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CLOUD COMPUTING AND ITS APPLICATION IN THE IRISH CONSTRUCTION INDUSTRY

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ABSTRACT: The significance of Irish Small to Medium Size Enterprises (SMEs) being more effective and efficient with eBusiness solutions in the construction industry has never been more evident than in today's global economy. Through the development of a strong and proactive network the Construction IT Alliance (CITA) hope to create a platform for implementing the use of eBusiness in the SME community. This network will provide SME companies with a direction on how to improve their efficiency and effectiveness through the use of technology. At present CITA has identified a potential business solution that would make construction software more accessible by SMEs. Open Source Software (OSS) has the ability to increase productivity and reduce capital expenditure and production costs. This solution offers SME companies the opportunity to streamline their fragmented operations by implementing the best applications available to the industry through the use of service providers on the World Wide Web. The SME community would now have the ability to use on-demand applications that were previously only the domain of large enterprises.

Keywords:
Cloud Computing, Construction, eBusiness, Network SMEs.

1 INTRODUCTION

According to Teicholz (2004) the productivity of the construction industry has gradually declined over the past 40 years. Teicholz acknowledges the fact that there has been a significant adoption of Information Communication Technology (ICT) by the construction industry over the past 35 years, however, these applications are largely stand-alone and do not permit for effective collaboration. Gallaher et al. (2004) recognised the potential to revolutionise the industry and streamline historically fragmented operations. However, the problem associated with not being able to manage and communicate electronic product and project data between collaborating firms and within individual companies is compounded by the large number of small companies that have not adopted ICT. In this report Gallaher et al. cites the Construction Financial Management Association (CFMA) 2002 survey, which identifies that only 25 percent

of construction firms surveyed use collaboration software and that usage increases relative to the firm's size.

The problems associated with fragmentation of the construction process and the level of implementation and penetration of ICT by SMEs is not a new revelation. In an Irish context Duffy et al. (2007) identified the potential benefits that construction collaboration technologies (CCT) had to offer the construction industry but also stated that the problems of fragmentation and resulting levels of poor communication and information exchange are not just limited to SMEs in Ireland. In Hore and West (2005), the key results of an Irish construction survey illustrated a low level of awareness of appropriate technologies and the absence of appropriate industry standards to support purchasing processes.

According to Alshawi and Ingirige (2003), the industry should work towards minimum common standards to facilitate the flow of information across the supply chain. These standards will enable exchanged information to be fully integrated with the business, thus giving people the necessary skills and environment to harness the benefits of the internet. Alshawi and Ingirige recommend that the industry should fully address the management of change and showed how people can best take it on board when considering the implementation of Web-enabled tools.

The aim of this paper is to report on the work of the Construction Information Technology Alliance (CITA) in Ireland in encouraging SME's interest in subscribing to a software marketplace that deploys an open source solution. The issues surrounding SMEs ICT needs and OSS will be addressed together with an investigation into a potential case study. The recent results of an Enterprise Innovation Network (EIN) member's pilot survey on developing a business case for an OSS marketplace for SMEs in the Irish construction industry will also be presented. The paper will conclude with a description of the deployment of a future strategy based on a solution commonly known as 'Cloud Computing'. This solution could potentially meet the particular needs of Irish construction SME, such as offering SMEs the opportunity to rent software rather than buying, providing lower initial costs through incurring licenses for the amount of support that is needed (SIIA, 2001).

2 CITA AND THE ENTERPRISE INNOVATION NETWORK (EIN) PROGRAMME

2.1 Background to CITA and EIN Programme
CITA was established as a research project in Dublin Institute of Technology (DIT) in association with Waterford institute of Technology (WIT) in May 2001, with the vision of harnessing the potential of ICT in the Irish Construction Industry. CITA was formally incorporated into a company limited by guarantee with no share capital in November 2005.

CITA was selected as one of the three networks in Ireland for funding by the semi-state body Enterprise Ireland under the new EIN programme. The project commenced in early October 2008 and is funded for a three year period. The project will promote ICT and its use in the Irish Construction Industry. The project will involve carrying out detailed research into the particular needs of CITA SME members and other potential new members. The objective of this research is to identify the eBusiness and eTendering software products tools and platforms available or potentially available to meet the business needs of SMEs in the construction industry in Ireland.

It was recently proposed to undertake a programme designed to develop a viable product/service solution to address agreed ICT needs of the construction industry. It is fundamental that any CITA product or service will not compete with products or services currently provided by CITA members, but will focus on the unique independent position, role and strategy of CITA in the industry. The process adopted will be a staged process, designed to progressively evaluate and refine ideas, and will involve seven main stages:

- Stage 1   Idea Generation
- Stage 2   Screening
- Stage 3   Concept Development and Testing
- Stage 4   Business Analysis
- Stage 5   Product/Service Market Testing
- Stage 6   Development
- Stage 7   Commercialisation

2.2 Progress To-Date

CITA has over the years attracted a number of ICT vendors to join the CITA Network and over the past 6 months the CITA team has carried out research to identify software products and tools that currently support eBusiness and eTendering business processes in the Irish construction industry. In carrying out this work, a software register with approximately 80 listed vendors comprised of members and non-members has been developed. The register is currently hosted on CITA's Website.

The information emerging from EIN discussion meetings in conjunction with the research has allowed the identification of the need for a special interest group based on giving advice and support on both traditional and cloud computing. Consequently, a CITA SaaS (Software As A Service) group representing members from the EIN programme has been established. Depending on the main survey results and the attitudes of the members it is envisioned that the SaaS group (a group formed provisionally around SaaS implementation) may be used as a pilot test for providing a cloud computing service in the Irish construction industry. The distinction of cloud computing and SaaS is best defined by Ambrust et al. (2009). Ambrust et al. acknowledges that the services provided by cloud computing (applications delivered over the Internet) and the hardware and system software in data services that provide these services have for a long time been referred to as SaaS.

3 CITA 2009 SOFTWARE AS A SERVICE SURVEY

3.1 Purpose
The initial purpose of this pilot survey was to assist in introducing the concept of cloud computing to the EIN group at a relatively early stage. It was envisioned that by engaging in this procedure the survey would act as a catalyst in developing a 'SaaS group' for cloud computing. The key focus of the group is to investigate the technology of SaaS and its particular application in the Architectural, Engineering and Construction (AEC) sector. The first task for the group was to complete the CITA SaaS survey of both customers and vendors. Outlined below are the other tasks that need to be considered in the future:

- Engaging involvement from the Irish Internet Association, Microsoft, Salesforce.com, Google, Intertrade Ireland, IBM etc
- Invite the Irish Software Association EIN to get involved.
- Identify those vendors who presently provide a SaaS solution.
- Identify interesting construction case studies of SaaS implementation.
- Identify the current costs and inefficiencies with procuring traditional software tools.
- Investigate if there are any other similar groups or initiatives in Ireland or overseas.
- Secure key business partners.

3.2 Sample
A representative sample of SME's from within the CITA EIN project were selected to partake in the survey. The response rate for the pilot survey was 90% representing 15 consumers and 12 vendors. The survey's main target was high positioned respondents, for example, directors / managers from within SME companies. The survey only focused on vendors and consumers within the AEC sector. Geographically this meant that the initial respondents were Irish and UK based. This factor contributed to the high response rate and the opportunity to develop a SaaS group.

It is intended that main survey will be based on random sampling in relation to the consumers and selected sampling for the vendors. The 80 listed vendors registered on the EIN database will be the initial target for the vendors. The vendor database is composed of national and international vendors, which will represent a more complete baseline on the current industry. A key purpose of the vendor selection criteria is to benefit from international perceptions and knowledge on new or existing software that can be available to the Irish market. The consumer selection criteria will be random but only within the Irish construction industry to enable Irish companies in identifying and utilising the best software applications available.

3.3 Consumers Questions
The pilot consumer survey was divided into four sections. Each of these segments was designed to analyse the potential of creating a business case for SaaS applications in the Irish construction industry. The first set of questions identified the overall business strategy of the respondents and their attitudes towards purchasing software and their use of ICT in the next three years. The purpose behind these questions was to establish the

market requirement for SaaS. In identifying the most popular types of software being used in the marketplace, the survey would assist in acknowledging the main applications that should be included in the cloud into lesser known applications would have the potential to be deployed. The questioning of the management's purchasing strategy towards software is essential in understanding how the market would view the potential benefits of this service. Finally, the last question in this section was intended to investigate if there is a market for future applications or whether companies were happy to continue with their current software collection.

The next set of questions was associated with the drivers and barriers of using SaaS by the respondents. The type of drivers associated with using SaaS is the ability of paying per user per month, the ability to access SaaS through the Internet anywhere in the world, and total cost, not having to worry about maintenance fees. The types of barriers are knowledge about SaaS, security concerns in relation to data storage and choice of actual services required. The reason for examining the barriers and drivers was to assist in finding a strategy that would allow analysis of the current views and structure them into a positive ideology. The lowest drivers and the highest barriers would indicate the areas that needed attention. Both the driver and barrier questions were designed in a ten point ranking scale format which allows the respondents to choose a set of attitudes in ranking order indicating their importance, priorities or preference. The listed barriers and drivers were based around the literature that has been researched to - date.

The final question of this section targeted opinion's on the perceived benefits of SaaS. The benefits of SaaS that are identified in the various literature such as Ramanujam's (2007) perception of allowing the user not to worry about managing a premise based facility may not necessarily be the same for the construction industry. In addressing this problem the question was presented in a likert scale to measure a range of options from "Strongly agree" to "Strongly disagree." The results of the perceived benefits can only assist in judging whether this service will be a success for the industry.

The following set of questions analysed the attitudes of the respondent's interest in renting SaaS and its various choices in receiving SaaS. The first question on renting options was derived from other industry models and again was identified from SaaS literature. This question is simply designed to identify what type of renting option the consumers are likely to prefer from their cloud service. The principle of the next question is similar to the renting option but focuses on receiving the service, in order, to recognise the required infrastructure.

The final section was a single open question phrased to analyse the respondent's perception of SaaS in the Irish construction SME market. This question was deliberately placed at the end of the survey to summarise the attitude of the respondents to SaaS. As with all fully open-ended questions it allows for positive and negative views to be expressed. The market need and interest for forming a SME cloud service in the Irish construction industry is predominately addressed in this question.

3.4 Vendors Questions

The structures of both questionnaires are designed to be similar, in order, to evaluate whether there is a strong relationship between the two samples (vendor and consumer). The methodology used for both questionnaires is designed on quantitative and qualitative research, which can be classified under two categories. Firstly exploratory research is used to diagnose a situation, screening alternatives and to discover new ideas. Secondly, attitudinal research is used to subjectively evaluate the opinion, view or the perception of a person, towards a particular object. The pilot vendor survey was structured almost identically as the consumer's survey. The principal difference was the phrasing of the questions; for example, a question aimed at establishing the drivers for the vendor would be focused on providing SaaS, unlike consumers who would be receiving SaaS. Another clear distinction is the fact that vendors provide applications and this was taken into consideration when structuring the marketing type of questions.

3.5 Consumer Research Findings

In considering the responses the results were generally analysed by a descriptive statistic method (category frequency) which provided a general overview. The results were then presented in the form of tabulation, a bar chart, pie chart or graph. Outlined below are some of the key findings in relation to the questions investigating the overall business strategy of the respondents and their attitudes towards purchasing software and their use of ICT in the next three years.

- The majority of the respondents feel that their firm's approach to purchasing new software will be based on price assessment. This factor is probably related to the construction industry's severe economic downturn.
- The majority of the respondents use a computerised drawing application, document management and some form of accounting application.
- Some of the respondents did express a concern with their lack of knowledge on existing and new applications. However, the majority of the respondents confirmed that their firms are anticipating further involvement in ICT in the next 3 years.

The second section of questions on drivers, barriers and benefits concluded the following key points:

- The lowest drivers were green solutions; organisations that traditionally have operated their own data centres in regions with high electricity costs, and access from any PC anywhere in the world.
- The main barriers for the respondents were choice, the ability to locate a specific application when needed and security.
  The histogram in Fig.3 is a graphical representation of the results to the sample question; "indicate your position on the following perceived benefits of SaaS?"
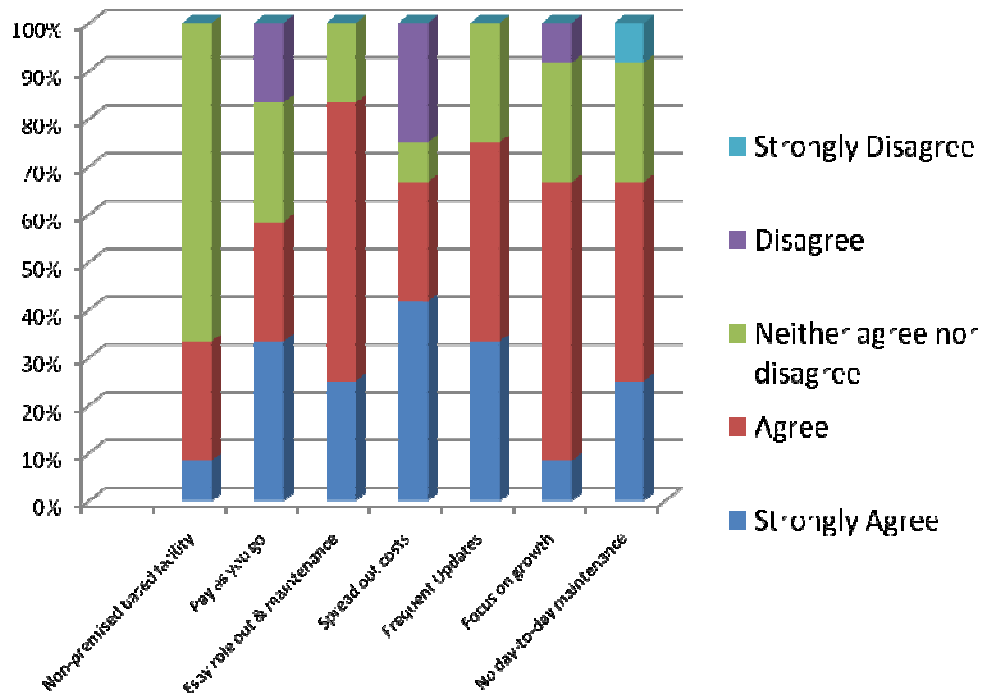
Figure 3: Customers perceived benefits of SaaS.

The responses to this question indicate that the majority of the respondents are in favour of the perceived benefits of SaaS. 25% of the respondents disagreed with the benefit of reducing capital cost and 8% of respondents strongly disagreed with no day to day maintenance. This type of response from the Irish construction industry is expected as SaaS is a relatively new concept that has not been fully embraced.

The key findings of the next phase of questions illustrated the respondent's interest in renting SaaS and the various choices in receiving SaaS:

- The majority of the respondents favour the subscription base model; payment for software which is actually used when determining the renting option it would choose.
- The industry's standard of a Web based application is designed to be maintained on a server and viewed through a browser and this represented the preferred manner for receiving SaaS.

The general perception of SaaS by the consumers is that it has certain potential advantages of assisting SMEs with operating in a unified manner and supporting new business ventures during their initial start up stage. However, the majority of the respondents still feel that because it is such an innovative concept with a limited amount of case studies in the Irish construction industry, they are reluctant to speculate on its future. This reflects the natural conservatism in the Irish construction market with respect to ICT.

3.6 Vendor Research Findings
The following is a summary of the results from the vendor sample.

- The majority of respondents feel that identifying the consumer's needs before developing their application is the best practice.
- The main types of application deployed by the vendors are the typical financial management processes of supply chain management (SCM) and custom relationship management (CRM).
- The majority of the respondents in this survey acknowledged that the SME market should be exploited as a niche market and that their firms are focusing on continuing to support this market in the next three years.
- The lowest drivers were green solutions; organisations that traditionally have operated their own data centres in regions with high electricity costs, and the desire to have no commitment (month by month).
- The main barrier's for the respondents was choice, the ability to locate a specific application when needed, and performance.
- None of the respondents strongly disagreed with any of the benefits and only a small amount (11%) disagreed with some of the benefits such as spreading out cost, avoiding huge capital expenses and installation fees as one spreads subscription costs over time.
- The most favoured option for licensing SaaS resulted in equal preference for a subscription-based model, (monthly payment on the software actually used), and a transaction-based model (charge customers for each business transaction).
- Reflecting the same result as the consumers, Web based applications were the most favoured approach to delivering software.

The general perception of the vendor's is that SaaS or a service similar in nature is needed in the Irish construction market. However, the concerns associated with not having an appropriate infrastructure and lack of actual economic benefits data means that further research will be required before potential vendors can contemplate implementing this service.

4 CONCLUSION

The aim of this paper was to investigate the work of CITA in Ireland in encouraging SMEs interest in subscribing to a software marketplace that deploys an open source solution. ConstructHub (2007), indicates why enterprises in the construction industry are so focused on obtaining the benefits of cloud computing, such as, speed, agility, accelerate information access, communication in real time and assisting collaboration internally and externally. It is these types of benefits that will streamline the industry's fragmented operations. Cloud computing principles are based on a centralised heterogeneous network allowing developers to create a product from several applications. In the case of a construction cloud, effective collaboration would enable professionals in the industry to improve their knowledge management and create more viable projects. The results of the pilot survey indicated that both vendors and

consumers could avail of the potential benefits of cloud computing. Cloud computing undoubtedly has the potential to improve the competitive positions of SMEs in Ireland by allowing them to have access to software that was previously only the domain of large enterprises. But the realistic barriers which are perceived by SMEs will have to be overcome before widespread adoption of cloud computing becomes a reality in the construction sector.

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