mobile bookings are implemented by Apps (2). For hotel groups,

maximizing the use of IT could mean freeing themselves of physical infrastructure, associated maintenance and risk to have unrevealed access to their mission critical hotel property management and reservation systems, customer relationship management systems, business intelligent reporting as well as reservation channel management.

Cloud computing (6) has demonstrated the potential to fulfill such demands. The cloud phenomenon brings about a change in the way IT is devised, developed, implemented, extended, improved, maintained and sold (11) (3). Cloud computing has been used for tourism management, for example to rank popular tourism destinations in cities (22), to support distributed big data analysis for smart tourism (10). Limited research has been done in how cloud computing can benefit to hotel industry. A study has showed that excluding the hotel chain which use clouding partially, the franchise or local do not implement this technology (15). Our paper aims investigate the level of cloud adoption, and the cloud service models on the basis of over 300 hotels.

This paper studies how and why hotel groups need to operate in the cloud, in specific with relation to the service and deployment models implemented by these enterprises, and benefits and challenges encountered through their adoption. Case studies have been undertaken with four hotel groups representing 306 hotels, of which data gathered were analyzed and presented in the format of a cross case analysis.

## 2 Background

Cloud computing is a technology that allows the provision and utilization of resources over the internet in lieu of installations on a desktop computer (6). Information Systems (IS) can be consumed as utilities like water and electricity through cloud computing (5). Four deployment models are specified in the National Institute of Standards and Technology (NIST) cloud computing definition: Private, Public, Community and Hybrid clouds. Adoption of cloud computing brings about technological, economical and environmental benefits to an organization, which is also the case for hospitality industry. New technologies and competitive marketing strategies available through the cloud such as the use of social media, channel management, online reservation streams, hotel review portals and increased use of mobile technology for improved customer service have significantly changed the way hotels interact with their customers and will still change for a long time to come (16).

After the 2008 recession, when lowering costs was a key objective for hotels, PAR Springer-Miller, introduced ATRIO as the Next Generation Hospitality Management Software <sup>3</sup> into the market. An application in the cloud, on Windows Azure, ATRIO allows hotels around the world to perform reservations, billing and other guest related transactions. Through such deployments hotel groups are able to lower the Total Cost of Ownership (TCO) as it reduced the

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<sup>3</sup> <http://www.atrio.com/>

amount of investment needed in purchasing, maintaining and updating hardware (13). In this context, research has been carried out widely in this field. The work of (21) discussed how cloud computing is utilized in the hospitality and travel industry. This work particularly describes how a Quality of Service (QoS) ranking mechanism enables cloud applications such as airline ticketing systems, hotel booking services and car rental services to interact with each other to deliver services to their customers. The Falkensteiner Hotel Schladmig, in Austria is an example of a hotel that has moved from the traditional telephone system to a cloud based VoIP solution which is integrated to their SaaS hotel management system solution provided by Protel (16).

The hospitality industry is one where budgets are limited and whose market is highly dynamic. Cloud computing enables organizations within this sector to extend the life of their existing systems with new innovations, improve time to market through affordable pricing, and ultimately gain competitive advantages (9). Reservation booking centralization and electronic distribution was one of the key factors to implement this. For instance, motivated by this, the Louvre Hotel Group to deploy OPERA property management system cloud application in over 850 of their hotels. The hotel management system is no longer maintained on the hotel premises and storage of their data is outsourced (MICROS Systems Inc., 2013). InterContinental Hotels Group were able to eliminate hardware infrastructure costs and centralize management activities such as updating prices, at the touch of a button across sixty one of their UK properties by adopting a cloud solution for their restaurant point of sale systems called SIMPHONY. As a result the hotel group is making use of improved business intelligence reporting through detailed sales tracking as well as improved customer relationship management by means of targeted marketing (12).

Ian Miller from the cole htelire de Lausanne states that Cloud computing is the only way forward for hospitality. It offers better uptime, flexibility and security than installed software and allows hoteliers to concentrate on being hoteliers (16). Various cloud services for hospitality industry have been developed. Oracle has acquired hospitality solutions provider MICROS in September 2014, and launched its Hospitality Global Business Unit in February 2015. Carlin, VP for Hospitality Strategy and Solutions Management at Oracle states that the benefits that hospitality industry can reap through cloud adoption are mainly through the agility these services bring. Rapid technology deployment in his view tops the benefit list through faster introduction of new functionality and latest release deployment. Ability is given to the hotel operator to become more responsive through Oracles cloud, mobile and guest experience solution (7).

### **3 The Methodology - Case Study**

It is difficult to find existing data bases detailing the cloud usage and its impact in the hotel industry. Therefore, case study is used in this work to sample the industry in an effort to understand: i) how ICT solutions are delivered by some main players in the hotel industry to their businesses when cloud computing is in

use; ii) what are the most used services and deployment and why are they favored over others by hotels; and iii) the most significant impact, positive or negative, of cloud computing experienced by this industry and how that compares to the findings reported in the literature.

### 3.1 Case Specification

This research took multiple cases for facilitating cross-case analysis. A basic data set relating to the way that cloud computing is utilized by hotel group establishments was collected in advance of a in depth analysis to realize the research goal. Questionnaires were identified as the most appropriate way in the case study, in addition to in-depth interviews. In order to guarantee the quality of this research, tests for construct validity, external validity and reliability were adapted as proposed by (19). In particular, the validity tests used for this research are summarized in the Table 1. Both the questionnaires and interviews were reviewed by specialists from the cloud computing and hospitality field to check adequacy.

**Table 1.** Quality tests employed in this case study research (Adapted from Case Study Tactics for Four Design Tests (20))

Validity Test	Selected case study tactic for this research	Research phase in which tactic is employed
Construct	Data collection using multiple evidence sources	Data collection phase
External	Replication logic was used in multiple case study design	Research design phase
Reliability	Utilizing a case study protocol	Data collection phase

### 3.2 The Participants

The units of analysis were determined ahead of the research study commencing. Each of the case study units of analysis consisted of a hotel group, representing hotels in Europe, Middle East and Africa (EMEA) at regional level, of which some already started adopting cloud computing technology. Note that hotels are usually organised in hierarchy from hotel group, to hotel brand and finally individual hotels. It is assumed that all hotels are managed, franchised, leased or owned under the brand, depending on the hotel group’s business model. The units of analysis in this study were the hotel groups, as it is often the case that decisions or negotiations with suppliers are made at this level, on behalf of their hotels to leverage economies of scale. Profiles of the studied hotel groups are listed in Table 2 which details their geographical presence, number of hotels for the hotel group, respective number of rooms, as well as profit for each hotel group in 2014. One survey participant and one interviewee per hotel group were selected in collecting the required data.

The survey partakers, identified to collect basic operational data, needed to be in a lead position, closely involved in daily cloud computing operations.

**Table 2.** Profiles involved in the case study units of analysis (The Profit figures are based on Consolidated Income Statement Reported figures for 2013; Hotels are EMEA Only; the No. of rooms are worldwide figure)

Hotel Group	Hotels	Brands	Hotel Locations	No. of rooms	Profit (€ 000)
Hotel Group 1	54	1	Europe, Africa, Middle East	22,582	Data not available
Hotel Group 2	14	3	Europe, Africa and Middle East	4,343	26,24
Hotel Group 3	38	3	Europe, Middle East	8,300	26,117
Hotel Group 4	200	14	Europe, Africa and Middle East	675,623	528

Also, the interview participants, with whom the more in depth interviews were held, needed to be in a managerial position, and were either decision makers in key aspects relating to cloud computing implementation or had a high level of influence in this decision making process. Participants included this study were all Senior IS Directors, Regional IT Managers and Senior Application Managers.

### 3.3 Data Collection

The questionnaire was applied to collect data about the cloud computing service and deployment models in use by hotel groups to run industry specific ICT solutions. In addition data was also requested about challenges and benefits of cloud computing from a hotel group operational perspective. In the format of a structured questionnaire, the survey was composed of in total 11 questions (provided in the Appendix <sup>4</sup>). A multiple choice type question was utilized for the respondents to select one of three service models and one of the three deployment models in use in their properties. The participants were also asked to indicate if each IS listed was in use, and if so whether it was only running on-premise, only on cloud or both across hotels. Rating questions were then used to ask the respondents to rate cloud computing benefits and challenges in order based on their importance.

The purpose of the interview was to obtain a more in-depth perspective on why specific cloud computing deployment and service models are used, and what drives such decisions in addition to the insight of hotel groups future cloud related plans. An interview schedule was prepared in advance by the researcher to ensure key points for which data collection was necessary were not missed. A semi-structured interview design was utilized as this type of interview combines the structure of a list of issues to be covered together with the freedom to follow up points as necessary.

<sup>4</sup> <http://computing.unn.ac.uk/staff/kwff2/interviewandsurvey.pdf>

### **3.4 Data Analysis and Analytics**

Date cleansing and data reduction took place which summarized the collected raw data to a manageable set followed by data interpretation. Triangulation of perspectives was achieved by comparing responses of questions in the interview and questionnaire. This procedure was initially performed per case, followed by a cross case analysis by comparing data across the four cases.

## **4 Cross Case Synthesis**

### **4.1 Cloud Computing Usage**

The distribution of the usage of cloud information system (IS) or on-premise IS in the studied hotel groups shows that the majority of IS used by hotel groups were running on the cloud, and that the smallest (in terms of number of rooms) hotel groups' (group 2) level of cloud adoption is equivalent to that of the largest (group 4). The volume of those running on cloud supersedes in each of the case studies than those running on premise as well as those running partially on premise and partially on cloud.

For those solutions identified as running on cloud, further investigation was made to uncover which service and deployment models were being used. In particular, 82.43% of the investigated hotel groups applied SaaS; 14.86% employed IaaS; and the remaining 2.70% used PaaS. 89.19% hotel groups used public cloud deployment modes; 8.11% employed hybrid models; and 2.7% used private models. These numbers imply that SaaS and Public solution were the mostly adopted service and deployment models. This research findings suggest that there are industry specific variations to cloud service and deployment models used. The paper (18)'s survey was performed across multiple industries. The results conflict with this research's findings in that (18) reports 94% of surveyed organizations are currently running or experimenting with IaaS and 74% considering Hybrid model as the preferred deployment choice.

### **4.2 Service and Deployment Model Selection**

Five out of thirteen interview questions provided answers in the reason of service and deployment model selection. The most pronounced reason provided by the researched hotel groups, in justifying the combination of a SaaS and Public deployment cloud solution, was connected to the participants core business. There was an emphasis identified during the interviews that outsourcing the maintenance of the necessary service and software delivery in order to allow the hospitality groups to concentrate on customer service and hotel management. An additional factor mentioned by Hotel Groups 2 and 3 is the change driven by their operation in critical application providers. There were scenarios where the software vendor, moved away from providing thick client software to a SaaS cloud delivered solution. In that case, the participants naturally followed the move of their service providers.

PaaS was mostly discarded due to the lack of developers employed by the participants. It was commonly argued that there was a general unwillingness to invest in in-house infrastructure as well as the supporting human resource element to maintain the system. These thoughts emerged when discussing with the participants reasons for not using IaaS or Private cloud solutions. Some contributors acknowledged that even though at times cloud solutions may be more expensive, the reality is that an inferior service would be provided in-house for critical tasks such as the provision of regular useable backups as well as adequate and functional redundancy.

### 4.3 Impacts of Cloud Computing Adoption

The hotel group representatives, were asked in both the interview and survey, to list the five most important cloud computing challenges and benefits to their organization, and the results are listed in Tables 5 and 6. The most common two benefits identified are: 1) solving the problem of lack of hardware on site, and 2) transferring the risk relating to security and PCI / PA-DSS requirements to the cloud service suppliers. Not having hardware on site alleviates finance, skill and resource pressure from the hotel groups who do not require to purchase hardware and recruit personnel that have the required skills to maintain such an important component of their operations service delivery. The transfer (or sharing) of risk, time and effort to ensure that data security and PCI / PA-DSS compliance is also another benefit that the hotel groups value greatly, as having to look after the latter individually at their properties can potentially result into a costly, lengthy exercise with inconsistent results.

The cloud related challenges that have stood out from the hotel groups responses were a) the increase in Opex (OPERating EXPense), b) restricted access to the environments and c) concerns about information security. The increase in Opex comes as a result of the cloud financial model which moves away from the typical initial capital expenditure involved. Higher operating expenses put a strain on hotels to meet budgets, on which management key performance indicators (and in turn bonuses) are usually based. There are concerns about information security possibly arise from lack of transparency provided by cloud vendors on the methods used to ensure the required measures are in place and available at all times. The reason for hotel groups listing limited cloud environment access as a challenge could emerge from one of the two factors. The hotel groups may not feel satisfied enough with the support quality or speed provided by the cloud provider. Alternatively, it could be due to the change in process experienced by IT Managers and now having to depend on a third party for issues which previously could be quickly checked and resolved with servers being on site.

The challenge which received the highest average rank (12.38 points) by the participants was the Dependency on bandwidth whilst that of least significance was the issue of Software licensing (3.38 points). (8) mentioned of the cost of bandwidth but not the dependency on it, as a challenge in a study. However internet access dependency is validated as a challenge that could hinder cloud

**Table 3.** Respondent rank of cloud benefits based on the role each had during the cloud implementation process

Rank/ Role	Consultative	Influencer	Decision maker and influencer
1	Security, Less headaches in maintaining hardware	No on-site hardware to maintain; Work from anywhere; Flexibility in moving from one application solution to another, Data security, PCI & PA-DSS;	Round the clock support based on SLA; Application and field expertise
2	Compliance; Less human resources required	No need to worry about software upgrades; Reduced capital cost; Scalability; Support and maintenance being outsourced to guarantee system availability	Standard conformity (HW, versioning ); Reduces hardware that we need on site
3	Speed of Implementation; PCI / PA-DSS compliance	Available redundancy; Scalability; Moving from Capex to Opex; Ongoing stability and system monitoring services	Information sharing across estate; Speed of delivery
4	Reduction of capex; Unlimited redundancy	Data backup looked after. Transfer risk to vendor; Easier for vendor maintenance due to access; Access control and data security; Ease of system upgrades and security patches	Minimal downtime and controlled upgrades; Scalability
5	Focus and resolution as all in one environment; Physical data security	Ability to have SLAs; No need to manage the environment; Obtaining latest available software in the market with least effort; Changes in system standards are applied with minimal effort	Focus and resolution as all in one environment

**Table 4.** Respondent rank of cloud challenges based on the role each had during the cloud implementation process

Rank/ Role	Consultative	Influencer	Decision maker and influencer
1	Increased opex; Limited environment, accessibility	Capex to Opex, Information security, System stability and availability is not always guaranteed or per SLA, Data security	Restricted access, Reliance on network availability
2	Impact of issues (global issue); Dependence on internet, connectivity	Challenges in exiting; Connectivity issues due to internet problems; One issue can impact the entire hotel estate; Data privacy and storage location	Reliance on third party; Performance latency
3	Reliance on vendors (reputation); Increase in bandwidth requirement	Difficult to see financial viability of vendor; Data privacy protection; Dependency on network connectivity; Internal training for users to keep up with changes to cloud computing	Issue impacts all estate; Having to have the right processes to ensure access levels etc
4	Central management team needed; Not knowing where data is	Location of own data; Issues due to lack of customer specific testing; Identifying vendors that have cloud computing compatible software	Level of impact in case of issue
5	Central management cost; Switching providers not easy	Maintenance schedules according to vendor availability; Lack of single sign on solution across cloud vendors; Cloud based solutions are mostly for consumer not enterprise world	

computing accessibility by (14). Dependency on bandwidth is of so much concern for the respondents possibly due to the fact that it is hard to find the right balance between cost and performance whilst depending on third parties. Business continuity in contrast, was the cloud computing benefit uncovered as most important in the research with an average rank of 11.38 points. Greener IT was the least ranked (3.13 points) in value by the research contributors. This result is challenged by business continuity being included in a top ten list of obstacles to cloud computing growth ranked by (1) but supported by (17) study uncovering reliability as the highest ranked benefit in that study for SaaS. One reason of this discrepancy is that some of the benefits and challenges appeared in this study were not presented in reviewed literature.

#### 4.4 Service Vendor Selection

The most important criteria in selecting cloud service vendors is shown in Table 5. This question was included in both the research questionnaire and in-

terview. In addition, the reasons driving the selection were also listed in the table.

**Table 5.** Criteria for cloud vendor selection

Hotel Grp 1	Vendor expertise in the field; alignment of vendor’s strategic direction with that of the hotel group
Hotel Grp 2	Level of adoption of same solution; vendor by other hotel groups
Hotel Grp 3	Vendor reputation; operational and functional requirements
Hotel Grp 4	Vendor competency; vendor ability to meet today’s and future requirements; balance of the above two criteria against cost

## 5 Conclusions

The paper investigated the cloud computing adoption specifically in the hotel industry. In particular, it identified what kind of cloud computing combinations hotels have adopted; investigated the reasons of such decisions; and analyzed the benefits and challenges that cloud computing could offer in the hotel industry. The work therefore provides insights in the adoption of cloud computing that will assist hotel groups making strategic system development plan. The information is also useful for cloud providers to understand their customers experiences and better address the challenging they may have, which eventually helps to improve their services and open more business opportunities. Discrepancies between this research findings and the reported results in the literature suggest the future work, which will consolidate the results documented herein.

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