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Finding a Middleware ICT Solution for the Irish Construction SME Sector

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Abstract:

A key feature of the Irish construction industry is its fragmented structure. Some 16,000 businesses list their main activity as construction, yet no company has more than 3% of the total Irish output. The top 20 companies have less than 15% of total output. There is a very high number of Small to Medium Sized Enterprises (SME's) in the sector. However, most software products which address the specific needs of the construction industry are designed for larger companies. It is felt that the needs of the large number of SME's in the sector are underserved. The Construction IT Alliance (CITA) under is Enterprise Innovation Network (EIN) programme has launched a programme of meetings and discussions with SME'S, and their representative bodies in the industry to identify their particular information technology needs and their usage of currently available software products. It is proposed to undertake a programme designed to develop a viable product/services solution to address agreed information technology needs of the construction industry. This paper will report on the status of a strategy adopted by CITA to progressively evaluate and refine ideas, and ultimately identify the Information Communication Technology (ICT) product offering for its SME members.

Keywords:

1. Introduction

The severe lack of demand in the building and construction industry has been a significant factor in contributing to negative economy-wide growth rates. In generic terms GNP in Ireland has declined by 13.8% between 2007 and 2009, while investment in building and construction

has declined by 47.5% from the peak in 2007 (DKM, 2010). In a recent Ulster Bank Purchasing Managers Survey respondents reported lower new business, lower demand for inputs, intense competition amongst suppliers and further reductions in employment. However, according to the Ulster Bank New Orders index, construction firms continue to believe that the industry will show signs of recovery with future expectations index above 50 for each of the opening three months in 2010 (DKM, 2010). In the ICT and Telecom industry the current crisis is perceived as being more significant than that of 2001, as it combines on two levels, an economic and financial one. The amount of ICT expenditure has dropped considerably and one of the most affected areas is the ICT sector, where the crisis has negatively influenced sales. Contracts have been frozen and many ICT companies have reduced their fixed costs and monthly distribution expenses, in order to make savings and are now developing strategies more adapted to current market models, such as the Software as a Service (SaaS) model, which has not yet been directly affected by the crisis (CompuBase, 2010).

The use of ICT has proven instrumental in creating productivity gains within global markets. For example, through reduced transaction costs, scalability, and fast, reliable information flows and enhanced online collaboration tools and new ways to market goods and services (Pepper et al. 2009). The modern digital economy has market revenue of over €200 billion in Europe and growth rates of between 6 and 8% software is the largest and the fastest growing segment of the ICT market (European Commission, 2009). The SaaS market is one of the most dynamic elements of the software market. It is currently estimated at less than 5% of the total European market value. According to the market figures, in three years time at least 25% of software packages are expected to be deployed using the SaaS mode (CompuBase, 2010). Cloud computing utilizes public networks, such as the internet, which promotes advancements in mobile technology enabling users to work from anywhere by accessing such common cloud applications as Webmail, Customer Relationship Management (CRM) and similar SaaS solutions (TechRepublic, 2010).

This paper is a reflection on the work carried out to date by CITA EIN project. The aim of the EIN project is to promote, through detailed research and analysis of requirements, development or procurement of solutions, and promotion of their implementation, the use of electronic business in SMEs in the construction sector. The paper will illustrate the results of 2010 EIN members survey on cloud computing and analyse the stages involved in a product service development programme. The product service development programme is part of CITA's

strategy development to create a viable product/service solution that will address the agreed ICT needs of the construction industry.

2. ICT Up-Take by SMEs in the Construction Industry

Hore and West (2005) reported that building materials account for up to 50% of all construction costs and in the field of Business to Business (B2B) interactions there is a huge untapped potential for productivity gains. Technologies, such as Automatic Identification (Auto-I) and bar coding have become widespread within manufacturing, medicine and retail industries but in comparison with the construction industry adoption worldwide it is very piecemeal. Hore and West carried out a survey of over 100 Irish construction companies. The survey analysed the current level of technology uptake in B2B purchasing transactions between building contractors and material suppliers; the driving forces which attract firms to adopt electronic purchasing; the barriers of such adoption and the future development in adopting technology within the Irish supply chain. The key results illustrated a low level of awareness of appropriate technologies and the absence of appropriate industry standards. The need for an increase in the ICT literacy skills of purchasing staff and familiarity with electronic purchasing was also recommended.

Kotelnikov (2007) addressed knowledge, change and globalisation as the driving force of a new economy. Kotelnikov acknowledges that increasing emphasis is now being placed on firms to not only be familiar with their local context but also with global developments. This impact has generated an environment where SMEs will rely heavily on ICT. Many countries such as India, the Republic of Korea and Taiwan have created enabling environments to ensure that SMEs are well positioned to capture emerging business opportunities. For example, India offers relief from import duties for ICT hardware and tax deductions for income earned from software exports. Gatautis and Vitauskaitè (2008) insisted that the use of eBusiness in the construction sector is very limited and the potential of eBusiness to increase productivity and efficiency is not exploited.

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 recommended 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.

Hore et al. (2010a) identified in a recent combined vendor and consumer survey of almost 90 respondents that 32% of the market indicated a significant increase in their firm's involvement in eBusiness and the use of ICT in the next three years. 87% of vendors indicated that they were developing products for the construction SME sector. These results evidently identify that there is a market for software in the Irish construction SME industry.

3. Construction IT Alliance

3.1 Background to CITA

CITA was established as a research project in Dublin Institute of Technology (DIT) in association with the 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. Membership of CITA is open to all stakeholders in the Irish construction industry who all share the CITA vision and want to participate in fulfilling CITA's objectives. CITA has identified its objectives as:

- To inform the Irish construction sector of ICT developments.
- To establish and disseminate good practice in the use of ICT in the Irish Construction Industry.
- To encourage ICT related research collaboration between Irish academia and Irish construction practitioners.
- To establish and maintain links with relevant national and international organizations.
- To encourage the strategic use of ICT by all firms in the Irish Construction Industry (Hore et al. 2009a).

3.2 Construction IT Alliance eXchange (CITAX)

In July 2006 CITA initiated the CITAX project as an industry-led networking pilot project. The CITAX project involved a collaboration of Enterprise Ireland and CITA. The project aimed to demonstrate that significant measurable economic improvements could be achieved by using readily available ICT tools to radically improve business processes in the Irish construction industry. The project was supported by Enterprise Ireland and CITA membership and was completed in June 2008. The project consisted of five separate but collaborative modules, namely:-

- Module 1 – Design

- Module 2 – Trading
- Module 3 – Electronic Tendering
- Module 4 – Project Collaboration
- Module 5 – Computer Aided Measurement (CAM)

Project results demonstrated that clear economic benefits could be achieved through the pilot projects associated with the modules. For example, CITAX Module 3 (Electronic Tendering) demonstrated that there were clear economic benefits to be achieved by organisations that replaced the traditional paper-based system with an electronic tendering process. A pilot scheme was undertaken using File Transfer Protocol (FTP) technology and the results showed savings of 11% for Professional Quantity Surveying (PQS) firms; 10% for contractors on their tender costs and 11% for sub-contractors.

CITAX Module 4 (Project Collaboration) findings indicated that main contractors normally drive the use of project collaboration software and that implementation of the software are limited to projects depending on size and project duration. The module team concluded that by using project collaboration software project teams can reduce the length of time to address queries by 50-60% over traditional paper processes (Hore et al. 2009b).

3.3 EIN Programme focus

The EIN project focuses on the particular use of ICT by SMEs in the Irish construction industry. Initially the objectives 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 Irish construction industry. In collaborating with the industry CITA has developed a software directory of construction applications. It is envisioned that this directory will be designed to emulate Citrix® Dazzle™. Citrix have identified the growing gap between Web-based consumer services and traditional enterprise computing. By responding to the market they have developed a lightweight storefront for all applications. The user can simply browse and search the applications name, description or type and by clicking on the icon and dragging it to the application folder the application will be stored.

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 group representing members from the EIN programme has been established. Depending on the overall

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.

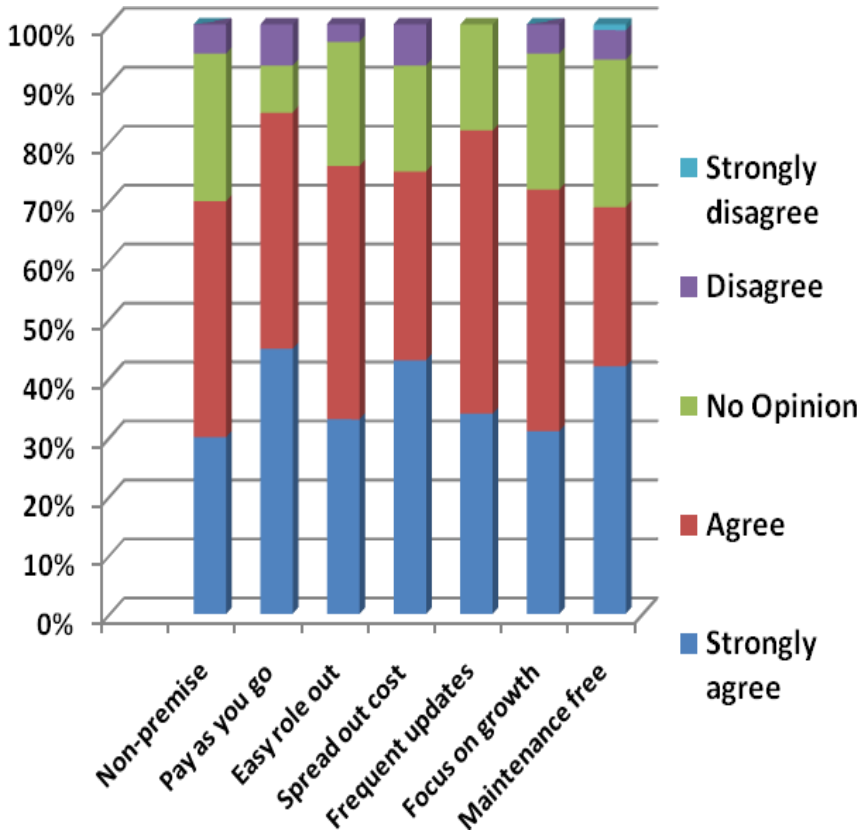
3.3.1 Technology Check Service

CITA have implemented a technological check programme, as part of the CITA EIN service offering. To-date 25 EIN enterprises have been interviewed representing a broad spectrum of organisations. The interviews have identified a wide variation in the effectiveness to which ICT is used to support business activities. The results indicate that a mixed proportion of companies value ICT and view it as a major benefit in how they conduct business. However, the majority of the organisations do not have a sales and marketing function which is reflected in their ICT system. Their Websites were reported as largely out of date; not reflecting accurately what the business actually trades under and in most cases the Website is simply a brochure with no social media marketing leads. A key finding of the analysis was a lack of online collaboration. The secure use of hosted services to store documents where authorised staff could download files was substituted by the use of emails. However, some businesses have embraced virtualisation, particularly desktop virtualisation. Virtualisation has the potential to streamline how ICT is used, as it can offer optimization of licenses by tracking license compliance and re-harvesting unused licenses.

3.4 CITA Research Activity

The purpose of CITA's EIN 2010 survey was to highlight the drivers, barriers, and benefits associated with cloud computing in the Irish construction industry. The results of this survey have strongly indicated a need for a Web-based model that has the ability to promote collaboration between all construction disciplines. The main incentives for adoption were 'sales' and 'value added service'. In analysing the barriers the majority of the respondents agreed that 'lack of awareness or knowledge' may deter them from implementing this service. However, the perceived benefits of having convenient on demand network access to a shared infrastructure, with elasticity and consumption-based pricing, has demonstrated to the Irish construction industry the capabilities of this new layer of internet architecture (Hore et al. 2010a).

Figure 1: Perceived benefits of cloud computing adapted from Hore et al. (2010a).



In relation to the perceived benefits figure 1 illustrates the combined responses of both vendors and consumers and as the histogram graphical indicates the majority of the respondents were in favour of the benefits. This clearly demonstrates that the market values the attributes of cloud computing.

Figure 2: Customers perceived requirements for the marketplace.

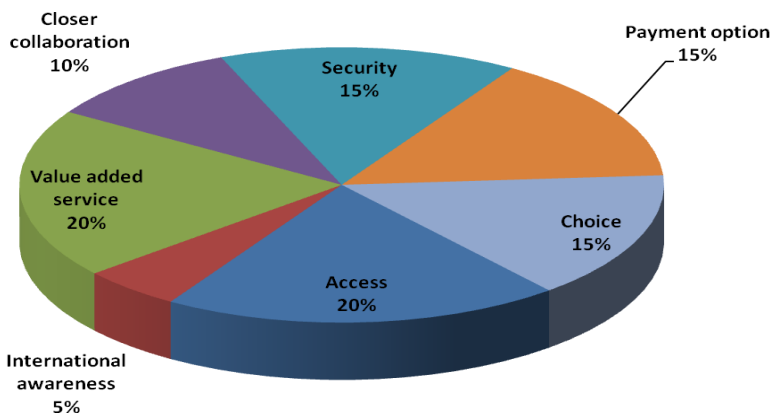


Figure 2 illustrates the requirements of customers in relation to how this new solution should benefit them in the marketplace. 20% of respondents identified with the ability for SMEs to have more access to their market and to generate more revenue from using a product/solution that added value service. 15% of the sample were of the opinion that they need to have more choice/knowledge on the various solutions that are available. Another 15% viewed security as an essential means to conducting business. The issue of SMEs being able to compete not just domestically but also internationally received a 5% response rate. The results provide an insight into how customers perceive their marketplace and the types of attributes required to assistance them in providing efficiency and increase their productivity.

4. Methodology

In review of these activities CITA has started to undertake a programme designed to develop a viable product service/solution that will address the ICT needs of the construction industry. It is fundamental to CITA's ethos that any solution does not compete with solutions currently provided by its members, but will focus on the unique independent position, role and strategy of CITA within the industry.

The process to be adopted will be a staged process emulating Dibb and Simkin (2009), designed to progressively evaluate and refine ideas involving 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

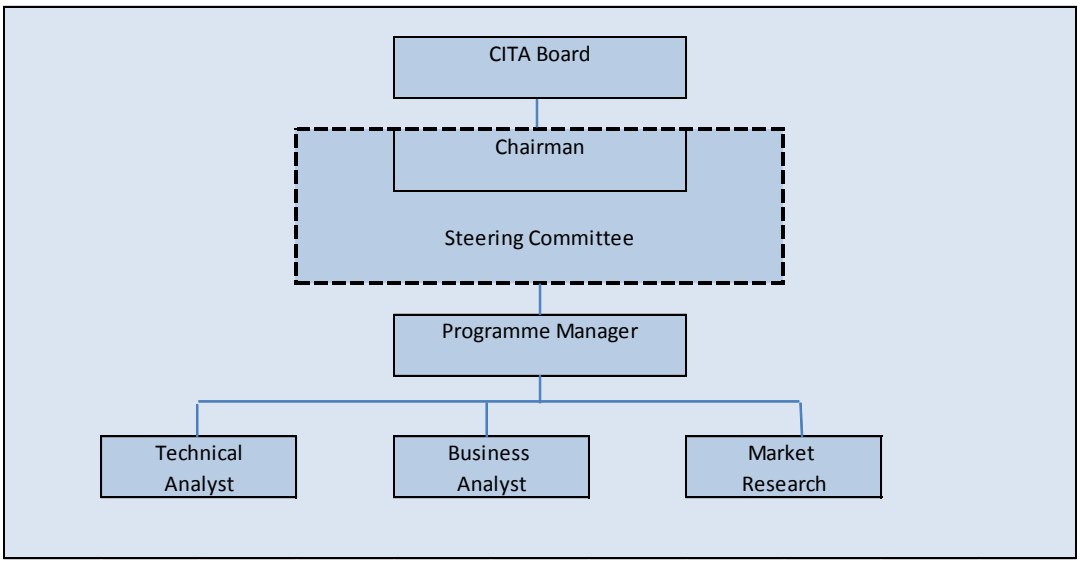
4.1 Operational plan

The first five stages of the EIN product development plan (PDP) will require a range of resources, including:

- Programme Management
- Business Analysis
- Technology Analysis

- Market Research
- Direction

Figure 3: Organisation of resources for the Product Development Plan



The CITA board will be responsible for the overall review of the project. The organisational chart for the project is shown in Figure 3. The steering committee, under the chairmanship of the managing director, will be responsible for the detailed planning and review of each stage. The next tier will involve the programme manager who will be responsible for the delivery of the programme, in particular, for planning and organising the tasks and activities in each stage. The supporting framework of the organisation structure is divided into specialist operations. The various specialists' include a technical analyst who will be responsible for gathering ideas from CITAX and technological checks, a business analyst who will assess the business implications and feasibility of proposals, and a market analyst responsible for collecting available market data and undertake market research and customer analysis. All the specialists' will participate in workshops and team meetings.

4.1.1 Development process stages

<u>Stage 1 - Idea generation</u>

This stage involves gathering ideas to be evaluated as potential product options. The ideas will be drawn from the following:

- Research work already undertaken within the CITAX programme.
- Analysis of the findings of the technology check programme.
- Outcome of meetings, discussions and workshops with CITA EIN members.
- Findings from research into current products and services and research by others into current developments and emerging trends.
- Needs arising from focus groups, such as, the SaaS group.

Stage 2 - Screening

The ideas generated in stage 1 will be critically evaluated by a matrix system to isolate the most attractive options that are feasible and do not compete with CITA's vendor contingents. It is anticipated that no more than six ideas in the group proceeding will progress to the next stage.

Stage 3 - Concept development and testing

This stage will involve a workshop that presents the ideas to a group in the form of concept board presentations (storyboards). The workshop will be used to include the opinions of the consumers as a means to value the potential of each product. These opinions will assist in identifying the level of interest in purchasing the product, frequency of purchase (assist forecast demand) and price points to determine how much customers are willing to spend to acquire the product. At this stage the customer needs will be taken into account and the number of ideas will be reduced to one or two options.

Stage 4 - Business analysis

The dependency on the market research is enhanced at stage 4 as efforts are made to analyse the viability of the product ideas. The key objectives at this stage are the forecast of the market size (overall demand), development, operational costs and financial projections, such as capital investment, sales, profits and ongoing maintenance and development. An overall risk assessment will be undertaken including a software product risk assessment. The primary research sample will target both consumer and vendors, and secondary data from external marketing research and competitor analysis will be used to form a business case for the proposed product/service.

Stage 5 - Product/service market testing

The idea that evolves from the business analysis stage will be developed into a prototype model. This prototype will be tested on a selective small segment of the market and reviewed as any other purchasable product. The customer's experience of the product will add weight to understanding how the market may view the solution. In undertaking a prototype structured interview the needs of the customer will be identified and the product will be redesigned before development stage.

Stage 6 – Development

In this stage the product/service will be designed and developed to CITA's or a third party's specification. This stage will involve a business process mapping of the product were the marketing launch, operating plans developed, and the test plans for the commercialisation stage will be defined.

Stage 7 – Commercialisation

Depending on positive market testing results the product may be introduced or alternatively roll-out in stages with parts of the market receiving the product on different schedules. This will enable CITA to format a delivery in a more controlled manner and to finalise the marketing mix as the product/service is provided to different market segments.

5. Progress To-Date

5.1 Early Ideas

In review of the scope of the research programme the most innovative concept to-date is to enhance the EIN vendor database on CITA's Website. As previously stated it is anticipated that this directory will feature certain elements of Citrix® Dazzle™. In analysing the success of directories one only has to look to databases, such as Capterra (www.capterra.com) and Construction Software Review (www.constructionsoftwarereview.com). These two enterprise software directories manage and showcase the latest construction software products. The literature and Web-based review identified cloud computing as a solution to the use of ICT by SMEs. As previously indicated the accompanying EIN survey illustrated a strong reaction towards the development of an open software marketplace via a cloud model. The results

showed a clear indication that a cloud or a service similar in nature is needed in the Irish construction market.

5.2 Stage 1 (idea generation)

The number of ideas drawn from the CITAX programme, analysis of the technology check programme, findings from primary and secondary research, and the idea generation workshop (brain storming) reached 90. An intial ideas summary template has been drafted with five main categories representing general construction process applications, point specific applications, information, infrastructure support, and support services. The general construction process application category is further divided into three sub categories winning business, design, and delivery. The type of applications associated with this category are eTendering, building information modelling (BIM), project collaboration, eCommerce, and mobile computing. Point specific applications has two sub divisions construction applications and general software tools such as, online database tool, applications for iPhones, CRM, and a product data information portal. The information category was aligned with the issues of product specificiations, regulations, and standards for information exchange. Business continuity and general infrastructure were the two sub categories associated with infrastructure support. The categories affiliated with support services range from technology support on software products to training support including an online self paced training portal. The potentail for international market revenue was also identified with applications that allowed for a virtual market presence and a check list for conducting business in different countries.

5.3 Stage 2 (screening)

Four key evaluation citeria were identified for stage 2, namely:

- Meets CITA requirements (does not compete with members, address CITA goals, affordable manageable).
- Positive commerical assessment (adequate, growing market, low competition, potential competitive advantage for CITA).
- Positive technical assessment (feasible in context of current, foreseeable technologies).
- Positive financial assessment (positive ROI, breakeven within 3 years, long term profitability).

These four citeria were assessed individually by a yes, possible or no indication before progressing to an overall assessment of the combined results. This assessment evaluated which

concept's should be investigated further. Table 1 illustartes the concepts that should be further investigated.

Table 1: Possible solutions to be further investigated

Overview of Ideas	Possible Solutions to be further investigated			
General Construction Process (delivery)	Project Collaboration	Site Mobile Computing	Electronic Document Management	
Information	Information Resources Services	Standards for Information Exchange	Software Directory	
Support Service	Technology Support Service	Training Services	International Marketplace Services	General Services

<u>General construction Process (delivery)</u>

Three possible solutions were identified under the category general construction process. These solutions were all chosen from the sub category Delivery. The project collaboration solution was identified as a possibility by two areas of the criteria; meets CITA requirements and positive financial assessment. The reason cited for this was the fact that it may be in conflict with CITA's members and the need for reasonable volume of users. However, it was rated as a yes under the criteria of positive commercial assessment and technical assessment. The solution is deemed to be applicable to all CITA members and it would be possible to configure an existing solution to make it meet the industry's needs. A similar marking was given towards site mobile computing, as before it has a possible conflict with members and the number of users is critical. However, the widespread adoption of smart phones was seen as a vehicle for user's acceptance and a platform, such as the iPhone may provide real-time communication. The final solution identified under the category of general construction process was electronic document management. For CITA it is viewed as offering members a secure data exchange portal. Commercially the project would be low risk, as there is a demand from members for a trusted partner in this area. However, the issue is that a number of products already exist and from a financial perspective, it would be difficult to develop a similar product.

Information

The solutions to be investigated under the category information were information resource services, standards for information exchange, and software directory. Information resource services was a popular choice as CITA members need to obtain business orientated information. Commercially it has widespread market appeal and technically most of the functions required can be delivered through 'shopping cart' type solution. The standards for information exchange solution received a degree of support. The general perception is that standards are a necessary for the industry, however with previous experience it can take a very long time for standards to be widely adopted. The software directory service was viewed as a definite possibility, as it has widespread applicability, it currently exits in the market as a configurable off-the shelf item, and CITA can improve their existing database directory.

Support services

The support services category prompted the most suport. The solutions ranged from technology support services that would require a third party influence, a training portal that would evolve with CITA Skillnets and an international marketplace service that would meet Enterprise Irelands objectives.

6. Conclusion

Since CITA's establishment in 2001, CITA has been at the forefront of promoting ICT to the Irish construction industry. In 2008 CITA acknowledged the need for SMEs to be more productive within the industry. The EIN programme was identified as the tool that would initiate this radical new concept in fundamentally rethinking the business process of changing the current traditional methods into ICT techniques that would add value and service.

This paper outlined the progress to date of the EIN programme, illustrating the key findings of the technology check programme and CITA's research activity. The results of the 2010 survey demonstrated the markets perceived benefits of cloud computing. It is evidently visible from the market research that a solution based on a cloud system would add substantial growth to Irish SMEs, reducing overheads and assisting them in entering global markets.

In order to provide the industry with the most efficient means of obtaining a solution that can increase their productivity and efficiency both nationally and internationally CITA has developed a seven stage Product Development Plan. This plan has combined all previous ideas generated to date and the expressed views of the alliances members through a brain storming session. The screening process has identified a total of ten potential solutions grouped under three categories which will be investigated further. The next stage 'Concept development and testing' will involve construction practices participating in several individual workshops that will extract requirements from scenarios (story boards). These requirements will facilitate in reducing the number of solutions to one or two options.

The development plan has been designed to enable the industry to participate at every stage. CITA will fulfil their obligation to the Irish construction industry by investigating the needs of SMEs and assist in developing a solution that can create productivity gains for the industry though the use of ICT.

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