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Assessing the Relevance of Cloud Computing for Micro, Small and Medium Enterprises in the Northern Region of India

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Micro Small and Medium-sized Enterprises (MSMEs) in developing economies like India face many challenges in the form of limited capital, lack of skilled manpower, and low ICT usage. Due to these constraints, MSMEs are not able to reap various benefits which modern ICT solutions offer. In such a scenario, cloud computing can be an appropriate option for such MSMEs which are looking for improving their internal processes, enhancing communication with clients and business partners, and extending their market reach through modern ICT solutions with minimum investment and efforts. Cloud computing is an innovative technique of providing the required information and communication technology (ICT) to customers on demand and on a pay-per-usage basis through the internet. This study is an attempt towards assessing the relevance of cloud computing for MSMEs in the northern region of India. Literature review and a questionnaire based survey method were used for this purpose. Perceived benefits, perceived ease of use, cost advantage, simplicity, affordability, scalability, rapid implementation and improved business continuity were the major benefits revealed in this study whereas, security, privacy, reliability and vendor lock-in concern emerged as the main challenges in using cloud computing by the MSMEs. The study is expected to provide MSMEs an initial understanding about the significance of cloud computing for their businesses by highlighting the actual benefits and challenges linked with the adoption of cloud computing.

Keywords: cloud computing, MSME, ICT, India.

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Ocena przydatności chmury obliczeniowej dla mikro, małych i średnich przedsiębiorstw w północnym regionie Indii

Mikro, małe i średnie przedsiębiorstwa (MMŚP) w gospodarkach rozwijających się, takich jak Indie, stoją w obliczu wielu wyzwań wynikających z ograniczonego kapitału, braku wykwalifikowanej siły roboczej i niewielkiego wykorzystania technologii informacyjno-komunikacyjnych (TIK). Ze względu na te ograniczenia MMŚP nie są w stanie czerpać korzyści, jakie oferują

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nowoczesne rozwiązania z zakresu TIK. W takiej sytuacji przetwarzanie w chmurze może być odpowiednią opcją dla tych MMŚP, które dążą do usprawnienia procesów wewnętrznych, poprawy komunikacji z klientami i partnerami biznesowymi oraz rozszerzenia zasięgu rynkowego dzięki nowoczesnym rozwiązaniom TIK przy minimalnych nakładach inwestycyjnych i niewielkim wysiłku. Przetwarzanie w chmurze to innowacyjna technika dostarczania wymaganej technologii informacyjno-komunikacyjnej klientom na żądanie za pośrednictwem Internetu, za opłatą za faktyczne korzystanie. Niniejsze opracowanie stanowi próbę oceny znaczenia chmury obliczeniowej dla MMŚP w północnym regionie Indii. W tym celu zaprezentowano przegląd literatury i wykorzystano metodę ankietową. Dostrzegane korzyści, łatwość użycia, przewaga kosztowa, prostota, przystępność cenowa, skalowalność, szybkie wdrożenie i lepsze zarządzanie ciągłością działania to główne korzyści ujawnione w tym badaniu, podczas gdy bezpieczeństwo, poufność, niezawodność i obawa przez uzależnieniem od jednego dostawcy okazały się stanowić główne wyzwania związane z korzystaniem z chmury obliczeniowej przez MMŚP. Należy się spodziewać, że badanie umożliwi MMŚP wstępne zrozumienie znaczenia chmury obliczeniowej dla ich działalności dzięki wskazaniu rzeczywistych korzyści i wyzwań związanych z jej zastosowaniem.

Słowa kluczowe: chmura obliczeniowa, MMŚP, TIK, Indie.

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Introduction

Cloud computing is an innovative mode of delivering appropriate information and communication technologies (ICTs) to customers on demand and on a payper-usage basis through the internet. It is well-proven fact that adoption of ICT helps organizations in streamlining their processes, improving quality and increasing their market reach. Cloud computing has the potential to make available the necessary ICT infrastructure to enterprises in the most cost effective manner. In addition, cloud computing also provides improved back-up and business continuity services, automatic provisioning of resources as per the requirement and hassle-free implementation and maintenance (Armbrust et al., 2010). All such benefits and features make cloud computing a valuable option for organizations.

For Micro, Small and Medium-sized Enterprises (MSMEs), cloud computing has special significance. In developing nations, MSMEs are considered as the growth engine of the economy. However, at the same time, MSME sector faces many challenges in the form of limited capital, lack of skilled manpower, lower productivity, inefficient business processes and marketing strategies, increased competition and low level of ICT penetration (Shiralashetty, 2012; Singh et al., 2010; CII, 2015). Adopting appropriate ICT can help MSMEs in improving their essential business processes and solve most of the problems in an effective manner. However, very high cost and expertise associated with using and maintaining a modern ICT infrastructure hinder MSMEs from adopting ICTs (Tan et al., 2010). Though, with cloud computing, the situation is expected to change phenomenally. Cloud computing has potential to make available modern and relevant ICTs to MSMEs without making heavy investments and efforts. Through cloud computing, ICT penetration and usage among MSMEs is expected to get a boost, which would ultimately help MSMEs in reaping various benefits of ICT adoption. The benefits derived from ICT adoption through cloud computing will further enable MSMEs to become more competitive and agile to rapidly changing market conditions. However, due to the newness of this evolving computing

model and also due to the special nature of cloud computing, certain concerns have also been raised. These concerns, if not addressed properly, may hinder the adoption of cloud computing by organizations. Some of the concerns mentioned in the literature include security and privacy, vendor lock-in, availability, internet connectivity and speed. Due to the novelty of cloud computing, which is rapidly evolving, a limited number of studies exist on adoption of cloud computing by SMEs, especially in a developing economy context like India.

This study is an attempt towards assessing the relevance of cloud computing for MSMEs in the northern region of India. Literature review and a questionnaire based survey method were used for this purpose. The study is expected to provide MSMEs an initial understanding about the significance of cloud computing for their businesses by highlighting the actual benefits and challenges linked with the adoption of cloud computing.

Cloud computing

Cloud computing has been defined by various authors and institutes in many ways. There is no standard definition of cloud computing. Cloud computing can be thought of as a new and innovative way of delivering ICT resources to customers on demand and on a pay-per-usage basis through the internet. Cloud computing has the potential to revolutionize the way ICT resources are acquired, utilized and maintained in the organization. Cloud computing refers to delivering software and hardware resources as a service through the internet on a pay-per-usage basis (Armbrust et al., 2010). Using cloud computing eliminates the need for buying and maintaining complex ICT systems within the organization's premises (DeFelice, 2010). Buyya *et al.* (2009) have described cloud computing similar to parallel and distributed computing which comprises a collection of connected and virtualized computing resources that are offered to customers as service that can be dynamically provisioned, regulated and governed by mutual negotiations and service level agreements between the cloud service providers and consumers. The definition specified by the National Institute of Standard and Technology (NIST) is found most suitable and comprehensive in the present context. Therefore, the definition given by NIST is considered in this study to describe cloud computing. NIST describes cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction". NIST has specified three main cloud computing service models which are – "Cloud Infrastructure as a service (IaaS), Cloud Platform as a service (PaaS) and Cloud Software as a Service (SaaS)". Four cloud deployment models which are further mentioned by NIST include – "Private cloud (where cloud infrastructure is operated solely for one particular organization), Community cloud (where the cloud infrastructure supports a specific community and is shared by several organizations of that community), public cloud (where cloud infrastructure is made available to the general public) and hybrid cloud (a composition of two or more clouds that remain unique entities but are bound together by standardized or proprietary technology)".

Cloud computing benefits

Cloud computing can prove to be a very reliable resource when it comes to solving business challenges faced by organizations, especially by the MSMEs. Challenges such as expensive IT, mobility restrictions, and limited growth capacity can be solved by migrating to cloud computing and exploiting SaaS/IaaS/PaaS programs to the best of their benefits. It provides a valuable alternative to expensive and resource intensive in-house IT solutions. High overheads can be avoided by organizations by effectively utilizing cloud computing. Major benefits of cloud computing identified from the literature are summarized in Table 1.

Table 1. Cloud computing benefits

Sr. No.	Benefit	Description	Reference
1.	Cost benefits	Lower cost is the main benefit of cloud computing because in cloud computing customers pay only for what they use, customers avoid capital expenditure in ICT infrastructure and they avoid costs for maintaining the ICT infrastructure, the support staff to maintain the resources and the software licensing costs.	Marston et al. (2011); Olveira et al. (2014); Vidhyalakshmi and Kumar (2016); Alismaili et al. (2016); Sharma et al. (2017)
2.	Simplicity	Technical complexities related to ICT infrastructure set-up, operations and maintenance are taken care by the cloud computing provider, thereby reducing the burden on the SMEs to be equipped with technical knowledge. SMEs can thus focus on their core business.	Goodburn and Hill (2010); Marston et al. (2011)
3.	Affordability	Business applications like Customer Relationship Management (CRM) programs, Enterprise Resource Programs (ERP), and business analytics are very expensive to acquire, install and maintain. In a cloud computing model, these kinds of applications become much more affordable.	Bajenaru (2010); Sultan (2013; Senyo et al. (2016)
4.	Scalability	Scalability means greater flexibility, customers can easily add as much capacity as they need allowing for improved business performance.	Smith (2009); Ryan and Loeffler (2010); Vidhyalakshmi and Kumar (2016)
5.	Quick implementation process	In takes only a few days or in some cases hours to implement an application in a cloud.	DeFlice (2010); Marston et al. (2011); Vidhyalakshmi and Kumar (2016)
6.	Improved business continuity	Cloud Computing makes it easier for organizations to introduce business continuity and disaster recovery capabilities.	DeFlice (2010); Zessis and Lekkas (2012)

Cloud computing adoption concerns

Due to the novelty of this emerging computing model and also due to the very special nature of cloud computing, certain concerns have also been raised. These concerns, if not addressed properly, may hinder the adoption of cloud computing by organizations. The major concerns of cloud computing are summarized in Table 2.

Table 2. Cloud computing adoption concerns

Sr. No.	Concern	Description	Reference
1.	Security & Privacy	Due to the nature of cloud computing with its multi-tenancy and shared resources characteristics, there is a big concern for businesses of failure in the infrastructure potentially exposing important information.	Sultan (2011); Yeboah-Boateng and Essendoh (2014); Alismaili et al. (2016); Senyo et al. (2016); Priyadarshinee et al. (2017)
2.	Loss of control	Cloud Computing means that an organization give-up some control on IT related applications and activities. This makes the organization dependent on service provider.	Yeboah-Boateng and Essendoh (2014)
3.	Vendor Lock-in	Vendor lock-in refers to a situation in which a cloud customer is stuck to current cloud vendor due to the complexity in switching to another cloud vendor.	Armbrust (2010); Dillon et al. (2010)
4.	Availability and performance	Organization's concern about availability and performance of cloud services.	Armbrust (2010); Dillon et al. (2010)
5.	Internet connectivity & its speed	Internet connectivity, speed, and availability are the most crucial requirement for utilizing cloud computing services.	Yeboah-Boateng and Essendoh (2014), Abdollahzadehgan et al. (2013)

Research methodology

Considering limited research on cloud computing adoption by SMEs, especially in an Indian context, an explorative study was considered as the most reasonable methodology (Zikmund et al., 2013). Literature survey was utilized initially for the purpose of gaining understanding about the concept of cloud computing, benefits of cloud computing and the issues involved in cloud computing adoption. In the research on the diffusion and adoption of innovation, quantitative approaches which are founded on questionnaire based survey, are the most prevalent research methodologies (Wang et al., 2010). Therefore, a quantitative, cross sectional, and questionnaire based survey methodology was employed in this study.

The objective of this research was to assess the relevance of cloud computing for MSMEs in India. Based on the research objectives, the relevant literature was reviewed and a questionnaire was developed. The questionnaire contained questions about the general information about the company, software utilization in the company, the current cloud computing status and perception about benefits and concerns associated with adopting cloud computing. In order to capture the perception of MSMEs about the benefits and concerns of cloud computing, a five point Likert's scale was used. Statements or items measuring the benefit or concern were framed using the literature followed by five options ranging from 1 (strongly disagree) to 5 (strongly agree).

Data collection

Considering the nature and novelty of the innovation being investigated in the present study, some minimum eligibility criteria were laid down for SMEs to become qualified for the survey. The SMEs were expected to have some basic ICT infrastructure in place and the units were also expected to be using some software applications for carrying out their business activities and the prospective SMEs were also expected to be aware of cloud computing. Therefore, for selecting SMEs for the survey, some screening questions were asked like- whether they are using ICT in some form, what ICT infrastructure they possess, what type of software applications they are using, and whether they are aware about cloud computing. A purposive sampling technique was therefore considered to be the most appropriate sampling

technique for data collection related to the current research. In purposive sampling approach, "the respondents are chosen deliberately as they are expected to possess some predefined characteristics that allow the fundamental subject to be understood in greater detail" (Saunders et al., 2011). Purposive sampling technique is used by many researchers in various other similar studies (Carcary et al. 2014; Yeboah-Boateng and Essandoh, 2014; Park and Kim, 2014). The MSMEs selected for the survey mainly comprised those enterprises which were members of Confederation of Indian Industries (CII), Northern Region Headquarters, Chandigarh. The reason for choosing these SMEs was that the member firms were likely to have some basic ICT infrastructure in place and further, the member SMEs were expected to be more aware about the importance of ICT and latest technological innovations such as cloud computing through various training programs/workshops/seminars organized by CII for its members on technological interventions for enhancing SME competitiveness. The MSMEs selected were mainly from three states- Himachal Pradesh, Punjab, and Haryana. The respondents were mostly owner/partners of the MSMEs. The potential respondents were initially contacted through e-mail and telephone and certain screening questions were asked to reconfirm their suitability for the survey. A total of 685 MSMEs selected from the mentioned sources were finally found suitable for the survey and for further data collection. All of these MSMEs were the manufacturing enterprises from the diversified fields. Industry-wise segregation and comparison was not attempted due to the lack of knowledge about cloud computing among the units of a particular industry type. Questionnaires were distributed to the owners of these MSMEs with prior intimation. Questionnaires were sent to the owners of the selected SMEs in the month of December, 2016. The questionnaire based survey was administered for six months up to May, 2017. Most of the responses had to be collected through personal visits. Other responses were collected through e-mails. A total of 382 questionnaire were collected during this time period. Out of 382 filled in questionnaires, only 334 were found valid.

Results and discussion

Descriptive statistics was used to analyze the responses. The survey comprised almost equal number of three types of MSMEs. Out of total MSMEs covered in the survey, 34.7 percent were medium enterprises, 34.4 percent were small enterprises and 30.8 percent were micro enterprises. The answer to the question pertaining to the type of software being used among the MSME revealed that word processing and accounting software were the most commonly used software among MSMEs. The software applications like ERP and CRM were not used very frequently by the MSMEs. The high cost of such software may be one of the reason behind this trend. This fact is also highlighted in other studies (Bajenaru, 2010; Sultan, 2013). Cloud computing can be one of the best alternative to use such type of expensive applications. Most of the MSMEs are using original software. The cost of using and maintaining such applications can be very high in the long run and this may deprive some of the MSMEs from using original software. 63 percent of the selected MSMEs were also having their own website. The respondents were also asked to specify the method of procuring software in the organization. Most of the MSMEs (65.9 percent) were found to use original software. Very few MSMEs (1.5 percent) were found to purchase software through internet. Question-wise analysis and results of the rest of the questions contained in the questionnaire are provided in the tables 3 to 6.

Table 3. Which of the following phrase best describes cloud computing adoption in your firm?

Sr. No.	Cloud computing status	Percent
1.	Already adopted cloud computing	15.0
2.	Using cloud computing on trial basis	8.7
3.	Planning to use cloud computing in next 2–3 years	61.7
4.	Not planning to use cloud computing in near future	14.7

Table 3 shows that about 70 percent of the MSMEs are planning to use cloud computing or using cloud computing on trial basis. 15 percent of the MSMEs have already started using cloud computing. These results indicate positive inclination of MSMEs towards using cloud computing.

Table 4. Which IT application/service you are most likely to adopt through cloud computing?

Sr. No.	Type of cloud computing	Percent
1.	Individual software packages (SaaS)	79.6
2.	Infrastructure services (IaaS)	1.8
3.	System software as service (PaaS)	7.2
4.	Security services	1.8
5.	Combination of above services	9.6

Table 4 indicates that about 80 percent of the MSMEs plan to adopt SaaS type of cloud computing. This indicates that most of the MSMEs are planning to use various types of application software through the cloud in the near future. SaaS thus turned out to be the most popular type of cloud computing among the MSMEs.

Table 5 comprised MSME's response towards eight statements regarding perceived benefits of cloud computing. Almost 54 percent of the MSMEs agree with the statement that cloud computing is useful and easy to use. These factors justify that perceived usefulness and perceived ease of use are significant factors in influencing intention to adopt information technology (Davis, 1989).

51 percent MSMEs agree that scalability is an important feature and benefit of cloud computing. 51 percent of the MSMEs strongly agree with the statement that using cloud computing drastically reduces upfront costs. In fact, this is the major advantage of using cloud computing for MSMEs, especially in developing economies where

Table 5: Perception about cloud computing benefits (in percentage)

Statements/items related to cloud computing benefits	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Using cloud computing services would make my job easier	26.6	**53.9**	17.1	2.1	.3
Overall we find cloud computing services easy to use	36.8	**53.6**	7.2	2.4	–
With cloud computing it is easy to 'scale-up' or 'scale-down' IT resources as per requirements	37.4	**50.6**	11.1	.9	–
Use of cloud computing services reduces upfront costs (Initial investment on IT)	**50.9**	35.6	9.3	3.6	.6
Upgrading/updating & maintenance of hardware & software is easy with cloud computing	**43.4**	42.5	10.8	2.4	.9
Back-up & disaster recovery capabilities are better while using cloud computing	36.2	**43.4**	18.3	1.8	.3
By using cloud computing we can easily get access to latest information technologies	42.3	**48.0**	8.4	3.9	.3
My company may acquire competitive edge if we use cloud computing	17.1	**64.7**	14.7	3.6	–

MSMEs have limited capital. 43 percent of the MSMEs strongly believe that it is easier to upgrade, update and maintain ICT with cloud computing. 43 percent MSMEs agree with the statement that by using cloud computing their back-up and disaster recovery capabilities are also going to increase. 48 percent MSMEs believe that cloud computing enable them to access and use latest information technologies. Almost 65 percent of the MSMEs agree with the statement that they may gain competitive edge by adopting cloud computing.

Table 6 consisted of MSME's response towards seven statements about perceived concerns associated with adopting cloud computing. Majority of the MSMEs are uncertain about security, privacy and confidentiality of their business data while utilizing cloud computing.

Table 6. Perception about cloud computing concerns

Statements/items related to cloud computing benefits	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The security systems built into the cloud computing services are strong enough to protect our data	5.1	37.4	**48.2**	8.1	1.2
The confidentiality of business data is guaranteed when using cloud computing services	2.4	29.9	**48.8**	18.0	.9
I am confident that cloud providers will not use my company's data for their own commercial benefits.	6.9	35.6	**46.1**	10.2	1.2
Cloud computing is reliable in terms of performance and availability	10.3	30.3	**37.4**	12.7	9.3
Switching over from one provider to another is a major concern	14.6	**38.4**	21.2	16.7	9.1
Integration of cloud services with existing systems is a big concern	3.6	20.3	17.2	**36.8**	22.1
Cloud computing results in loss of control on IT operations which is not desirable.	7.4	21.4	20.5	**32.4**	18.3

These results indicate that most of the MSMEs have no clear idea about the security and privacy of their business data in the cloud computing environment. This may be true due to the lack of awareness among MSMEs about security and privacy policies and procedures offered by the vendors. The lack of success stories or related case studies may be the other reason behind neutral attitude shown by the MSMEs towards security and privacy issues in cloud computing. Similarly, majority of the MSMEs are uncertain about the reliability and availability aspects concerning cloud computing. 38 percent of the MSMEs however agree with the statement that switching over from one provider to another is a major concern. Almost 37 percent of the MSMEs do not agree with the statement that integration of cloud services with the existing system is a big concern. 32 percent of the MSMEs do not believe that cloud computing results in loss of control on IT operations.

The results of this work should be interpreted in light of study's limitations. Firstly, the term MSME used in the study is based on the definition provided by Government of India. According to this definition, firms are categorized as micro, small and medium enterprise based on the total investment made in plant and machinery. This definition is different from the ones used in the other studies and in other countries where SMEs are defined on the basis of a number of employees and yearly revenue. Second, although the sample size was adequate for this study, it cannot be considered sufficient for generalizing results for all the MSMEs. It may have a regional limitation because the data collected for this study

comprised MSMEs from only one region in India.

Conclusion

Cloud computing has huge potential for accelerating ICT adoption among MSMEs. It is clear from the literature and survey results that MSMEs are aware about cloud computing and its benefits. In fact, all the benefits mentioned in the literature are supported by the survey results. The major benefits of cloud computing for MSMEs revealed in this study include cost advantage, easier upgrade and maintenance of ICT resources, scalability, perceived usefulness, perceived ease of use, improved back up and disaster recovery capabilities and easier access to latest information technologies. The study also revealed some serious issues concerning cloud computing adoption among MSMEs. The majority of the MSMEs covered in the survey were apprehensive about security, privacy and reliability of cloud services. MSMEs believe that switching over from one cloud service provider to another is going to be a difficult task. However, MSMEs were not much concerned about the integration of cloud services with their existing systems and were also not worried about the perceived loss of control on their IT operations. Overall, it can be safely concluded that through cloud computing, MSMEs can get access to relevant ICTs in a cost-effective and convenient manner, which will help them to compete and grow. There are some concerns which may hinder cloud computing adoption, but, with more support and interventions by the service providers and government agencies, these challenges can be easily managed. This study is an initial attempt towards understanding the relevance of cloud computing for MSMEs in the northern region of India. Some recommendations also emerge from this study. First, the adoption of cloud computing can be assessed by covering more MSMEs from different other regions of India. Industry-wise adoption of cloud computing can also be attempted within MSMEs. Second, the study can be extended to some other countries also.

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