The Role of Enterprise Systems
IT PRACTICES FOR SME SUCCESS SERIES

BOOK 2: THE ROLE OF ENTERPRISE SYSTEMS

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EDITED BY JESSICA CREES AND RICHARD SELF
This book is composed of articles written by A grade students at the University of Derby. These students have been taught the technologies and practices that are at the cutting edge of enterprise systems. The information in this book is suitable for small to medium enterprises that wish to know more about implementing technology into their business practices.

The topics within cover cloud computing, change management, dyslexia support, web vs mobile applications, project failure and success, collaborative decision making, resource planning systems, data sharing, and error reduction.

This book is composed of research from a variety of sources that have been compiled into easily digestible articles. Each article is aimed at one aspect of implementing technology in business. You can read the book from start to finish, or read each article as and when it applies to you, as they are written to be independent of each other.
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Can Cloud Computing benefit SME’s?
Definition, benefits and issues of Cloud Computing

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Abstract—Cloud Computing involves complex systems that use various different services and technologies. SME’s can benefit in many ways like reduced capital expenditure as well as providing dynamically scalable resources on a pay-as-you use service by implementing a cloud computing infrastructure. There are several challenges on the way that need careful investigation to ensure that data that is stored in the cloud is safe. This paper aims to deliberate what cloud computing is, expand on what benefits it has to offer in addition to further discussing the challenges it proposes.

Index Terms— Cloud Computing, SME, Benefits, Challenges

I. INTRODUCTION

At present, the embrace of cloud computing is increasing at a great pace. From a survey carried out in 2010, around 69% of American small to medium size enterprises (SME) were using cloud computing services such as webmail and online backup. Further to this, in India it is said that over 1,500 SME’s use cloud-based communication services for voice chat and data transmission (Kourick, 2011).

With many expanding businesses, IT is interpreted as both an opportunity and limitation. It is clear that for a SME to grow and keep its competitive edge, new technology is crucial. With high capital costs and lack of technical skills it is difficult to exploit the investment on return and benefits that the new technology offers (Kelly, 2011).

Senior management within SME’s are often not aware of what cloud computing is and how it could benefit within their organisation (Kourick, 2011). This paper aims to deliberate what cloud computing is, what benefits it has to offer in addition to discussing the challenges it proposes.

II. WHAT IS CLOUD COMPUTING?

There have been many contributions and debates over the meaning of cloud computing over the years; however the National Institute of Standards released a formal definition in October 2009. This definition in summary is that cloud computing is a model to enable delivery of computing resources over an on-demand network. These resources can be quickly accessed with minimal effort and service provider interaction (Kourick, 2011).

The cloud computing model upholds availability and does this by utilising five characteristics, three service models and four deployment models (Kourick, 2011).

The essential characteristics are broad network access, rapid elasticity, measure service, on-demand self-service and resource pooling. Broad network access allows new services to be offered via the Internet or over private networks whereas on-demand self-service offers customers the ability to request and manage their own resources. Pooled resources give users the capability to select from a pool of computing resources, normally in remote data centres (Office of the Privacy Commissioner of Canada, 2011).

Fig. 1 – Service Model Types (Dialogic Corporation, 2010)

The three service models that cloud computing offer are: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) (Kourick, 2011). Figure 1 illustrates a brief overview.

In SaaS, an application is provided along with any necessary software, operating systems, hardware and network. Applications that are in the cloud are accessed by numerous devices via an interface such as a web browser (Zabalza, et al., 2012). PaaS allows users to create new software applications by providing the essential components like operating system, hardware and network. IaaS lets users install the necessary hardware computing resources as a service. Hardware resources can be purchased as if they were outsourced services. By applying this model, physical resources can be expanded or reduced in a short period of time.
The key benefit that cloud computing offers any SME is cost reduction. By implementing cloud services, capital and ongoing expenses are reduced as you pay for what you use and can potentially reduce the number of in-house IT resources required to provide support (Dialogic Corporation, 2010; Morison Menon, 2012). Furthermore, by using cloud computing, the technology used is being rented which means no further hardware needs to be purchased to keep up to date with the latest technology. By paying a monthly service fee, SME’s are likely to see a 30%-50% saving (Shaw, 2011).

As mentioned previously, by using cloud services you only pay for what you use and theoretically rent the hardware. This means that cloud computing offers a very scalable solution to growing businesses (Morison Menon, 2012). Additionally, cloud computing offers flexibility which means that extra resources can be obtained at peak times, meaning consumer demands are met (Dialogic Corporation, 2010).

With availability and reliability of an information system being directly related with business benefits, it is important that outages are kept to a minimum to ensure customer confidence is not impaled. Another key advantage to cloud computing is its proficiency to provide support to increase the availability of cloud resources so that outages are close to being eliminated. Further to this, the support provided increases reliability so the impact of a runtime failure is minimised (Arcitura Education Inc., 2013). Reliability is also achieved by using multiple sites distributed across the globe, supporting business continuity and disaster recovery situations (Dialogic Corporation, 2010).

Security is a major concern for many SME’s. By adopting a cloud services strategy, many security factors are taken care of by the cloud provider (Morison Menon, 2012). Most on-site systems need to be constantly monitored with patches being tested and deployed comprehensively. Unfortunately, not all organisations have dedicated resources available for this, therefore by employing the cloud computing model patches are tested and deployed centrally by a more specialist, dedicated resource. This means the SME is up-to-date with new patches automatically without needing to waste their own resource (Gardner, 2012).

Various cloud service providers offer a 2-factor authentication process whereby an added layer of security is included on top of the customary username and password scenario (Gardner, 2012). Some larger enterprises may have the technical knowledge and resources to implement specific security certificates onto their systems, however smaller businesses are less likely to.

The cloud computing model allows organisations to benefit from recognised and trusted certifications that the cloud provider has already achieved, which means the businesses data is secure using a reputable means of security (Gardner, 2012).

In addition to the security factors that the service itself offers, physical security is also attained. Data centres are hosted in secure facilities where access is tight. This factor is rarely achievable by the average organisation as considerations such as staff access, usability, skills and resources are normally lacking (Gardner, 2012).

There are many potential benefits offered by cloud computing which stand out in comparison to other information systems. Figure 3 illustrates some of these potential benefits.

**III. BENEFITS AND CHALLENGES**

![Figure 3 - Potential benefits of Cloud Computing for SME’s](image)

There are four deployment models that have been acknowledged, Private Cloud, Community Cloud, Public Cloud and Hybrid Cloud. Reliant on the requirements and what is to be achieved from cloud computing depends on which deployment model will be used (Kourick, 2011). An example of the public, private and hybrid cloud is shown in Figure 2.

The private cloud is where the infrastructure has been deployed specifically for a company and is maintained and operated by that company or a third party. The community cloud infrastructure is shared between numerous organisations that have comparable requirements. By using this deployment method, capital expenditure costs may be reduced as they are split between the organisations. This procedure may be carried out in-house or via a third party. Services offered by a public cloud are available to the public but are owned and operated by a cloud service provider. Finally, a hybrid cloud can consist of several clouds of any type; however hybrids have the facility within their interfaces to allow data or applications to be moved from cloud to cloud (Dialogic Corporation, 2010).
For small businesses, opposing with larger enterprises can be a challenge, however cloud computing can help level the playing field. This can be achieved as new technology can be obtained without the large capital expenses, which mean your SME can get onto the market quicker. Additionally, your business is not liable for managing, maintaining and updating various servers. Finally, as the organisation grows, the infrastructure selected can be expanded quickly without the need to stop and acquire more resources (Shaw, 2011).

Cloud service providers will establish their data centres in the most affordable and convenient sites however consumers are not normally aware of the physical location and this can introduce legal concerns (Arcitura Education Inc., 2013). By not disclosing the locations of where the data is stored, it becomes difficult to determine if adequate safeguards are in place and if legal and regulatory compliance requirements are being achieved (Jansen, 2011). Once data stored in the cloud passes a national border, it becomes increasingly difficult to fulfil maximum protection under foreign laws and regulations as some countries have laws that entail data to be revealed to government agencies (Arcitura Education Inc., 2013; Jansen, 2011). Nevertheless, the majority of governing frameworks available recognise that the organisation using the cloud is responsible for the security and storage of their own data, even when stored in an external cloud (Arcitura Education Inc., 2013).

As cloud computing is heavily relied on Internet connectivity, a high risk to business continuity is presented, as organisations are reliant on Internet access to obtain their data. If vulnerability is recognised as a service the cloud provider delivers, the company may have to terminate all further access to the cloud until the vulnerability has been resolved (Choo, 2010).

IV. CONCLUSION

Cloud computing is a complex technology that proposes many potential benefits. Entry cost for great IT facilities can be reduced for SME’s by renting hardware and software from cloud service providers and keeping other resources low. By paying for what services you only use and require, start-up SME’s can definitely benefit from minimal expenditure. By making the most of the on demand and rapid elasticity characteristics of cloud computing, SME’s have the potential to grow quickly and level the playing field with larger enterprises.

Cloud computing does unfortunately come with some serious challenges regarding security and privacy. Security of the cloud is dependent on trusted certificates so therefore the organisations data should still be protected with consistent policies in place.

By combining legal contracts with SLA’s and constant monitoring, governance risks and issues can be mitigated. For that reason it is important for the SME to keep track of what service level is actually offered and other warranties that are made.

Providing the challenges with cloud computing are investigated thoroughly and any risks are mitigated, SME’s can benefit from implementing a cloud computing infrastructure.
REFERENCES


Implementing Change in an SME

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Abstract—Change management and employee involvement have a significant effect on the success of a project. Establishing good relationships and communication between employees, developers, and executives, contributes to project success. Understanding employees' wants and needs should be the main step in every model for change and project management, as not doing so will have a negative impact on the success of the project.

Index Terms—Project Success, Technology, Communication, Change Management, Employees

I. BACKGROUND

The Standish Group conducted a survey in 2003 that showed that 66 percent of IT projects were cancelled, challenged, or outright failed. Their research showed that a significant cause for this failure was the lack of change management implemented within their business (Standish Group, 2003).

The CHAOS Report found that the top reason a project was successful was if the employees were involved in it, and lack of employee involvement was the top reason for a project's failure. Many businesses understand that employees must be involved during the planning and development of the project for it to be successful. A healthy relationship between the employees, the developers, and the executives, keeps the project on track and vastly contributes to its success while also ensuring that employees get the product that they need (Standish Group, 2005; Thizy, 2012).

II. INVESTIGATION

Face-to-face interaction between employees and developers is the best way to get information and to avoid misunderstandings. It also establishes trust between the two groups (Highsmith and Cockburn, 2001; Jastroch et al, 2011; Paetsch et al, 2003).

Regular meetings between employees and developers are helpful as the employee can understand the development of the project, any questions can be answered, and any changes in design or implementation can be discussed. Developers can tell employees about the advantages and limitations of the project, and employees can test it to see if it reacts the way they expect. If it doesn't then they can clarify that issue with the developers (Paetsch et al, 2003).

Communication between employees and developers aids in defining the requirements of the project and helps to put those requirements into context (Paetsch et al, 2003).

Insufficient requirements have a negative impact on the project. The quality of the project is important, as employees will not implement it on a long-term basis if it doesn't meet their needs in the short term (Konary, 2012).

The aim of requirements gathering is to learn what must be developed before it is developed. This is necessary, as finding mistakes in the requirements late in the project development are often costly to correct (Paetsch et al, 2003; Wallin et al, 2002).

Requirements are not found by describing the project to be developed, but in finding the effect that the employee wants the project to have. This is where the discrepancies come from between what the user needs and what they think they need. It is up to the developer to do research into their needs to find what suits them best (Jackson, 1995; Donaldson and Siegel, 2001). It is also important that the project fits into the context of their environment. Researching these issues help to make the requirements more complete (Hock Ow and Yaacob, 1997; Osis and Asnina, 2008).

There are several methods used to help gather requirements. The three most commonly used are interviewing, observation, and focus groups. These methods are found in many development methodologies, both traditional and agile (Highsmith and Cockburn, 2001).

1. Interviewing is used to discover the thoughts of employees and executives regarding the proposed project. Developers can clear up misunderstandings during interviews and use the information from the interviewees to gather a large amount of information regarding possible requirements. However, this information can be contradictory and difficult to analyse (Paetsch et al, 2003).

2. Observation helps developers to put the employee's requirements into context and can help to fully explain work processes that may have been described in interviews in an idealised or oversimplified manner (Paetsch et al, 2003).

3. Focus Groups are informal and involve employees with a variety of skills and backgrounds. These groups help to identify what employees want from the project and how they feel about it. There is often a difference between what employees say and what they do so focus groups should be used in conjunction with observation. Focus groups can help to develop a shared vision of the project (Paetsch et al, 2003).

It is best if the employees are involved throughout the project from planning to implementation. As the project is
developed it becomes better understood and so changes to the requirements might need to be made (Paetsch et al, 2003).

Involving employees at the beginning of the project also ensures that the project has the full impact desired. When implementing projects, paying attention to change management results in positive effects on productivity and job satisfaction. Inviting employees to be a part of the design, development, and implementation process improves their engagement with the project (Hornstein, 2008).

Lack of engagement can have a devastating effect on the success of a project. Successful implementation requires engagement by the entire organisation, otherwise the expected benefits won’t be fully achieved. Three main causes for lack of engagement are:

1. Employees don’t understand the benefits.
2. Employees are afraid to learn how to use the new technology.
3. The technology does not meet their requirements.

Change management is critical to ensuring the success of the project and should be a part of the project from the beginning. There should be representatives of employees from all levels of the business and they should have a significant role in making decisions in the project. All employees that will be affected by the new technology should be aware of why the new technology is being implemented, how it will affect them, and their role in it’s success. Communication with all employees is critical throughout the development process to ensure there is no resentment towards the change. The executives should be seen to be participating and encouraging the change and not just showing verbal commitment (Deloitte, 2011).

Lawson and Price (2003) suggest that four basic conditions must be met before employees will accept change.

1. Project must be described in a compelling way, as a story or vision, so that employees will see the reason for the change and agree with it.
2. Employees must see their executives and peers accepting the change.
3. Reinforcement of behaviours and procedures that are in line with the changes.
4. Training the employees so that they have the skills required to change.

Other suggestions are to involve employees so that they won’t worry about their job being lost during the change and to emphasise the benefits to them from the project and what is expected of them. Having a meeting as soon as the project is ready to implement can create excitement. Giving employees a chance to see the project implemented elsewhere first and give them experience in using the project before fully implementing it can encourage their engagement with the change. It is also important to provide employees with support and acknowledgement. By recognising and appreciating what they are doing. This reduces the amount of stress they feel from the change. Making sure that employees follow proper procedure is also recommended, as shortcuts could result in unintended results (Simmons, 2006).

It is recommended that executives work with employees who love new technology, and those who are frustrated with it, to implement training programmes, but not to rely on classroom training to change their behaviour. Executives should also encourage employees to be self-sufficient regarding their IT needs by allowing employees to manage their own passwords; on average, 30% of calls to technical support are regarding passwords. Ensuring that employees can configure their software to suit them best and providing incentives to encourage them to follow proper procedure can also be effective (Cramm, 2010).

Kotter (1996) developed an eight-step change management process:

1. Create urgency about the change: Kotter believed that at least 75% of the executives should be enthusiastic about the change for the project to be successful.
2. Create a guiding coalition: convince employees that change is necessary, identify the people that can lead change and work with them to encourage other employees to accept the change.
3. Develop a vision and strategy: summarise the change to help employees to understand why it is happening.
4. Communicate the change vision: aside from meeting with employees about the project, also talk about it often and emulate the desired attitude and behaviour.
5. Empower people to effect change: check for employees who are resistant to change and assist them in seeing that the change is necessary.
6. Generate short-term wins: success is a great motivator so it is more encouraging to create many short-term targets instead of one long-term goal.
7. Consolidate gains, produce more change: after each win, analyse what went well and what went badly and use this information to help the next short-term win be successful.
8. Sustain new approaches in the culture: for the change to be permanent, the changes must be a part of the core organisation and be reflected in the business culture (Hornstein, 2008; Kotter 2006).

Microsoft.com (2013) suggests a five-step plan to implement accessible technology:

1. Define strategy: identify reasons for implementing technology.
2. Identify requirements: develop a set of requirements for your organisation and evaluate the current technology being used.
3. Design, develop, and purchase technology: design and develop the technology based on the requirements from step 2.
4. Implement and train: part of implementing technology is increasing awareness of it among employees and training them on how to use it.
5. Maintain technology and continue learning: increase awareness of the overall vision for the technology throughout the organisation, support employees in their use of it, and evaluate where there are places for improvement.

In this technique, employees aren’t included until the end of the design and development process and only become involved at the start of its implementation (Microsoft, 2013). While this
method doesn't encourage the involvement of users during the requirements gathering phase, their involvement could be included without disrupting the rest of the process (Highsmith and Cockburn, 2001).

All of these procedures are rational and seem like common sense, which is what makes them so popular to executives. However, Aiken and Keller (2009) have found that they are less effective in practice due to their ignorance of the irrationality of human nature. Through research and working with companies implementing change, Aiken and Keller (2009) have developed nine insights into human nature that have decreased the success of the project when the above procedures were applied:

1. Different motivations: there are typically two types of change stories used to encourage change: 1.) Good to Great: regaining advantage due to intense competition, 2.) Turnaround: performing below standard and need to do better. Research shows that what the executive cares about, and usually bases at least 80% of his change story on, does not motivate about 80% of employees into adapting to change. A change story needs to include 5 types of impact: impact on society, impact on the customer, impact on the company, impact on the working team, and impact on 'me'. This approach has been used in a large US financial services company and lifted motivation from 35.4% to 57.1% in a month and the project achieved a 10% improvement in efficiency within the first year.

2. Let employees write their own story: employees are more committed to something when they have chosen it for themselves. This has been used in the company BP when they developed a leader-training programme. It took eighteen months to finish the design of the project due to this, but it is the highest rated programme of its kind at BP and the executives that have taken the course are consistently ranked higher than their peers who haven't (Brown and Eagar et al., 2005).

3. Provide both positives and negatives in the story: focusing on negatives encourages blame and resistance to change; focusing on positives can cause the story to have less impact. To encourage change some anxiety is useful, as employees are more willing to take risks if they think they can gain more.

4. Executives think they are already representing change: most executives don't think they need to change, as it's human nature to think highly of yourself. The best way to get around this idea is to use feedback techniques, such as Kevin Sharer, CEO of Amgen, who asked his top 75 employees what he should do differently and then openly shared his personal development and commitment with them (Keller, 2012).

5. Change leaders aren't a cure for resistance to change: the success of change leaders depends less on them and more on how receptive their audience is. As long as not too much emphasis is placed on change leaders, to the cost of other parts of change management, then change management will still be effective.

6. Money is too expensive to use for motivation: companies who have used financial incentives to encourage change have found that it doesn't increase motivation as much as they'd like. However, small, unexpected rewards have a large effect on employee satisfaction regarding change.

7. Process and outcome must be fair: if an employee believes that the change is unfair, such as it having a negative impact on customers, they will work against their own interests to fight the change out of a sense of fairness and justice.

8. Employees aren't just their behaviour: executives try to change employee behaviour to encourage change but this often results in neglecting employee's feelings and beliefs. It is an employee's feelings and beliefs that drive their behaviour, not the other way around, and so research into what your employees think should be done before trying to change how they work.

9. Good intentions aren't enough: people learn better through practice but often learning new skills is added to an employee's workload on top of their existing commitments. Training should be spread out over several sessions and with fieldwork given in-between sessions. These fieldwork assignments should link directly to the employee's job and require them to put their new skills and way of thinking into practice. These assignments should have quantifiable, outcome-based measures to indicate the employee's level of competence and these outcomes should be recognised and rewarded.

III. CONCLUSIONS

A lack of change management can cause projects to fail. A healthy relationship between employees, developers, and executives, and the involvement of all three groups from the start of the project, can greatly contribute to the success of the project. Communication establishes trust and aids in requirements gathering, regular meetings are helpful in maintaining this communication.

Gathering requirements is important to the design of the project and relies on a good relationship between employees and developers. Requirements can best be identified through talking to employees and observing them while they are working.

Involving employees during all stages of the project helps with refining requirements later. It also helps when it is time to implement the project if they have been involved throughout. Lack of support from employees regarding the changes implemented can severely impact the success of the project. The main reasons that employees aren't engaged with the project can be traced back to their lack of involvement during its design and implementation.

Many of the change management and project management models are rational and act as more of a guideline for common sense. However, human nature isn't rational and recent research has provided some suggestions on how to improve these models. All of these improvements involve listening to and involving employees from the start of the project and letting them lead the change.
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Dyslexia Support and Training within SME’s

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Abstract—The education sector from school to university provides thorough comprehensive support for dyslexic students. When students leave full time education and start work, from others research, only a few companies address the dyslexia issue within the workplace and provide support to dyslexic individuals using best working practices. This article will focus on the possible strategies that could be beneficial for small and medium businesses to help staff create an environment which is more productive and stress free for dyslexic employees. Computer aided software may be a possible strategy to help dyslexic employees in the work environment; there are extensive software applications used for educational purposes which could perhaps be applied to the work environment.

Index Terms—Dyslexia, employee training, discrimination, assistive software, SME, support.

I. INTRODUCTION

During the past several decades dyslexia has become a recognised disability in education; the SEND Act (2001) requires educational institutions to provide support and help to meet a student’s individual needs. However, many dyslexic students find difficulties accessing support in the workplace. In all organisations, disabilities such as dyslexia should be addressed and if ignored can lead to legal proceedings under the Disability Discrimination act. More importantly this applies to small and medium enterprises (SMEs) because it necessary to maintain a successful and proactive workforce, as this is vital to the growth and survival of any competitive SME. Dyslexia is difficult to define because of the broad spectrum of characteristics of the disability; each individual will experience different characteristics. Dyslexia comes under the umbrella term of specific learning disabilities; the most common specific learning disabilities that are known are dyspraxia, dyscalculia, attention deficit disorder (ADD) and, of course, Dyslexia.

A. Definitions of Dyslexia

However, the British Dyslexia Association (BDA) in 2007 approved this definition: “Dyslexia is a specific learning difficulty that mainly affects the development of literacy and language related skills... It is characterised by difficulties with phonological processing, rapid naming, working memory, processing speed, and the automatic development of skills that may not match up to an individual’s other cognitive abilities. It tends to be resistant to conventional teaching methods.” British Dyslexia Association (2006). About 10-15% of the population are affected by dyslexia; depending on each person, individuals are affected at different levels from mild to significant learning parameters. Dyslexics are generally known to have traits that make them experience difficulties in reading, writing and verbal communication. This is due to the processing of information and other such difficulties such as a lack of concentration, short-term memory and organisation skills, which inevitably impact on academic learning tasks. However, dyslexia does not actually affect the intellectual ability of the individual; these individuals can be very intelligent and there are numerous examples of highly creative, intelligent people like Richard Branson and Albert Einstein. The key to successful learning for dyslexics is to adopt a multi-sensory approach teaching to both in schools and the workplace to enable the dyslexic student to learn effectively. However, often the workplace does not provide this type of support: “Unfortunately, we have been very slow to understand what changes must occur in the process of instruction if the person is to learn” The International Dyslexia Association. (1998).

II. DISCRIMINATION

The Disability Discrimination Act (DDA) is aimed at reducing discrimination towards those with any kind of disability and largely helps those with more physical or mental impairment; therefore to provide equal opportunity. “The DDA points out the need to review procedures relating to Recruitment, Work Conditions, Promotion and Dismissal to ensure that discrimination are not taking place.” Jameson, and Moody (2002). Part of the Disability Act 1995 stipulates that the employer has a duty to make adjustments for their employees in either “acquiring or modifying equipment and or modifying instructions or reference manuals” Legislation.gov.uk. (n.d.). There is also the Special Educational Needs and Disability Act 2001 which all educational institutes have to comply to.

A. Reasonable Adjustment

Reasonable adjustments should be strongly considered if not enforced in organisations, as failure to do so would be a breach of the Equality Act and the DDA. An example of the DDA would refer “to a situation in which the coping strategies of an employee with dyslexia may be suspended
by undue stress and such a situation is regarded as discrimination” Jameson and Moody (2002). This would be damaging towards the company and potentially a loss of a productive employee. “It is important to open our minds to this difference to better understand dyslexia” Canadian Dyslexia Association (2002), as it should be any organisation prerogative to improve the efficiency and diversity of their work force and help stimulate those with creative minds. “Often small, low-cost modifications are all that will be needed” University Of Southampton. (1996) in a business to improve on this and would be recommended by any dyslexia organisation as British Dyslexia Association (2012) stated that “dyslexic employees can be particularly prone to stress and this will exacerbate dyslexic difficulties. Where well supported, these difficulties will be less prominent.”

III. TACKLING DYSLEXIA IN THE WORKPLACE

There are many steps an employer can take to tackle dyslexia in the workplace, some are simple and easy to implement and others may require some minor training to provide affective techniques of deploying instructions and help. These techniques can help “particularly with regards to an employee’s performance and their ability to maintain high levels of accuracy, neatness, their ability to plan their work correctly and achieve the goals set out for them” PHC Occupational Health (n.d.). Providing such necessary steps can help reinforce the positive effects that come with dyslexia, as they are often incredibly artistic and creative.

A. Verbal Communication

Providing effective verbal communication is an asset to any company in providing clear and concise instructions with any employee, with or without dyslexia. Dyslexics however, depending on the severity of the inherent ability, find it hard to understand first hand, a given instruction or task. It is important that tasks are explained in broken down steps, giving the dyslexic employee time to digest and understand. You should always “take the time to explain things properly and repeat if necessary” Dyslexia Assessment and Consultancy (2013) as well as offering discreet guidance and support without appearing doubting of their abilities. Often dyslexics discourage themselves from seeking help and so this should be addressed.

B. Visual Communication

Visual aids are very useful for dyslexic’s as they are visual and creative learners, show them and they will understand as “visual learners remember best what they see, pictures, diagrams, flow charts, time lines, films, and demonstrations” Felder, M.R. and Solomon, A.B (n.d.). Providing imagery and diagrams with written instructions or presentation slides will help provide a clear understanding of what needs to be achieved; as dyslexics are visual thinkers and using images to link with words will help make things memorable. Using body language is also important in many aspects of explaining tasks and also being sensitive towards a dyslexic, as Dyslexia the Gift (1996) says they “can develop remarkable visual and intuitive abilities, including reading body language and facial expressions.” It is essential that managerial roles can effectively communicate while being aware of their mannerisms and how this might affect the person in question. Also when standing in front of a room full of employees that everyone has a clear view of the presenter, clearly seeing body language and facial expressions.

C. Environment

The environment is another important infrastructure to uphold as distractions can interrupt a dyslexics mind flow, as it can take longer for a dyslexic individual to get into a concentrated workflow. A lot of third party research dictates that in education “The classroom is as quiet as possible to avoid noise disturbance” British Dyslexia Association (1996) which in any case should not differ from a workplace environment. So if at all possible, provide a discrete workplace that is quiet and far away from disturbance as possible or provide and allow earplugs or earphones. Also providing spacious work areas with non-stressful lighting as some people can suffer from visual stress as “particularly fluorescent lighting” Dyslexia Assessment and Consultancy (2013) can be stressful and so natural lighting would be the most appropriate.

D. Reading and Writing: Styles and Formats

Reading and writing is one of most common characteristics amongst dyslexics and written material, whether its manuals describing job instructions or in meetings where presentations are being undertaken; the way in which information is being presented to employees is essential. This can cause visual stress and inhibit the processing of information as dyslexics “have particular difficulty absorbing written information which shows the following features: small print, poor spacing, a confusing mixture of fonts and styles and reproduced on bright white paper” Jameson and Moody (2002). The most common factors to remember are, keep away from black text on white paper and to use dark texts on light colourful paper. Use short and simple sentences with clear, evenly space sans serif fonts like Courier New font. Remember that the use of excessive text can be overwhelming and so the need to keeping it concise and using flow charts and diagrams would be most beneficial.

IV. EMPLOYEE TRAINING

Staff training is essential with any small to medium sized enterprises (SME’s) as it provides new employees the skills to manage the particular tasks that companies require them to do. Often individuals come with a unique set of skills acquired from related degrees or work experience. It would also be believed that prospective employees coming fresh out of university or have attended a degree in the recent past would be equipped with ideas
and techniques of how to work around and tackle their dyslexia; so in this sense training would only be require for management level of how to approach those with specific learning disabilities such as dyslexia. "By establishing effective training and development practices... crucial for survival and/or growth and, secondly, be at the forefront of top management’s policies" O'Regan, Strainer and Sims (2010). It is clear that training is needed on every level, providing employers with effective techniques that will help stimulate dyslexics in the workplace to enable them to achieve at their highest level but also to offer training to employees that might struggle with handling and organising information and tasks. It should be considered that businesses should be looking to constantly improvement their employee’s ability and help stimulate those discouraged by their learning disability.

V. AVAILABLE SUPPORT

The amount of information on the Internet alone provides enough help for the most basic needs of dyslexia support. It is therefore taking and most importantly it is free and so any business should take advantage of it. A list of informative websites are itemised below, which provide material on understanding dyslexia better and how it can be talked in the workplace.

A. Dyslexia Associations

- The International Dyslexia Association: 
  http://www.interdys.org/FactSheets.htm
- British Dyslexia Association: 
- The Dyslexia Association: 
  http://www.dyslexia.uk.net/infoemployer.html

B. Discrimination Awareness

- What is discrimination? A failure to make reasonable adjustments: 

VI. ASSISTIVE APPLICATION SOFTWARE

For dyslexics time is everything, and depending on the individual, computers can often be a useful form of understanding and constructing information because it allows them to create notes quickly (if they are computer literate) that are neat and readable. It is however that sitting down in a meeting where concise and informative instructions are given, that making notes and being clear on the given instructions can be difficult. As mentioned earlier that working memory and processing speed can be a main inhibitor of this but “its effect can be mitigated by appropriately specific intervention, including the application of information technology” British Dyslexia Association (2006). All dyslexics differ in the way they process information and so not everyone is computer literate and so “the continuous development of employee potential is dependent on training at every level to acquire improved skills” O’Regan, Strainer and Sims (2010). Whether this was to improve computer skills to make notes affectively, which are clear concise or to provide assistive software to improve skills with reading and writing. There are numerous assistive software and technology that are beneficial for those in the workplace. A short list is compiled bellow of useful software and hardware that would be worth providing for the dyslexic members of staff.

A. Software

- Voice recognition software (Dragon Speech Recognition) helps those who find it difficult writing down notes on paper or who are not computer literate and can’t type very quickly, by enabling them to speak into a microphone. Possibly an alternative to providing training in the use of touch
- Assistive literacy/Text reading software (NaturalReader and Read&Write) reads aloud texts from any form of word document or Internet page. Very useful for those who are slow at reading and also provides a means of proof reading software. It also provides support bank on spelling and writing with definitions and prediction tools, which would help efficiency and improve one’s literacy skills.
- Mind mapping software (Mindgenius) is a fantastic piece of software that’s colourful and imaginative, providing dyslexics a way of organising their ideas and planning tasks out in stages. Not only useful for dyslexics but for management too.

B. Hardware

- Portable computers (Laptops/Tablets/Netbooks) are the most useful forms of carrying around documents and having software listed above ready at hand. Often the best means of reading and editing information as texts and fronts can be changed and the colour of the screen can be changed for easy reading.
- Audio recording (Dictaphones/Mobiles) are most useful when receiving instructions or in a meeting where dyslexics find it difficult or if not impossible to take notes while trying to understand what is being said. Sometimes it takes several attempts to understand what has been said and this would save time, enabling the individual to formulate constructive questions about the required task, when it has been better understood.

VII. CONCLUSION

Complying with individual needs of every employee within a company is not an easy task but a task that must be done in any case. Whether there are staff members who are dyslexic or not, appropriate accommodations should be made to facilitate the efficiency of an ever growing work force and taking measures to simulate and support
their ability to achieve more. It is however those dyslexic individuals need extra support and guidance to help them work to their full potential and it isn’t without great rewards in doing so, as dyslexics are very creative, thinking outside the box and can be a valid asset to a business. Although training can be a costly expense, especially towards SMEs that have a limited budget, the training and support that is available to SMEs is extensive and a lot of it is free knowledge. So creating awareness and encouraging managerial positions to independently inform themselves of such free information could be a crucial step towards providing a better supportive system within SMEs for dyslexics.

REFERENCES


Effects of Server Side Languages upon Project Delivery within SMEs

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Abstract— This paper explores the effect of server side language choice upon project delivery within SME web development agencies, and challenges the reader's preconceptions regarding established technologies and their advantages in relation to functionally equivalent alternatives.

Index Terms— Server Side Language, Small Medium Enterprise, PHP, ASP.NET, JAVA, Project delivery

I. INTRODUCTION

Fighting for survival within an increasingly competitive sector of the Information Technology industry, SME (Small Medium Enterprise) web development agencies are faced with ever increasing external pressure to deliver projects both on time, and to budget. Despite these constraints, SMEs within this sector continue to thrive despite this highly competitive, rapidly evolving market.

Research from the Standish Group's CHAOS report reveals 23% of all ICT projects fail, either through cancellation, exceeding budget or failing to deliver to deadlines (The Standish Group, 2009). Specific to SME, Mieritz's 2012 Gartner survey regarding project success discovered these issues are not isolated to large enterprise, finding 20% of small projects failed. This paper aims to explore factors affecting project delivery specific to SME web development agencies, placing emphasis upon how the choice of server side programming language impacts project delivery.

II. SERVER SIDE LANGUAGES WITHIN INDUSTRY

<table>
<thead>
<tr>
<th>Language</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHP</td>
<td>79.9%</td>
</tr>
<tr>
<td>ASP.NET</td>
<td>20.0%</td>
</tr>
<tr>
<td>Java</td>
<td>4.1%</td>
</tr>
<tr>
<td>ColdFusion</td>
<td>1.1%</td>
</tr>
<tr>
<td>Perl</td>
<td>0.8%</td>
</tr>
<tr>
<td>Ruby</td>
<td>0.5%</td>
</tr>
<tr>
<td>Python</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

Fig. 1. W3Tech Server Side Language Stats(W3Techs, 2013)

Figure 1 shows the most popular server side languages within the web development industry. Despite increasing project diversity, and growing numbers of domain specific languages, industry focuses upon a few popular choices leaving many highly respected and functionality rich languages such as Ruby or Python with less than a percentage share of the overall market.

III. PROPOSED FRAMEWORK FOR CHOOSING SERVER SIDE LANGUAGES

With a fundamental understanding of both the practical, theoretical and empirical constitution of an SME established, discussion focuses on the definition of an academically sourced framework designed to provide SMEs with a qualitative measure of a language's effect upon project development and delivery. Identified by Bener and co-authors, when selecting components for implementation within IT projects, SME must focus technological capabilities toward flexibility, client orientation and cost effectiveness (Bener, et al, 2009). Jong-Ku et al (2012) assert that regardless of industrial sector, development resource such as project budget and development time constitute the primary influence upon project management decisions, including the choice of system components. Jong-Ku's observations may be extrapolated, and subsequently applied to the context of server side languages. Whilst Jong-Ku asserts development resource as the single factor governing an SME's decision when choosing project components, he acknowledges the practical implications of other factors. In choosing a server side language therefore, this paper asserts the following criteria for SMEs choosing a server side language.

a) Development Community
b) Tools and Frameworks
c) Accessibility
d) Security

IV. FACTORS AFFECTING PROJECT DELIVERY

A. Development Time

As identified within Jong-Ku's research, a project's development time represents a key part of a company's holistic view of project management. Within the context of web development agencies, effectively measuring a language's suitability has many practical implications including community support and accessibility. Highlighting the importance of time management within smaller IT projects, Mieritz's 2012 Gartner survey identifies failure to meet project...
I. INTRODUCTION

This paper explores the impact of open source technologies on development projects, with a focus on Server Side Languages (SSLs) and their role in the success of Small and Medium Enterprises (SMEs). The study is based on an analysis of open development questions on Stackoverflow.com, a leading platform for software development questions and answers. The data collected is used to compare the popularity of PHP and ASP.NET, two prominent SSLs, and to assess their suitability for SME development projects.

II. SERVER SIDE LANGUAGES (SSLs)

A. PHP

PHP, short for PHP: Hypertext Preprocessor, is a server-side scripting language that is widely used for web development. It is open source and has a large community of developers. Despite its comparatively inexpensive setup costs, PHP has been adopted by many SMEs due to its flexibility and ease of use. This has led to a proliferation of tools and frameworks, contributing to PHP's continued popularity in the development community.

B. ASP.NET

ASP.NET is a server-side web application framework developed by Microsoft. It is part of the .NET framework and is designed to provide a comprehensive set of tools for building web applications. Unlike PHP, ASP.NET requires a server running IIS (Internet Information Service) and its usage is typically associated with larger companies. Despite this, SMEs have been able to use ASP.NET by leveraging community-driven support packages and free alternatives to subscription-based ASP.NET solutions.

III. IMPACT OF SERVER SIDE LANGUAGES ON PROJECT DELIVERY

A. Development Community

Since PHP's 1995 inception into the public domain, its popularity has become self-perpetuating, with subsequent releases adding both additional functionality and expanding upon its rapidly developing international following (PHP.net, 2013). This prolonged popularity has resulted in a phenomenon referred to as information cascade, causing a wealth of free, accessible development resource and support. This provided PHP developers with a free alternative to the often subscription based support packages offered by enterprise level ASP.NET solutions. The availability of free community driven support, whilst a potentially unreliable source for large multinational companies, has suited SMEs perfectly, providing impersonal access to tutorials, example code and support which would otherwise require additional expenditure, or consume extra development time. Illustrative of this point is the level of activity on the popular software development site Stackoverflow. Presenting a comparative example, Figure 2 shows the number of currently open development questions within the ASP.NET and PHP categories, illustrating the scale to which activity within the PHP development community dwarfs its ASP.NET counterpart.

![Fig. 2. Statistics representative of activity with PHP and ASP.NET communities on Stackoverflow.com on the 4th April 2013 (Stackoverflow, 2013)](image)

B. Tools and Frameworks

Beyond technological support provided by an extensive development community, an additional consequence of PHP's prolonged popularity is a proliferation of tools and frameworks freely available for developers. Contributing to PHP's potential for rapid application development, are a wide range of IDEs (Integrated Development Environments) (Muhammad, 2012) and application frameworks, designed to provide abstraction for commonly performed functional and procedural tasks (Chan, 2012).

Despite the often misquoted assumption that ASP.NET development restricts the developer to Visual Studio, many alternative IDE technologies are, in fact, available (Secqinstien, 2011). Java developers have an equally extensive range of choices, including established tools such as Eclipse and Netbeans.

The emergence of CMSs (Content Management Systems) such as Wordpress and Joomla has provided SMEs with a highly flexible and immensely customizable functional boilerplate from which a diverse range of projects can be completed. This observation is supported by Parikh and co-author's comparison of popular open source CMSs, citing their intrinsic worth as being found in an ability to automate common functionality, saving development time that would have been spent re-implementing existing functionality (Parikh et al., 2011). Although PHP driven CMSs such as Wordpress are undoubtedly the most popular today, both Pozder (Pozder, 2012) and Vikas (Vikas, 2012) identify a wide range of CMSs built upon ASP.NET and Java respectively.

<table>
<thead>
<tr>
<th>Server Side Language</th>
<th>Open Development Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHP</td>
<td>368,935</td>
</tr>
<tr>
<td>ASP.NET</td>
<td>164,168</td>
</tr>
</tbody>
</table>

![Table: Comparison of open development questions on Stackoverflow.com between PHP and ASP.NET](image)
Evidence regarding the availability of IDE and CMSs undermines the credibility of choosing languages specifically because of the tools and frameworks available to each. This statement should be understood within a generic context, recognizing that specialist tools exist within niche domains facilitating domain specific tasks.

Despite PHP's reputation as the most established, community driven language within the sphere of web development, exploration into development tools and frameworks suggests less of a disparity than commonly cited. Within niche domains however, CMSs and application frameworks enjoy greater levels of support within specific languages, with tools and technologies created to facilitate both language and domain specific task.

C. Accessibility

In his 2008 technical evaluation of PHP, Cholakov identifies a comparative simplicity and gentle learning curve as contributing factors towards PHP's sustained popularity (Cholakov, 2008). Due to language structure, when directly compared with Java or ASP.NET, numerous fundamental language design factors can be identified as contributing towards this accessibility. Java, for example, requires a greater peripheral knowledge of associated libraries and functionality to take full advantage of its expressive power. Additionally, being an interpreted language, PHP removes the often daunting barrier to entry of code compilation, allowing new developers to get basic programs installed and functional in fewer, less complex steps. McElwee provides a practical demonstration of differing levels of accessibility, comparing the syntactic terseness of popular web technologies. McElwee illustrates his assertion through a comparison of simple computations, observing the fundamental suitability of PHP's functional abstraction to functionality common within web development (McElwee, 2010).

D. Security

In her 2011 exploration into security challenges facing SMEs, Kelly identifies information security and compliance with best practice standards as often neglected aspects within SME policy. Kelly asserts this neglect of security can often be traced to the intrinsic resource disparity found between large enterprise and SMEs (Kelly, 2011). Specific to the context of server side languages, Leung affirms Kelly’s observations regarding information security challenges within SMEs. Within his 2012 paper examining the primary security threats facing SME, systems and applications are identified as commonly exploited vulnerabilities (Leung, 2012).

Having established the importance of open source language specific tools and frameworks to SMEs, discussion regarding the security implications of utilizing such technologies is important. Ihantola and co-author's 2012 assessment of security vulnerabilities within Wordpress plug-ins exposes numerous security issues prevalent within open source, community driven application development (Ihantola, 2012). The requirement for 3rd party plug-in or component development arises from the inherent differences in the theoretical underlying principles behind each CMS. Wordpress, for example, focuses functionality around the popular medium of the blog, providing less functionality in an attempt to maintain simplicity (Wordpress, 2013). In contrast, Joomla is designed to offer a larger range of functionality, optimized to handle greater quantities of data, at the expense of ease of use (Open Source Matters, 2013). In a well intentioned effort to provide missing functionality for certain CMSs, the creation and implementation of free, open source 3rd party plug-ins provides a contextual illustration of one of PHP's drawbacks as examined by Cholakov. Such open development marketplaces afford little accountability or jurisdiction over how code is written, introducing an array of potential security concerns. Identifying the issue's scale within the Wordpress development community, Ihantola and co-authors in their work upon quality and coding standards within 3rd party plug-ins, cite numerous security vulnerabilities prevalent within existing, highly respected and well used plug-ins, ranging from XSS (Cross Site Scripting) to SQL (Structured Query Language) injection.

Security is not an issue isolated to PHP development; other languages are not immune to security issues. Both ASP.NET and Java have gained a reputation for insecurity through incidences such as the 2001 Nimda worm (F-Secure, 2013), and the more recent spate of Java vulnerabilities (Constantin, 2013). Server side languages such as ASP.NET and Java do not have the community support which PHP boasts, resulting in reduced availability of 3rd party components. As a direct consequence, an increasing percentage of code is written in-house, affording greater control over coding standards, allowing SMEs to be aware of security threats and risks resulting in higher levels of security than their PHP counterparts.

VI. CONCLUSION

Research demonstrates that, despite many of its disadvantages, PHP has maintained its popularity thanks to its comparatively inexpensive implementation costs, development efficiency and functional flexibility. Specific to SME's within web development, PHP remains the de facto choice for project implementation as it best provides companies with the fundamental components and tools to create their primary product, web applications.

Despite this paper's assertion that PHP remains the most applicable choice for SME web development projects, managers should not simply assume PHP to be their only option when planning their next project. Industry should remain open minded, choosing technologies for their suitability to a project's functional requirements instead of relying solely upon prior experiential or theoretical knowledge.
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Web Applications vs. Native Mobile Applications
Benefits and Weaknesses for UK SMEs

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Abstract—This paper examines the benefits and drawbacks to UK SMEs that plan to commission either a native mobile application or a web application. We consider SMEs that are hoping to build stores or portals to sell products or services via their applications. Existing applications that have been released by UK SMEs are considered, in order to provide an accurate picture of the current mobile application landscape. Technological advances that have been made over the past five years in each field are considered. The paper concludes that for the majority of SMEs seeking to build their first application that the advantages of web applications now outweigh the benefits of native applications. However, in rare circumstances — powerful brands or applications that require special hardware features – native applications could still prove to be a lucrative offering.

Index Terms—mobile application, web application, JavaScript, responsive design, Android, iOS.

I. INTRODUCTION

In 2012 smartphone ownership in the UK rose to 39% of adults, up from 27% at the same point in 2011 (Ofcom, 2012). Tablet ownership rose to 11% of UK households. This shift in consumer habits means many UK businesses are now developing technology to specifically target mobile devices (Sage Pay, 2013). An SME in the UK can commission technology in one of two forms – native mobile applications or web applications – both described below (Charland and Leroux, 2011).

A. Mobile Applications

Mobile applications are pieces of software designed to run on smartphones or tablets. To use a mobile application the smartphone owner must download it from an application store that is compatible with their mobile device. Once installed, mobile applications will replicate the “native look and feel” of that device by using the same controls as the applications that come standard with the device (Charland and Leroux, 2011).

B. Web Applications

Web applications are applications that are accessed over a network and run in a web browser. Unlike traditional websites made up of individual pages, web applications use client-side scripting languages, such as JavaScript, to contact the server and dynamically update the web page. This prevents the web page refreshing and creates an experience much more similar to traditional software applications such as Microsoft Office (Hales, 2012). Using these techniques, known as Ajax, developers can build complex software to run in the browser such as the Google Docs productivity suite (Viega, 2009).

C. Current UK SME Situation

Sage, Europe’s largest independent payment service provider, surveyed 1447 SMEs in the UK in January 2013. This is the largest survey of SMEs regarding mobile commerce in the UK. 48% of respondents intend to develop a mobile application within the next year (Sage Pay, 2013). As mobile applications typically cost businesses more money to build than web applications, yet result in similar levels of sales, is a mobile application the right choice for UK SMEs?

This paper intends to examine the advantages and disadvantages of both mobile applications and web applications for businesses and consumers in the context of mobile commerce for UK SMEs. This paper will also present relevant examples of both web and native mobile applications that have been released by UK SMEs, in order to present an example of the current state of play in the UK.

II. THE FRAGMENTED MOBILE OPERATING SYSTEM LANDSCAPE

Native mobile applications are written to work on one platform. An application created for iOS, the mobile operating system that powers Apple’s iPhone and iPad devices, is unable to run on Google’s Android platform. These are the two dominant mobile platforms in the UK, accounting for approximately 85% of mobile operating systems in use (Kantar World Panel, 2013). Table 1 shows a breakdown of the UK smartphone market.

<table>
<thead>
<tr>
<th>Platform</th>
<th>UK Market Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>iOS</td>
<td>29%</td>
</tr>
<tr>
<td>Android</td>
<td>58.3%</td>
</tr>
<tr>
<td>Blackberry</td>
<td>5.1%</td>
</tr>
<tr>
<td>Symbian</td>
<td>0.6%</td>
</tr>
<tr>
<td>Windows Phone</td>
<td>6.7%</td>
</tr>
<tr>
<td>Bada</td>
<td>0.3%</td>
</tr>
<tr>
<td>Other</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

This means a business needs to choose if it will develop an application for either one operating system, which will prevent the majority of users from accessing the store, or if they will pay twice to build and maintain two mobile applications.
Building a mobile application for both iOS and Android won’t allow all of an SME’s customers to access the store – as 15% of the smartphone market belongs to other, smaller platforms (Kantar World Panel, 2013). It will be difficult for an SME to justify funding two mobile applications, which won’t reach all of a business’ potential customers.

The main reason for having to build two separate mobile applications is primarily due to the technology used to write web applications. iOS and Android both use different languages (Java and Objective-C respectively) and have different build processes (Charland and Leroux, 2011). It is common for developers to specialise in building applications for one platform and SMEs could run the risk of buying lower quality applications by hiring a “jack-of-all-trades” developer. Table 2 shows the different skills required to write applications for each mobile operating system.

### TABLE II. SKILLS REQUIRED TO WRITE APPLICATIONS FOR MOBILE DEVICE OPERATING SYSTEMS (CHARLAND ANDLEROUX, 2011)

<table>
<thead>
<tr>
<th>Mobile OS Type</th>
<th>Skill Set Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple iOS</td>
<td>C, Objective-C</td>
</tr>
<tr>
<td>Google Android</td>
<td>Java (Harmony flavoured, Dalvik VM)</td>
</tr>
<tr>
<td>RIM BlackBerry</td>
<td>Java (J2ME flavoured)</td>
</tr>
<tr>
<td>Symbian</td>
<td>C, C++, Python, HTML/CSS/JS</td>
</tr>
<tr>
<td>Windows Mobile</td>
<td>.NET</td>
</tr>
<tr>
<td>Windows 7 Phone</td>
<td>.NET</td>
</tr>
<tr>
<td>HP Palm webOS</td>
<td>HTML/CSS/JS</td>
</tr>
<tr>
<td>MeeGo</td>
<td>C, C++, HTML/CSS/JS</td>
</tr>
<tr>
<td>Samung bada</td>
<td>C++</td>
</tr>
</tbody>
</table>

The division between iOS and Android is not the only split in the mobile operating system market. Android itself is fragmented in to a number of different versions. For example, the Google Play Store doesn’t serve the Amazon Kindle tablet. Developers need to submit their application to the Kindle Store, which has a separate set of submission guidelines again (Amazon.com, Inc., 2013). Businesses may also look to the rising sales of Windows Phone mobile devices and see another platform they need to develop for (O’Connor, 2012). We have established that UK SMEs face a huge problem when faced with commissioning native mobile applications – market fragmentation. Businesses risk locking out potential customers because of the closed nature of app stores. Maintenance costs are also increased.

### III. THE NATIVE MOBILE APPLICATION ADVANTAGE

Businesses will view the fragmented mobile operating system and app store problem as a huge disadvantage when deciding whether to build a native or web application. Advantages do exist for native applications – for the right business.

**A. User Experience – Look and Feel**

The user experience is important in mobile commerce. Businesses with easier to use applications have higher conversion rates (Sage Pay, 2013). Native mobile applications can very easily conform to the look-and-feel of the target platform. iOS and Android both have a different user interface as well as a number of features that work differently. Their respective users are familiar with the look and feel of their platform of choice. Clearly, by designing an application that conforms to the design guidelines of each platform, a user will already be familiar with how to use an application and be more likely to see a purchase through to the end.

The differences for the user between the major platforms are mainly apparent in the controls the operating system uses. These controls are usually user interface components, that is – buttons, sliders, drop down menus and more. These components not only look different but also often require different gestures to use (Mikkonen and Taivalsaari, 2011). Web applications don’t have this native user experience advantage. The standard APIs available for use in a web browser don’t allow developers to create an “iOS button” or an “Android button”.

**B. Direct Hardware Access**

Another huge advantage that native applications have over web applications is direct access to the hardware. The APIs provided by Apple, Google and Microsoft allow applications to access parts of the mobile hardware such as the camera. This functionality may be useful to some SMEs in the UK. However, for those organisations that are simply building a store portal, then it is unlikely that access to these hardware features would be useful.

DFS is a UK company that makes use of hardware access to provide a unique mobile offering. Customers can download the iOS application and use the built-in iPhone camera to see what a new sofa would look like in their own home (DFS, 2013). It’s interesting to note that this application suffers from the main problem that we discussed earlier for native applications – operating system fragmentation. An Android or Windows Phone version of the DFS app does not exist.

**C. Offline Access**

A final native application advantage is offline access. This is because the resources that make up the application are permanently stored on a smartphone when the user installs the app – or at least until it is uninstalled. Unfortunately, this benefit doesn’t exist for applications that need to be frequently updated with new products or prices.

### IV. THE HYBRID SOLUTION?

Products have been developed that aim to rectify the situation of having to build essentially the same application two, or more, times. PhoneGap is a framework that allows developers to build applications for both iOS and Android at the same time, using the same languages and tools used to build web applications, and then deploy them as native applications to the individual mobile app stores (Lunny, 2011).

Hybrid applications often have poorer performance compared to their native counterparts. This is in part because developers are unable to optimise them to work for each individual device.
V. WEB APPLICATIONS

A. Reach
Web applications have one major advantage over native mobile applications – reach. All smartphones come equipped with a web browser (Wang, Lin, Zhong, and Chishtie, 2011). This means that every smartphone operating system seen in Table 1 can be targeted at the same time – with one single application.

B. Limitations
Web applications require an Internet connection to function. This is so the content that makes up the application – text, images, style-sheets and client-side scripts are stored on the Internet and transferred to the mobile device each time the user requests access to the application (Wang, Lin, Zhong, and Chishtie, 2011). This is unlikely to provide a significant barrier to entry for UK consumers – only 0.9% of UK premises cannot receive a 3G signal (Ofcom, 2012). However, circumstances exist that could prevent some customers from accessing the web application. These include devices without a 3G subscription or those in tunnels such as the London Underground.

C. Responsive Design
Mobile devices come in a number of different sizes and screen resolutions. Users on different types of devices, such as smartphones and tablets, expect a different experience. Web applications can use a design methodology known as responsive design to cater for the huge number of screen types that exist.

Responsive websites automatically adapt to the type of device the customer is using to access the website (Lane, Barker, Lewis, and Moscovitz, 2012). This means optimising for touch screen devices by including features such as bigger buttons. Other enhancements could include using less, or smaller, images for mobile devices, so that they can load the page quicker on their typically slower connections and reduced processing power (Wang, Lin, Zhong, and Chishtie, 2011).

An additional advantage of responsive websites is that they can be used in conjunction with an existing website. Users on larger, desktop or notebook monitors will receive a version of the website tailored to their needs (larger screen, keyboard and mouse); while tablet users receive a different version and so on. This brings all the advantages of responsive websites to an organisations existing website. This can reduce the costs of commission an application – as one firm will produce an organisations main website and mobile web application at the same time (Sage Pay, 2013).

The Financial Times web application is optimised to work on both smartphone and tablet sized devices. Depending on whether the users accesses via an iPad or iPhone the navigation will be positioned differently to take account of the different screen sizes. It’s interesting to the FT web application replaces a native application that was previously available in the iOS App Store. A web application was built so that users could see updates immediately and more devices could be supported (The Financial Times Ltd., 2013).

D. Increasing Support for Native Features
As smartphone web browsers have adapted more web standards such as those in the HTML5 specification they have been able to perform functions that were originally reserved for native applications (Charland and Leroux, 2011). Web applications can now typically access geo-location sensors and accelerometers. These are the features that technology such as PhoneGap attempts to implement – but web applications don’t have access to all hardware features yet.

VI. MAINTENANCE
Businesses must remember that in many cases simply building and releasing an application is not the end of the story for mobile applications of either kind.

If the company wants their mobile store to update with new products and prices then it’s likely they’ll have a database running on the Internet which the mobile application polls for new information about products. Wherever this database is located – a dedicated server or in the Cloud – the business will need to pay a fee to operate it.

For native applications the business may need to update their application to include new features that are added in new phones or operating system versions. They could even be patching bugs – 38% of e-businesses have lost out to fraud in the 12 months to January 2013 (Sage Pay, 2013).

Unfortunately, with native applications users can turn down an update and continue to use the old version of an application. This means it’s a bad idea to “hard code” product details into the application and security bugs could continue to persist for a significant amount of time after a patch was released.

VII. CONCLUSION
It is important for companies to provide the best possible user experience to customers – as this leads to a higher conversion rate. Unique advantages and disadvantages exist in terms of the user experience for companies whether they build either a native or web application. For many it will depend on the exact features they require and the size of their current user base.

Shortly after the launch of the iPhone in 2007, it was clear at that time that native applications would offer a far superior user experience than a mobile website. However, significant progress has been made in the web application field to bring a much better user experience to mobile web browsers. These developments include the broad adoption and implementation of the HTML5 specification, significant fragmentation of the mobile operating system market and the use of responsive design.

It is clear that web applications can now provide an almost exact replica of native applications – and the main problem they suffer is also shared with native applications – discoverability. It is possible that now web applications have matched many of the abilities of native applications, they may even go one step further; and surpass those features. For many UK SMEs, the advantages of a responsively designed, web application will outweigh the ever-shrinking native application advantages.
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Have you considered IT solutions?

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Abstract—Information and communication technology have been playing an increasingly important role in business from the beginning, but now after changes brought to business with Year 2000 and current Internet age it is crucial to efficiently manage data and processes, to be ready to adjust to changing markets. This paper aims to provide introductory knowledge to the reader who has little or no knowledge of information systems that help manage the enterprise. Information systems, and their evolution, will be discussed in accordance to organisations of all size, outlining key points and issues to provide a simplified guidance on assessing the enterprise.

Index Terms—Enterprise resource planning, reengineering, alignment, strategy, SMEs.

I. INTRODUCTION

The field of information systems is very broad and lively, meaning that the area still needs to be fully researched no matter the amount of currently available guidelines. This article is aiming to introduce the key constituents for information systems implementation with consideration for small-medium enterprises, in order to provide the reader, who has no or little awareness of the subject, with knowledge base of the field. Discussions of historical events in the field, possible benefits, strategies, reengineering etc., are meant to familiarise with the most important issues and offer adequate understanding to be able ask yourself ‘have I really considered IT solutions?’.

II. TECHNICAL BACKGROUND

Let us start with basic definitions related to the topic. In 1990s a new buzz word ERP (Enterprise Resource Planning) emerged, the name given by Gartner (2013) was meant to describe specific type of information systems with integrated suite of tools and applications that promised to automate business processes in all functional areas. Information Systems (IS), Enterprise Systems (ES) or ERP systems at some level mean about the same – combination of hardware and software that is used by business to organise and run its operations, processes etc. However, as documented in the first chapter of the book by Rashid et al. (2002) ERP origins go back to 1960s when software engineers started creating programs for automating and controlling processes involved with manufacturing, which in 10 or so years evolved into Material Requirements Planning (MRP). Fast-forward another 10 years and by 1980s MRP incorporated more manufacturing processes, therefore term Manufacturing Resource Planning (MRP-II) emerged. It did not stop growing, attempting to encompass all operational processes from functional areas, thus setting the stage for a specific type of information systems now known as ERP. Another driving force for ERP was technology, upcoming Year 2000 (Y2K) bringing technical advancements and legacy systems limitations to quickly respond to changing markets as stated by Fahy (2001) in ERP and change management section.

Any company is required to manage and keep track of their products and services, processes and resources to help business run more smoothly. As Information Technology (IT) got more involved with everyday business processes – it can now be considered even as an entry requirement. In this paper let us make use of the term ERP system with clarification that, unlike previously mentioned IS or ES, ERP is not focused on one particular operation or functional area but attempts to integrate all of them. The idea behind ERP system is to integrate all information that relates to business, make use of single database and access everything through single interface.

III. BENEFITS

Many benefits can come from ERP system implementation, useful discussions and evaluations can be obtained from Fahy (2001) and similar literature with detailed guidance but it is still tricky to identify them because benefit realisation can only be achieved if everything was planned and implemented correctly and successfully. To simplify, let us consider integration as the most important benefit, which may also be outlined as the main characteristic of ERP that brings efficiency, simplicity and the other possible benefits. Integration is the ultimate goal of ERP, by having a unified system where all business information can be stored and accessed it should become simpler to manage the business and all processes/operations that are related to it, thus allowing speed up operations or remove obsolete employees etc. Organisations are using ERP systems to eliminate/replace old and diverse legacy systems because, for example, if a legacy system on manufacturing floor generates a spreadsheet that is to be used by financials – someone, either from manufacturing or financials, has to make that spreadsheet available in means of re-entering data in some other system or just physically forwarding it to the right person. But even in such scenarios there is room for failure, e.g., mistake while re-entering or delay in forwarding, in contrast, a unified system is meant to do all those things by itself, automating processes and eliminating tedious, error-prone tasks. Thus resulting in a
system where, coming back to previous example, relevant data from a spreadsheet in manufacturing will automatically and nearly instantaneously be available for financials.

This suggests another important feature of ERP – it acts as a tool for reengineering. Hammer (1993) wrote an article which got enterprises very interested in ERP, because after obliterating old processes and systems it was not clear what to substitute them with. ERP systems are based on best practices, thus providing organisations with the best chance to make the most of ERP implementation by adjusting/improving current business processes.

This section aimed to provide basic understanding of possible beneficial scenarios that may be expected from ERP pre/post-implementation. Even though benefits are realised or not, are out of the scope, but the introduction to the process of getting the best chance of successful implementation and benefit realisation is the focus of this article.

IV. STRATEGIC IMPACT

Business processes and operations need to be efficiently managed in any organization, but while large enterprises can allow themselves to invest quite significant amounts of money into systems to support strategic goals – Small Medium Enterprises (SMEs) are faced with difficulties. ERP software was designed to automate many basic company processes from all functional areas but essentially ERP systems evolved to support large enterprises. This causes a problem since most SMEs usually have rather distinct business processes as compared to large organisations, thus making it difficult for SMEs to adjust the software to fit their strategies. Publication from Zadeh et al. (2012) outlines some of the differences in ERP implementations to support previously stated ideas about consideration of ERP cost in large and small enterprises, as well as subjective ERP vendors that focus more on requirements posed by large enterprises and SMEs dependence on legacy systems. Also, IS strategy methods for SMEs seem to be under-developed and out-dated as stated in a publication by Levy and Powell (2000), as well as technology focused thus further highlighting legacy systems impact on SMEs when it is meant to be replaced by ERP system. But SMEs forms the biggest portion of economy and as researched by Levy and Powell (1998) the number and importance of SMEs increased since 1990s thus pushing software vendors to support and ease SMEs migration to ERP.

Since IT has become an integral part of almost any business, in addition to organisational strategy required for operating business, Information Systems (IS) strategy should also be present. Also, as Burn (1993) found out – even though it is widely accepted that organisational and IS strategies should be aligned, linked or even integrated, but little proof is found to support such realisations thus suggesting a possible reason for implementation failure.

However, information systems evolved quite a bit since the rise of “ERP” 20 years ago and different approaches exist to help achieve closer business and information systems alignment especially if done in sync with reengineering (more about in section VI).

A. Outsourcing.

First of all, an organisation can choose between on-premise and cloud-based systems (Software-as-a-Service (SaaS)) to find what may be more suited for their strategy. For example, if ERP system is needed but lack of premises or funds exist (as in many cases of SMEs) – cloud-based ERP fits right in. However, if enterprise is planning to be quite dependent on the system, use it for competitive advantage etc. – it should invest into on-premise solution to gather skills and experience during implementation that could be used in the future to further develop the system to fit the business.

B. Proprietary or Open-Source software.

Secondly, the choice can be made between proprietary and open-source products but licensing, support, initial costs etc. should be considered. For example, vendors of proprietary software may have higher costs but offer experience to support the software at all stages, while open-source software may be initially cheaper but lack support etc.

C. ERP Rollout.

Finally, having chosen products to support strategic goals, another step is to decide the ERP system implementation rollout approach. To help with that, Khanna and Arneja (2012) indicate possible methods like big bang or phased implementation, but the decision may depend on personal/organisational preferences, as well as be a response to reengineering.

It is visible that much has changed since the introduction of ERP to enterprises of all size, planning process is getting more complex but at the same time easier because there is a variety of ERP systems to choose from to support the enterprise business and IS strategies.

V. PLANNING AND IMPLEMENTATION

There are a number of checklists/guidelines out there focusing on different aspects of ERP implementation that help to decide whether it is time for your company to implement ERP etc., yet even with resources available to help prepare – according to statistics many projects fail overall, many endure cost and duration overruns or some expected benefits may not be realised (see Table 1).

TABLE III. ERP STATISTICS

<table>
<thead>
<tr>
<th>Failure</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost overruns</td>
<td>53%</td>
</tr>
<tr>
<td>Duration overruns</td>
<td>61%</td>
</tr>
<tr>
<td>Half, or less, benefit realisation</td>
<td>60%</td>
</tr>
</tbody>
</table>

To overcome the statistically forecasted failures, let us familiarise with them in the first place. ERP systems are very fragile during planning and implementation stages, meaning that any miscalculation or variable forgotten to be accounted
may result in a disaster. This should give a clue how important the planning stage is. And even if the system survives and gets implemented, it is very plausible to face one of the following common pitfalls revealed in article by Krigsman (2013).

D. Cost overruns.

Off-the-shelf ERP software may cost significantly even without any customisations but over half of ERP implementation projects eventually cost more than expected, which can be devastating news for tightly planned SME budget.

E. Duration overruns.

Almost two thirds of ERP systems take extra time to get them up and running. Thus further highlighting the importance of planning no matter what type of ERP rollout (big bang, phased, hybrid etc.) is chosen.

F. Receiving 50% or less expected benefits.

This can be considered as the biggest risk; after all the time and money invested it may be devastating to find out that little benefit has been achieved.

The best chance to avoid aforementioned pitfalls is to do everything right the first time, meaning planning stage must be as extensive as possible but implementation should take place in controlled steps each with achievable yet meaningful target. This section attempted to explain what negative aspects to expect from implementing the ERP system, choosing ERP product to fit the strategy may be one the easier tasks as compared to the whole lot of planning that is required to prepare the organisation for the big shift.

VI. REENGINEERING AND ALIGNMENT

The final section of this article will attempt to explain and generalise previously discussed aspects of ERP system to provide introduction for ‘going ERP’ but it is out of the scope to provide guidance on how to reengineer and align the enterprise since many extensive guidelines/how-to’s are already available.. Having discussed different ERP aspects to build a basic understanding of the subject, it is now time to focus on the most important issues that were uncovered – business and IT alignment and Business Process Reengineering (BPR), as it seems that no matter how much time or money is spent on ERP implementation the key success factor is planning. The reason why BPR and alignment issues are discussed together is that they share common feature, i.e., both attempt to maximise efficiency through review of existing enterprise processes.

Business Process Reengineering (BPR) or just reengineering perhaps should be viewed as initial stage of ERP implementation planning and was first defined by Hammer and Champy (1993) as reconsideration and thorough remodelling of business processes that is meant to provide the enterprise with dramatic improvements in performance. This and other BPR definitions have been synthesised by Barothy et al. (1995) resulting in four key concepts BPR relates to (change task, performance improvements, business process and information technology). Thus helping better understand reengineering process with a new definition as ‘a complex, top-down driven and planned organisational change task aiming to achieve radical performance improvements in one or several cross-functional, inter- or intra-organisational business processes whereby IT is deployed to enable the new business process(es)’. Reengineering is not meant to fix anything in particular, but rather fix the enterprise by starting over, activities involve review of current business processes, for example to identify key processes that are vital to organisation and will be implemented firstly during phased ERP rollout etc.

Business and IT alignment address issues related to information systems and business strategies because as outlined earlier – the two strategies have to be at least linked together if enterprise wishes to compete for a place in the market. Definition by Macehiter and Ward-Duton (2005) suggests that IT-business alignment process is about balancing investments made in IT to reflect and support business priorities, thus clarifying the need for alignment and perhaps suggesting it should be done in sync with BPR for maximum benefit realisation. Yet another reason for business and IT alignment is the benefit increase in terms of cost, process standardisation etc., but again many researches are available to extensively introduce with possible benefits.

VII. CONCLUSIONS

Discussions in each section can and should be used for considerations during initial ERP planning stages, but it is important to point out that every aspect should be researched further and in depth as wide range of supplementary texts exists. To summarise, the article discussed a few key aspects of ERP systems implementation including benefits and strategies, planning and implementation, business process reengineering and alignment. Aforementioned components are to be expected if enterprise decides to go ERP, this article attempted to introduce the reader to the variety of choices and decisions that form and affect ERP project.

The importance of planning is the key message to be comprehended from this article, thus enabling SMEs to prepare themselves for big changes, and hopefully big gains.

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Secure File Deletion in SMEs
And the risks sensitive data can pose

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Abstract—An in-depth review of the types of sensitive data stored on a typical workstation computer followed with advice for secure removal of this data and an explanation of why simple file deletion is not adequate.

Index Terms—File Deletion, Sensitive Data, SME

I. INTRODUCTION

A modern SME is likely to use computers extensively, for data processing, creating reports, research, network communication etc, all of these have the potential to store information specific to both employees and their company. Such data can be used to identify a person or an active area of research, company finances, generally things that are private to companies.

This sensitive data is stored on a computer's hard drive, and probably the simplest way to gain access to these hard drives is to wait for a company to upgrade its computing system, as this often means throwing away or selling the old workstation PCs, which makes any data on them available to the public. Other more malicious methods of getting hard drive access exist but going into detail about these would cross over into another field of computer security. It should however be remembered that simply deleting files or formatting a hard drive before selling it on is not enough, it should always be securely erased, instead of just using the operating system's deletion tools (explained later). If a hard drive is not being sold on, the quickest and most effective deletion method is to simply destroy the drive. This article covers in detail the reasons for such methods and how to properly execute them.

II. COMMON TYPES OF SENSITIVE DATA

A lot of the data computers use while performing everyday activities is hidden from the users, mainly as it is not needed by most people. But this can store personal information and so it is worth understanding where and why it exists.

Cache files - these are files that are not vital to an application but may simplify its use, or may be needed during its installation. These are often stored in a user's application data folder and forgotten about, many employees may not even be aware of this folder as network administrators often disable access to it.

Browsing history - the list of locations that have been visited in a piece of browsing software, this is mainly associated with internet browsers but programs such as file explorers can also store a history of recent locations and recently opened files.

Cookies - temporary files that are created when users visit websites, they store the state of the website for the user, along with information such as user and computer details.

Metadata - this is information usually stored at the head of a file, detailing things like how the file should be read, its structure, creation data etc. This data can also contain user information.

Printer spool files - files stored for future use by a printer that allow people to queue documents.

Page/Swap files - these are files that act as extra memory when the operating system is running low on physical memory. That means that data that would normally be disposed of almost instantly in memory, may be stored for a while longer (Mallery, 2012).

III. REDUCING SENSITIVE DATA STORAGE

Reducing the amount of any kind of data stored on a system is likely to conflict with the usability of that system, so the first step is to figure out what isn't needed in the workplace. If the last known state of websites or login information doesn't need to be known, it might be acceptable to turn off cookie storage (this may interfere with some sites). Some applications can be installed in 'portable' mode, this generally means they'll store less information in the computer's registry and cache folder, making it easier to clear up when the application is no longer needed. A method worth mentioning that may not be effective in practice is using a RAM drive. This is basically a simulated hard drive, stored in a computer's RAM that can be used as a regular drive (with increased read/write performance), but with the added benefit of having all data on it wiped when the machine is powered off (Smith, 2012). A good way to make use of this is to have a small RAM drive that starts with the computer, which has a web browser loaded onto it, that way, any data saved by the browser will be removed after the session. This can be set up relatively easily as explained by Chacos (2012).

IV. HOW HARD DRIVES STORE DATA

The overall design of a hard disk drive (HDD) is fairly simple, data is stored on a set of rigid disks called platters,
which are capable of being magnetised. Data is 'written' to and 'read' from these platters by an arm that moves over the surface of the platters and then either magnetises that section to write some data, or by responding to the section's magnetism to read it. This type of storage is classed as permanent, meaning the data will stay as it is until modified manually by a user or the system.

A platter itself is divided up into tiny regions, each used to store one bit of information, so the main area of study with hard drives is the shrinking of these regions to increase the capacity of a drive. Currently, a hard drive can have a density of around 1 terabit (around 1 trillion bits) per square inch. To visualise how dense this is, in comparison our galaxy has an estimated two to four hundred billion stars (Ngo, 2012).

V. TYPES OF FILE DELETION

Most operating system deletion tools do not actually delete the contents of a file, using the Windows NT system as an example, files are accessed using references (similar to desktop shortcuts) and when you delete a file, all that's actually being deleted is that file's reference, the content is still available on the system's hard drive (Torres, 2005), which is where file recovery tools become a security issue as they can search the drive and find blocks of data invisible to the user and recombine them into the original file (See Figure 1).

Erasing a file is a deletion method that actually replaces each bit of data within that file. There are several methods available, but most use some form of randomly generated bit pattern to overwrite the original data. This method of deletion prevents file recovery tools from reconstructing deleted files, in the a similar way to how encrypting text prevents us from reading it, all we see is a jumble of characters.

A widely disputed method of retrieving data that has been previously overwritten was published in 1996 by Guttman, but this no longer seems to be viable due to the huge increase in the data density of modern hard disks. The method involved using a magnetic force microscope to examine the tiny magnetic fields of a disk. The underlying idea being that when data was overwritten the actual value wouldn't be exactly what was written, but more of an average of the old and new data, so instead of a bit being exactly '1', it might be stored on disk as '0.95'. Even though this method has received a lot of scepticism (Mallery, 2006), government and security agencies still advise hard disks to be destroyed after use instead of having the data overwritten.

VI. DATA OVERWRITING IN DETAIL

A file is represented as a series of '1's and '0's, these are called bits, and these bits are what are replaced when a file is overwritten. A simple way to do this would be to just randomly write a 1 or a 0 to each bit of the file, but this wouldn't be very effective as if a bit is overwritten with the same value too many times, the file could still be partially recoverable. An accepted method used by the department of defence is to overwrite a file once with all '1's, then once with all '0's, then once more with random values (Mallery, 2006). This ensures that every bit value is changed. Guttman (1996) proposed a method that passed over the data 35 times, and was convinced this was the only way to be completely sure that any original data was overwritten, but this causes a large increase in disk activity compared to other methods.

There are several tools available that make the task of securely deleting a file easy, such as 'Eraser' (http://sourceforge.net/projects/eraser/). From a business point of view, it should be taken into account that securely erasing files will increase hard disk activity, making them wear down slightly quicker than normal, but this should be weighed against a company's hardware update policies and the fact that hard drive prices are relatively cheap. A good approach could be to allow employees to delete files as normal, placing them in the network recycle bin, and then once a week or month etc., erase the contents of the recycle bin. Regardless of the chosen method, employees should be given an outline of the importance of following any file deletion policies and shown how to any tools.

For the secure deletion of some of the data discussed earlier, such as temporary files, a more practical tool would be something like 'CCleaner' (https://www.piriform.com/ccleaner), software like this is designed to scan through a computer for all the not well known areas that can hold sensitive data and clear them. Most also come with overwriting procedures.
VII. DESTRUCTION POLICIES

A company should have a set procedure for destroying old hard drives that are no longer needed. There are data destruction companies who provide the service, but it can be done freely and relying on someone else to destroy private data seems counter-intuitive.

To destroy a hard drive effectively, there are several options available. Some of these are impractical and can be dangerous, such as burning the drive, or soaking it in hydrochloric acid. Breaking the disk platters with force is a common method, smashing them with a hammer or drilling holes through them. Probably the most thorough method is to take the hard drive apart and then sand the platters. To be certain the data is truly gone, before physically destroying the disk, it should be degaussed, meaning it should be placed between two powerful magnets (typically neodymium). This ruins the magnetic patterns on this disk. It's important to assign someone to this task making sure they fully understand what to do, passing all old machines by them to stop any hard drives being accidentally thrown away in full working condition. A log of all machines should also be kept to guarantee that one isn't overlooked when being disposed of.

VIII. OVERVIEW OF PROCEDURES

An SME should follow the following guidelines with their data:

- Use the normal deletion method to delete files in order to avoid loss of data accidentally but make sure they are eventually erased.
- Ensure all employees have an understanding of what data can be created about them and the company and ways they can minimise it.
- Regularly clear out and erase temporary file locations and histories etc.
- Securely wipe hard disks before selling them on.
- Securely destroy hard disks before throwing them away.

Following these guidelines should minimize the risk of sensitive data leakage from the point of view of this article, but companies should back up this information with a strong security system for full coverage.

IX. CONCLUSIONS

Sensitive data is much more accessible than the general population realise, and with information technology playing such a huge part in people's lives, it's more important than ever to understand how and where this data is stored. The data protection act (1998) requires that anyone who has personally identifiable data has the right to not have such data used in a way that can cause damage or distress, which makes it vitally important that such data is handled correctly. Enterprises should have a policy for handling such data, including what types should be stored, how often they should be erased and how to handle old hardware. Employing these policies decreases the risk of data leakage by a substantial amount and should be practiced both at home and work from an employee point of view to be fully effective, bearing in mind that more security may mean less functionality in some cases so this should be well thought out in a business environment to avoid having a negative impact. Another point is that the information covered in this article is in no way a full data security guide and any steps taken should be combined with knowledge from other fields to provide the maximum amount of information security.
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Avoid 1 in 4 web project failures!

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Abstract—A high percentage of web development projects are over budget, not on time and provide less functionality than originally agreed upon. As a result of one in four projects failing, this article argues the significance of utilising agile methodologies as a means of alleviating these determined causes of failure. Finally, a suggested agile implementation approach with regard to how people react to change is presented.

Index Terms—Web, SME, agile, methodology, failure

I. BACKGROUND

The Standish Group reports approximately two thirds of IT projects fail or are “challenged” (Standish Group, 2006). Whilst Sauer et al (2007) argue against this statistic, the failure rate is still reportedly too high; specifically a quarter of all web projects result in failure (ZDNet, 2008). As this article will further explain, this rate of failure can be significantly reduced by conforming to well established and successful practices that have been proven within the web development environment and SME (small to medium sized enterprise) scope.

The term challenged is referred to by The Standish Group as a complete and operational project that is over budget, late and/or offering fewer features and functionality than originally specified (Standish Group, 2005). Before we can avoid or successfully handle challenged web projects, we must first understand what common issues constitute failure and how such issues arise.

A. What are the issues?

A New Bamboo study (ZDNet, 2008) found that web project failures are most frequently due to the following; a high level of requirement changes (55%), inconsistency in stakeholder demands (48%) and lack of time or budget (31%). These findings are also consistent with an extensive and similarly motivated study (Schmidt et al, 2001) where the top ranking IT project risk factors include those found within the web specific survey. Each of these issues relates to an inadequate level of project management which many studies support as being a major cause of failure stating that good engineering is redundant without successful management (Al-Ahmad et al, 2009). It is clear that the key to avoiding failure is through successful management. Such a task however is challenging, requiring an assortment of multidisciplinary skills (Al-Ahmad et al, 2009).

II. INVESTIGATION

A. How can this be resolved?

Dorsey (2005) suggests that successful projects share three critical factors which can be visualised as supporting legs of a tripod. The three factors consist of top management support, a sound development methodology and solid technical leadership. To ensure project stability, all three legs must be in place to avoid the tripod collapsing and the project failing.

Bauer (2005) experienced a series of a challenged web projects, consecutively further affecting staff morale and future projects expectations. Bauer (2005) realised that whilst there is no silver bullet for solving all the issues, a new methodology was needed in order to perform more effectively. Implementation of the new methodology lead to greater success rates and a reduction in issues that were also easier to manage. Dorsey (2005) concurs with this, stating that projects are often built with failing strategies and that a lack of interest towards methodology is at the heart of the problem.

B. Get a new methodology

The nature of web application development typically stipulates a short time-to-market, need for concurrency, performance and a continuous evolution cycle (Al-Ahmad et al, 2009). These inherent attributes, in particular the need for rapid development and continuous evolution, help determine an appropriate development methodology.

1) Why traditional methodologies don’t fit
Bauer (2005) explains web development time frames are often shorter than with general software engineering projects. Additionally, developer experience levels vary more dramatically and clients more commonly have a poor understanding of imposed limitations. As we now understand, a methodology should account and allow for greater management, more communications between stakeholders, clients and employees and a way of rapidly developing applications for short deadlines.

Whilst there are many software engineering methodologies available, as Bauer (2005) and Clutterbuck, Rowlands and Seamons (2009) point out, many are not appropriate for web project development. Traditional and sequential approaches such as the Waterfall model come at the expense of flexibility and productivity when compared with an agile approach which allows for fewer phases, smaller teams and an overall shorter development time (Clutterbuck, Rowlands and Seamons, 2009).

2) Taking an Agile approach

Dorsey (2005) compares software engineering to the construction of a multi-tiered office building in that it is more successful if initially an architect generates detailed plans, and during each phase, plans are reviewed with testing and inspection of the current state. This approach mirrors agile methodologies which provides iterative work cadences, referred to as “sprints”, which allow for incremental software development (see Fig. 2). Combined with forward planning, the common misconception that writing code is the only real contribution to a project can be avoided. Extending upon the office analogy, this would be equivalent to bringing in painters before the walls are built (Dorsey, 2005).

![Fig. 4. General agile methodology life-cycle.](image)

This iterative, agile approach alleviates the common causes of failure through short development phases, typically consisting of small teams and more effective communications. Short development cycles or “sprints” allow for more flexibility and damage limitation during the likelihood of a client altering the project specification. Importantly, stakeholders are also frequently kept up to date due to a claimed, 91% of agile teams regularly providing value to stakeholders and 92% claiming that continuous process improvements being made throughout the development lifecycle (Ambler, 2013).

After encountering difficulties with project success, Bauer (2005) found many benefits to the adoption of the agile methodology FFD (Feature Driven Development). This approach gets the client(s) to think about their requirements in terms of “features”, allowing developers to more easily identify how much work was required and what had already been completed. Furthermore it was also noticed that the approach helped bring together different disciplines (particularly development and project management) which, as Al-Ahmad et al (2009) states, is a requirement for successful project management. With his team lacking motivation, Bauer (2005) found that the agile implementation boosted team morale levels providing a more “palpable sense of focus and direction.”

a) Tailoring Agile for your SME

Whilst fundamentally all agile methodologies abide to the same principles, there are several different implementations (the most popular of which is Scrum (West, 2011)) with each offering subtle deviations. As such, a specific implementation will not be recommended here, instead you should choose one that it is best suited to your organisation. The chosen approach may need tailoring as Clutterbuck, Rowlands and Seamons (2009) did by combining the two agile methodologies Scrum and Extreme Programming (XP) for use within a SME. The combination involves sprints and a heavy influence on communication including daily team meetings (known as Scrums) which allow the team to monitor progress and discuss issues.

b) Agile criticisms

The emphasis of success through using agile development is concurred throughout abundant research however, as Clutterbuck, Rowlands and Seamons (2009) identified, there is an assortment of associated risks that you should be aware of. Such risks include; developing over-complex plans, having socially incompatible programmers and delegating an imbalanced workload. Clutterbuck, Rowlands and Seamons (2009) deduce from this that risks also pivot upon level of experience, skill and interaction quality. This is to say – it would be futile to expect a group of inexperienced developers who lack the skills to adequately communicate to work effective together.

After successfully transitioning to an agile methodology, Bauer (2005) found that whilst they still experienced problems, they were lessened and easier to manage. It must therefore be understood, whilst successfully implementing an agile methodology can significantly reduce or remove both foreseen and unexpected challenges that may arise, it is not a “silver bullet” for solving all web development issues.

c) Managing the transitions

People often resist change and can consequently end up reverting back to original methods that they are more comfortable with (Bauer, 2005).

In a critical review to find IT implementation strategies for effective change, Kuruppuwarachchi, Mandal and Smith (2002) suggest many considerations for pre-implementation,
implementation and post-implementation phases. In accordance with these considerations, before implementing the change in methodology, you should prepare plans for the recruitment, selection and training of affected team members. Figure 3 lists many suggested implementation strategies for an efficient and successful transition.

Bauer (2005) was able to effectively incorporate several of these strategies by involving everyone within the team and ensuring that the “key decision-makers” were accepting of the new approach. Due to the simplicity of the approach, Bauer (2005) did not struggle to convince the organisation of the benefits and provided training for everyone affected. Like Bauer (2005) you are likely to be in a situation where it is not possible to train all staff concurrently and one or more projects are already in production. A staged or phased-based approach is appropriate here to allow aspects of the new methodology to be slowly introduced. In order to assess the effectiveness and become more comfortable in adopting the approach, it is a good idea to initially use the methodology to develop something internal to your organisation, such as redeveloping your website or Intranet.

Having a post-implementation strategy is vital with project evaluation being critical for change acceptance (Kuruppuarachchi, Mandal and Smith, 2002). Analysis of the implementation and employee feedback will allow for further refinements to the methodology and development process.

III. CONCLUSIONS

A quarter of web projects fail and a large percentage are challenged due to too many requirement changes, inconsistent stakeholder demands and a lack of time and budget. Successful management is critical to avoiding or significantly reducing the severity of these challenges. Whilst there is no silver bullet, an agile methodology offers a suitable approach for the characteristics associated with web development; for example short development times. There are many agile methodologies to choose from but all conform to the same principles; this will consist of regular communications with stakeholders, potentially daily team meetings and short iterative development cycles which allow for requirement changes to be handled effectively. The approach should be tailored with your specific organisation in mind which may be limited by internal politics and business structure.

It is important to plan how the transition will be managed and get everyone involved to provide feedback before, during and after the implementation. Consider a phase-based approach by gradually introducing aspects of the new methodology whilst offering training where necessary to anyone affected; this will help staff comfortably adapt to the imposed changes. Involving those affected by the change and, importantly, listening to feedback will ensure developers and stakeholders are happy with the changes and just don’t end up resorting to the original approach.
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The Implementation of Modern Virtual Meeting Software

Benefits and Considerations

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Abstract—Virtual Meetings have seen an increase in popularity recently, but are still being under-utilised by many businesses. This report weighs up the pros and cons of virtual meetings against face-to-face ones to determine that for most SMEs, there are numerous benefits to adopting a modern virtual meeting system, including money, time, productivity and even a business’ carbon footprint. Face-to-face meetings are however, crucial to any business due to the personal nature of them compared to their virtual counterparts and will likely remain a staple part of a company’s practices.

Index Terms— Virtual Meeting, Face-to-face, Software, Conferences, SMEs, Web Conferencing, Videoconferencing

I. INTRODUCTION

Meetings are a crucial method of communication for all businesses, not excluding small and medium sized enterprises (SMEs). They are so important that managers have been estimated to spend up to 80% of their time in meetings (Romano and Nunamaker, 2001). Due to trends such as outsourcing, globalisation, and the use of individual project teams, meetings between employees in geographically separate locations have become increasingly commonplace in the last few decades (Gustafson, 2012). This means that many businesses have seen a large rise in their business travel – this is inconvenient for several reasons, which will be covered in further detail in this report.

The concept of virtual meetings is not a new one and they have existed, albeit in somewhat basic forms, for some time, but recent advances in technology has allowed them to be used to their full potential. This has not gone unnoticed by many businesses – in a Forbes survey, 59% of executives said that during the recession, their use of technology-driven meetings had increased (Rizy et al, 2009).

Virtual meetings have now evolved into three kinds of solutions (James and Pamlin, 2009). “Desktop” solutions are low-cost – utilising existing computers with additional webcams and widely available software (which could have just messaging capabilities, up to video and voice chat). “Dedicated” solutions use specialised hardware and high capacity telecommunications. These are more expensive than desktop solutions, but provide a business with reliable and highly functional virtual meetings. “Studio” solutions are the most expensive of all, normally compromised of a carefully planned room dedicated for videoconferencing, equipped with high resolution displays and cameras. This environment allows for an immersive and professional virtual meeting.

II. POTENTIAL BENEFITS

Virtual meetings are seeing a surge in popularity for a reason – if utilised efficiently, they can bring a wealth of benefits to businesses all over the globe. Not only do they offset some of the disadvantages of costly and frequent business travel, but they also bring their own unique advantages. The cost of a face-to-face meeting can be broken down into 3 key areas – the “private cost”, the “organisational cost” and the “societal cost” (Arnfalk and Kogg, 2003). Virtual meetings can reduce the cost in all of these categories.

A. Private Costs

Private costs are the impact of a meeting on each participant. They cannot always be quantified as a “price” but are important nonetheless as a motivated and happy individual is more beneficial to a business than a stressed and miserable one (LaMar and Laney, 2012), especially considering these individuals could be representing a company’s interests.

Business travel can be a stressful experience for many meeting participants (Yuh-Shy, 2010). Travel times are often at particularly unsociable hours, people have to spend time away from their homes and family, a large amount of material and resources might need to be brought by each participant and travelling can cause a lack of sleep - it is easy to see that for some, business travel can have a big personal cost.

Virtual meetings can resolve many of these issues – if readily available web conferencing software is used, each participant could attend the meeting from their usual workplace, or even from home (Seabrook, 2010). Much of the virtual meeting software on the market has built-in media and resource-sharing functionality, so there is no need to transport large quantities of documentation and folders (Geyer et al, 2001).

B. Organisational Costs

This category covers the impact of a meeting on the organisation(s) involved. These effects can often be quantified as an expense, and are often very costly.
One of the biggest organisational impacts is the travel costs (especially for SMEs that might budget less for said travel expenses), particularly when meeting internationally. The cost to accommodate and insure the participants can also be expensive, depending on the area the meeting is held in, and the length of stay. Virtual meetings negate the need for travel, which can avoid significant costs to the organisation, in fact Cisco held over 100,000 virtual meetings within 2 years of deployment of the technology and saved an estimated $90 million in travel costs (King, 2008).

Another organisational cost is the fact that there could be numerous employees taken out of their normal work schedule to go to a meeting. Any time they spend travelling (which can amount to a lot if travelling internationally), or not working effectively, is lost for the organisation (Gustafson, 2012). This can be costly depending on the number of attendees. Virtual meetings negate the need to spend time travelling, so each participant can use that time productively.

Finding the physical space to hold a conference can be a lengthy process when many participants are involved and venues might be limited or just busy (Malik, 1998). Virtual meetings require no space more than a computer for each participant.

C. Societal Costs

Business travel is damaging to the environment, and can affect society in more ways than one. These fall under the societal costs.

Many organisations are wary of their carbon footprint and try to operate as “green” as possible. Business travel is a huge producer of greenhouse gases (GHGs) – it is estimated that 20% of air travel emissions result from business travel (Brander, 2010), and for a non-manufacturing company, business travel can equate to 50% of their total carbon footprint (Reford and Leston, 2011). GHGs are not only produced from travelling to the meetings. The energy used to light and heat a meeting room has a lasting impact on the environment, too.

As mentioned before, virtual meetings avoid the need for travel which can improve a company’s green credentials. In a 2013 study, it was estimated that a company could prevent 110 tons of GHGs and save 1900 terajoules of energy each year by replacing a face-to-face meetings that involve air travel with virtual meetings (Borggren et al, 2012).

D. Other Benefits

Apart from offsetting some of the costs of face-to-face meetings, virtual meetings can also bring some of their own advantages.

A face-to-face meeting may be difficult for some employees to attend, or due to traffic or other travel issues they might miss them. They might even have to leave early to allow time to travel back. With virtual meetings, there are no real logistical barriers that would stop people from being present, so maximum attendance is ensured (European Medicines Agency, 2011). It is not even necessary to be in front of a computer anymore, as there are virtual meeting solutions that utilise mobile platforms, such as smartphones, including Apple’s FaceTime or mobile versions of the Skype application (Stalnacke et al, 2007).

If an employee could not attend a face-to-face meeting, it can be difficult for them to catch up on what was covered. There could be some paper records, or digital copies of presentations, but these might miss some of the verbal discussions that took place. Many virtual meeting services offer functionality to record meetings, meaning that in the case that somebody could not attend it the first time round, they can review the entire meeting, without missing any information (Geyer et al, 2001). This also means that an extensive and detailed record can be kept of what has been covered in case of discrepancies in a project.

Most virtual meeting software allows the rapid sharing of media and documents (Stalnacke et al, 2007) and with cloud-based solutions, some can even be edited simultaneously by multiple users. In a face-to-face meeting, media would either have to be distributed to each individual participant (this could be a time consuming task), or displayed to all the attendants at once (meaning people cannot go back and review the media if they missed something).

Using virtual meeting software often increases the productivity of a business – IBM studies show gains of up to 40% (Cascio, 2000). This is due to employees being able to work from multiple places (if using desktop software, they can effectively attend meetings from anywhere with an active and stable internet connection (Dolci et al, 2011)), and also the lack of travel time being basically “wasted” (Gustafson, 2012). It can also be argued that because it is easier to attend a virtual meeting due to the lack of logistical barriers, attendants will rarely need to be substituted in place of others who could not make the meeting – the employees who will be most productive and of most use in the meeting should nearly always be the ones attending (Seabrook, 2010).

In a face-to-face meeting, if a large amount of attendees are present, and it is required to split them into smaller groups (to make separate project teams, for example), it might be hard to find an environment that is quiet, or has enough room to allow this and it could take a long time to organise. With virtual meetings it is easy and fast to set up smaller meetings, or join larger ones. Some software allows you to be in multiple meetings at once and join sub groups to ease this process even further (Millen and Fontaine, 2003).

If a business has limited office space (this is a concern for many SMEs), fewer people are able to attend. This can be resolved by renting an appropriate venue, but this of course, takes time and money to achieve. Virtual meetings allow virtually limitless numbers of synchronised users (Arkesteijn et al, 2004), providing the business’s bandwidth allows it. Unlike face-to-face meetings, it’s easy for participants to drop in and out without disrupting the meeting.

Expanding globally and sometimes even outsourcing is a target for many SMEs. Virtual meetings can help achieve this faster for several reasons. As virtual meeting software is becoming more popular and accessible, it is relatively easy to set up a meeting with other businesses practically anywhere on the planet. You can form business relationships much faster than with face-to-face meetings (Cascio, 2000). In the case of
outsourcing, virtual meetings are ideal for closely managing international departments without regularly sending people abroad on potentially expensive business trips (Pauleen and Yoong, 2002).

Face-to-face meetings often require extensive planning and advanced warning to all participants. This can limit their usability in the case of unexpected events that call for immediate discussion. As virtual meetings can be started and joined by participants instantly, require little to no set-up or travel, and can be attended from anywhere with an internet connection, they can function well as an “emergency meeting” (Seabrook, 2010).

III. CONSIDERATIONS

Although there is a range of benefits that virtual meetings can provide, it is important to note that they do have some disadvantages, and there are scenarios where they might not perform as well as a face-to-face meeting.

The fact that virtual meetings can cut down business travel might be seen by some individuals as a disadvantage, even though it saves the organisation money and time, and reduces environmental impact. Some employees consider travelling as a perk, as the fact that virtual meetings can cut down business travel can provide, it is important to note that they do have some disadvantages, and there are scenarios where they might not perform as well as a face-to-face meeting.

The initial start-up cost of implementing virtual meetings can be expensive (especially for SMEs with a limited IT budget) – up to $25,000 dollars (Reay, 2003). If a “studio” virtual meeting solution is used, with for example, projectors and dedicated hardware, technical expertise will be required to maintain the system and keep it running optimally (Johansson and Larsson, 2006). This is a cost that will need to be considered when deciding whether to switch to virtual meetings. Even if a simpler, desktop solution is used, the cost of training staff to use the applications must be factored in as studies have shown that a lack of training can drastically reduce the effectiveness of virtual meeting software (Arnfolk and Kogg, 2003).

An advantage that a face-to-face meeting has over virtual meetings is the fact non-verbal communication can be recognised. Body language and subtle facial cues can be difficult, if not impossible to display using virtual meetings (James and Pamlin, 2009), yet are a very important part of human interaction, with research suggesting up to 65% of the information humans receive when communicating is through body language (Sloane, 2007). With advances in internet speed, high resolution video streaming is now possible, which does lessen the impact of this, but it is still harder to pick up on the subtleties of body language through a monitor.

If several meetings are planned, there will probably be down time between each meeting. In the case of face-to-face meetings, this down time allows further bonding and discussion between participants that can almost act as a team building exercise (Rizy et al, 2009). This opportunity is not available in virtual meetings and many people find this a key disadvantage.

Face-to-face meetings are not heavily dependent on IT (although they can utilise it in ways), so they are “reliable”. There will be few technical issues to deal with, and if there are, they will not necessarily cripple the meeting. Virtual meetings on the other hand require a solid IT infrastructure in order to function (Geyer, Richter, and Abowd, 2005). Networks will need to be able to handle large throughput, computers will need to be in working order and also all be running the same version of virtual meeting software (Tremaine et al, 2007).

It is also worth noting that virtual meetings, by their very design can cause distractions and a loss of focus for the participants. If a meeting attendant is on a computer, they have access to multiple applications that could be running at the same time as the virtual meeting. A recent survey showed that 58% executives admitted to frequently surfing the web, checking emails and reading unrelated materials during a virtual meeting (Rizy et al, 2009). This kind of distraction isn’t present in a face-to-face meeting, but it can be limited in a virtual one by ensuring the meeting is well-structured and relevant to the participants to keep them engaged.

IV. CONCLUSION

Virtual meetings are seeing more use each year as businesses are seeing their potential. They can save time, money, drastically cut a business’s impact on the environment and even improve productivity by a surprising margin – Cisco reports productivity gains of over $40 million (King, 2008). An SME could reap many benefits from adopting even a simple desktop virtual meeting solution. This does not mean the end for face-to-face meetings, however.

There are certain disadvantages of virtual meetings that must be considered when choosing to implement one. Many of these disadvantages can be minimised with the correct planning and efficient use of a system.

Some types of meetings will always be more effective in a face-to-face scenario – it is hard to emulate the personal touch of a non-virtual meeting without using an expensive “studio” solution and even then, it is only really advantageous when communicating with an office that has a similar set up. It appears as though face-to-face meetings will remain in use for most formal and high-importance meetings in businesses, but there is a potential for most other meetings to be replaced by their virtual counterparts, as the benefits of a well-implemented virtual meeting system far outweighs the potential disadvantages (from a cost, time and environmental standpoint), and the current trend seems to reflect this.
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The Use of Smart Devices in Your Enterprise

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Abstract—This paper looks at the use of smart devices in enterprises. It looks at two companies that have already incorporated smart devices into their business and the steps they took to do so. The paper looks at “Bring Your Own Device” and how employees are already using their own devices at work, the security issues involved with using employee’s personal devices and the security issues involved with smart devices in general and their constraints. The paper concludes that as employees are already using their own devices at work, enterprises must take steps to ensure that their data is protected when being accessed or stored by smart devices.

Index Terms—Smart Device, Security, BYOD, Enterprise.

I. INTRODUCTION

This paper will begin by looking at two enterprises that currently use mobile computing on a day to day basis and how they implement it. The paper will then go on to explore “Bring Your Own Device” its meaning, why it’s becoming popular and the security issues surrounding it and then look at security issues with smart devices in general, even if they have been provided by the enterprise itself and are not the employee’s own device. The paper will explore the various constraints involved when dealing with mobile computing and how they can affect the software running upon them.

II. ENTERPRISES CURRENTLY USING MOBILE COMPUTING

A. Skanska AB

Skanska AB is a Swedish construction company, being a construction firm means that at least part of its workforce is out in the field. In 2005 Skanska USA Building was working upon a construction project at Duke University in North Carolina (Löfgren, 2007). During the project the management staff began to evaluate the ways in which field construction information was handled. From the evaluation “the team found that managing the physically overwhelming quantity of information that is passed to the construction site often generated poor quality of information in the field.” (Löfgren, 2007). In other words it would appear that the decisions being made by management, such as updated plans or specifications were not being communicated effectively with the workers who were implementing those plans or specifications.

As a result of the evaluation “the project team combined several existing commodity wireless ICT with internally developed software…” (Löfgren, 2007). The software mentioned was run on tablet computers and was used to synchronise them to always have the latest plans and specifications set by the management. Upon evaluating the new ICT tool it was found that the workers using it were able to respond “to a larger amount of issues in more detail…” (Löfgren, 2007). This was due to the reduction in delays between the management recognising a problem and updating the workers responsible for fixing it.

B. Deloitte Touche Tohmatsu Limited

Deloitte Touche Tohmatsu Limited (DTTL) is a professional services firm of which Larry Quinlan is the Global Chief Information Officer. Larry Quinlan has written an article explaining the “five-pronged approach for taking advantage of mobile (technology)” (Quinlan, 2013) that DTTL takes.

The five prongs cover: the hardware that will be allowed on the network, how to keep track of hardware and the users of the hardware, the software that the devices will be running, collaboration – allowing users to join web conferences from “…tablets and smartphones in addition to our laptops” (Quinlan, 2013).

The company has to decide what sort of hardware (and its source) to use. Quinlan explains that the provisioning of hardware can range between the company choosing a device and forcing it upon employees, to allowing them to bring in their own device. However Quinlan goes on to mention that the employees’ own devices may not be secure and that DTTL actually tests mobile devices and offers those that pass testing as an option to its employees.

Quinlan explains that DTTL has its own “enterprise app store” (Quinlan, 2013) which provides apps that “support business imperatives” (Quinlan, 2013) suggesting that the apps are carefully chosen before being selected for inclusion in the app store. The underlying theme of the article appears to be that the software and the hardware have to actually support the people who will be using them to do their jobs and that the company using the software has to be prepared to scrap ideas that are clearly not working: “Build prototypes, get feedback, and throw them away.” (Quinlan, 2013).

III. BRING YOUR OWN DEVICE

Bring Your Own Device (BYOD) is a term used to refer to the practice whereby employees bring their own devices to
work and use them to access the company’s network and resources.

Employees like to be able to use their own devices at work as “…frequently they have better, more intuitive devices of their own at home than they are given at work.” (Bennett, Runciman, and Tucker, 2012). Another reason why employees may prefer to use their own devices is that they are already accustomed to how they operate and it is a device that they have actively chosen to use.

Research by Ovum (Absalom and Drury, 2012) found that approximately forty per cent of those surveyed in the UK used their personal devices at work. Approximately eighty per cent of IT departments encouraged BYOD or ignored that it was happening. However less than twenty per cent of those surveyed had signed a policy covering what their responsibilities were if they were going to use their own device(s) for work. This leads on to the next topic: managing security with BYOD.

A. Managing Security with Bring Your Own Device

The increased number of different devices accessing the company’s network will also increase the number of security issues the IT department has to deal with. One method of reducing the security risk is to stop the users from using their own personal devices and offer them a selection of company tested (and configured) devices as suggested by Quinlan (Quinlan, 2013). However this removes the benefits of using employee’s hardware instead of your own.

There are a number of solutions that allow the employee to use their own device and the company to secure their data. One solution is through the use of virtual machines. By using virtual machines the company can stay in control of its data whilst allowing employees to access it from anywhere and with their own devices. One company that provides the software to run virtual machines is VMware, its “Horizon View” (VMware, 2013) is aimed at providing the end-user with a personalised desktop that they can access from multiple computers and other devices. This does however mean that the user must have a constant internet connection to access their data as it is stored in the company’s data centre rather than the user’s device.

VMware also have a new piece of software called “VMware Horizon Mobile” (VMware, 2012). It enables the set up of separate personal and corporate environments on the employee’s phone, allowing the company control the apps installed in the corporate environment and the ability to push updates to the user’s device. “VMware Horizon Mobile” does however have the disadvantage of requiring a “VMware Ready” (VMware, 2012) phone which will prevent the majority of employees using their existing devices which would prevent them from bringing their own device to work anyway.

BlackBerry also has its own enterprise service. “BlackBerry Enterprise Service 10” (BlackBerry, 2013). The service is designed to be multi-platform and so supports Android and iOS but seem to be mainly aimed at BlackBerry’s own operating system. The BlackBerry 10 phones come with two separate environments, one for work and one personal environment, the service also provides the ability to store, send and receive encrypted data from Android and iOS phones. BlackBerry Enterprise Service 10 also enables the company to set up security measures such as automatic wiping of the work space if the phone does not connect to the company’s network for a set elapsed time (BlackBerry, 2013) as well as enabling or disabling certain phone functions whilst using the workspace environment.

IV. SECURITY ISSUES

This section will look at security issues involved with using smart devices in enterprises that are present even if using enterprise provided devices instead of the employee’s personal device.

“…communication through wireless and mobile networks is more vulnerable to attack than in wired networks” (Murugesan and Unhelkar, 2010). The nature of smart devices encourages using wireless networks as a wired connection is not always available (and not necessarily supported by the device). However as stated by Murugesan and Unhelkar wireless connections are “…more vulnerable to attack…” (Murugesan and Unhelkar, 2010).

Steps can be taken to improve the security of the companies own wireless networks but employees must be made aware of the risks involved when using public networks as they are generally open and the data being transmitted may not be encrypted.

In addition to the security issues posed by wireless network there is also the issue of viruses and other malware to consider. As most mobile devices encourage the use of “apps” there is a risk that a malicious piece of software could be downloaded / installed onto the employees device which could then access confidential data. The concept of an enterprise store may be suitable for a company that provides its own apps but limiting an employee to the enterprise store only on their own personal device may pose more of a problem.

Another security issue to consider with smart devices is the issue of the device being lost or stolen. “…the very portability of mobile phones and PDAs makes them easy to steal” (Foote and Ruggiero, 2011). If when a device goes missing the data on that device becomes vulnerable. Whilst the security on the device itself may pose an obstacle to anyone trying to gain access to data most smart devices have removable storage which can be read by any compatible device / reader. It is however possible to encrypt stored data which can impede any attempt to read it. There is also software available that can be used to wipe a device’s storage remotely to delete the data stored upon it.

V. CONSTRAINTS OF MOBILE COMPUTING

If developing software to run on mobile devices, the developer has to be aware of the various constraints they will be faced with caused by the nature of mobile computing: “…small screen size, low resolution, small memory, and limited power.” (Adipat and Zhang, 2005). Small screen size is a problem as it limits the amount of information that can
be displayed at once. With touch screen phones now being the norm, the screen is also the main means of navigating through apps and so care must be taken to provide enough space to show the necessary information as well as providing a means of interaction.

Low resolution may not be as much of a problem today as it was in 2005, with some smart phones now reaching resolutions of 1920 by 1080 (Seng, 2013). However unless everyone in the company has the latest smartphone, screen resolution may still be an issue. Having a low resolution could mean that some smaller items do not get displayed properly or that text in a small font cannot be read easily or at all. Larger items such as images or video would have to be downscaled to fit on the screen which can result in loss of detail.

“Small memory” (Adipat and Zhang, 2005) restricts the number of resources that an app can load at once as well as the number of apps that can be resident in memory at any given moment.

“Limited power” (Adipat and Zhang, 2005) in this case refers to the processing power of mobile devices, however it must be noted that since 2005 there have been vast increases in the processing abilities of mobile devices though they still cannot match that of a desktop computer. As with the other constraints the amount of processing power available on each device can vary a large amount between devices and care must be taken when developing an app so that it runs smoothly on all the devices it will support. The use of a virtual machine such as the VMware Horizon View (VMware, 2013) would remove the need for the device itself to perform calculations (apart from those necessary to handle input and displaying the virtual machine) as they are performed on a server and so the processing power of the device itself becomes irrelevant (as long as it can actually connect to and display the virtual machine).

Network connectivity can also be a problem when dealing with any wireless device. As the network connection may not be constant the synching of data can become an issue. With an intermittent connection the device itself would have to store data to enable the employee to be able to access it whenever they want otherwise they may find themselves without a network connection and therefore no way to access the required data. However storing data on a mobile device has its own security issues as mentioned previously. Having a constant network connection could also incur additional costs from the network provider.

The final constraint that will be mentioned is that of battery life. As devices have become more and more powerful the amount of power required to run them has also increased. Larger screen generally consume more power as do faster processors and wireless communication. A device constantly using its radio to transmit and receive data will also draw more power than one that is not.

VI. CONCLUSION

As seen in section II there are benefits to using smart devices in your enterprise including an increase in collaboration and productivity. Research conducted by Ovum (Absalom and Drury, 2012) shows that employees are already using their own devices at work whether or not the company’s IT department know about it.

There are numerous security issues to consider when dealing with BYOD or company supplied devices. General security issues with mobile devices include them getting lost or stolen and the possible vulnerabilities of wireless networks. BYOD has additional security issues in that the company must take additional steps to ensure that the devices being used are secure: through encrypting data stored upon the device, partitioning the device so that it has different environments one for personal use and a separate one for work or by not storing data on the device at all and using a virtual machine which can be accessed using the device which contains all the data on the company’s servers.

Smart devices also have constraints that must be considered when developing apps for them or using them for work. The level of security required by the enterprise will determine which of the possible solutions to use, as they all have different limitations / advantages.
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Collaborative Decision Making
For distributed teams

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Abstract— In companies where team members reside at separate locations it can often be difficult to effectively work together when making decisions and to come to a final, agreed consensus. A relatively new area of Business Intelligence has arisen known as Collaborative Decision Making. Collaborative Decision Making software aims to aid in collaboration within teams that may not have a face-to-face presence. This article take a look at what key features makes this software effective and points out some of the pitfalls to be aware of when using such technologies.

Index Terms—collaboration, decision making, SME, distributed, business intelligence, CDM, group

I. INTRODUCTION

It has become common place in business for teams to work together from remote locations, whether this be due to multiple office locations, working during travel or working from home. The benefits from working as a distributed team are plentiful, costs can be reduced when people work from home, and projects are not interrupted when travel is required and locality of expertise isn’t an issue, but there are several pitfalls that companies must be aware of.

The most striking of these pitfalls is the additional time it takes for a team to understand each other’s intention. As most of this remote working is done via groupware systems, such as digital whiteboards and instant messaging software, they lack the workspace awareness (Gutwin and Greenberg, 2002) that one would get through face-to-face collaboration. There is also the obvious time delay involved when working with systems that are anything less than a live video/voice stream to the other team members. While these may be seen as acceptable trade-offs for low costs it is obvious that reducing their impact is of great importance for it to pay off in the long term.

There are many software packages available today that can aid companies in distributing their workforce and collaborating from afar. Instant messaging and video conferencing has been a core part of many businesses for years now. There are also more specific, task-focused pieces of software being developed that can become invaluable for teams to stay connected between locations.

This article will focus on the techniques essential for using such groupware systems in a collaborative decision making process. As collaborative decision making (CDM) is common in many business areas, such as economy, finance, engineering, academia, it is essential to outline some boundaries that will be adhered to in this article. We will first lay out a goal that is wished to be achieved by CDM software and use that as the running example throughout.

II. COLLABORATIVE DECISION MAKING

In collaborative decision making a decision is not made by a single individual but rather a collective of decisions from multidisciplinary experts (Indiramma and Anandakumar, 2008). This spread of decisions helps to reduce possible bias from the process and works towards a fairer review. Known experts of a given field are chosen to provide their feedback to give the best possible understanding.

In recent years a new sector of Business Intelligence (BI) has been rising that has been incorporating social facets into BI software to produce collaborative decision making software. Many of these emerging software products have harnessed the web as their platform as it has the apparent benefit of being distributed upon release. It is predicted that by 2014 the CDM market will be producing revenues of nearly $2 billion (Traudt, et al., 2010).

There are essentially two ways to approach groupware software, the first being a stand alone piece of software that tried to achieve some collaborative goal and the other is to extend existing single-user applications to incorporate collaborative features such as multi-user word processors (Grudin, n.d.). This article will be focusing on the former but many of the points highlighted could be applied to the latter.

III. GOAL

Businesses have countless uses for CDM software and many of them unique to the type of work they perform. Because of this reason a generic usage and goal is to be used within this article as an example.

For our purposes the imaginary company has a team responsible for assessing the quality of a number of proposals from multiple applicants and coming together to decide which is to be accepted by the company. The details of the proposals are irrelevant as it is the process we are concerned with.

This is a simple scenario of peer review and one that can be found in many areas of business from academia to construction. This example team is located across multiple countries, within different time zones and with a varying level of computer literacy.
The goal this team wishes to achieve is a system that would allow them to all review the proposals and provide their feedback to the others without the need to physically meet.

IV. DESIGN CONSIDERATIONS

Traditionally teams have worked around a physical workspace, such as a desk or a whiteboard, in which they could all interact and observe. This face-to-face collaboration allowed for a lot of environmental information to be gathered, often unknowingly, such as how others are interacting, their body language and where their focus lies. This is the up-to-the-moment workspace awareness as described by Gutwin and Greenberg. There is also the automatic social properties of working together, that is, the trust gained in others abilities from seeing them work and the natural responses to communication that become hard to replicate via technological means.

As more and more of these scenarios move to the digital landscape much of this subtle information is lost and thus dampens the effectiveness of the collaboration. For CDM software to be considered successful it must aim to replicate the natural working environment that occurs during physical collaboration. While it is unlikely any CDM could truly convey all the information you would in a physical setting due to limitations, such as types of input, certain consideration can be made to reduce the negative effects, as details below.

While not all considerations may be necessary, and not all carry equal weight, having a system that strives to achieve them will long way to achieving effective collaboration.

V. EFFECTIVE COMMUNICATION

The main aim of any CDM software is collaboration. For this to be effective the team must be able to participate in effective communication. Historically this has been handled by software such as instant messaging or video conferencing that allows users to discuss what they are working with. While this works it can often be far from effective, users regularly find the need to describe what they are looking at when the users on the receiving end have access to the same data.

When we talk about effective communication we are referring to the ability to convey meaning with more than just speech (or written text). This is what happens in the physical world, we pick up on people’s motions and responses to build a more complete meaning to their message. When assessing a single-user software product a cognitive walkthrough technique can be used to highlight three areas of contextual information, which is, description of the user, their knowledge and a description of the task they will perform (Pinelle and Gutwin, 2002).

Implementing this in a digital world is not an easy task, partly due to the limitations on input and output devices and partly because we pick up so much information subconsciously during face-to-face encounters it is difficult to determine exactly what should be conveyed. The most effective way of tackling this is to give context to a user’s message to allow the receiver to extrapolate meaning. This can be seen in many software products today, Google Docs will display a colour-coded indication of other users location within a document and provide real-time updates as they type, Microsoft Word allows users to highlight sections of a document and attach a comment to it making it clear what they are talking about, digital whiteboard application often show other users cursors to allow people to simply say “this is …” rather than “that thing in the top left next to the …”.

This can be applied to our example scenario also. As members of the team submit their feedback on the proposals their comments can be shown alongside the proposal details in such a way that it can be referred to. For example, just as with Microsoft Word, the team member may wish to bring a specific line to everyone’s attention by highlighting it and attaching a comment. This context helps to make sure meaning is not lost and the readers are not unsure as to what exactly it refers.

VI. FEEDBACK

Feedback is essential to collaboration. It help ideas grow into decision by using the collective knowledge of the team and giving the ability to challenge any weaknesses that may be present in arguments.

In a digital system good feedback is very much linked to effective communications but also has a specific need for notification feedback. A notification system allows users to take on two tasks, one that attracts their primary focus and another they are monitoring through a secondary system awaiting some update (Lee and McCrickard, 2007). The presence of notification is nothing new, it can be found in much of the software used on a day to day basis, such as with calendar reminders. Its presence within a CDM software, especially one that is to be used by a team spread across the globe, is critical.

When a team consists of members from different time zones it becomes very difficult to arrange communication without the need for someone to be awake during the night, disrupting their normal workday. This is where a CDM can be very useful and allow each member of the team to perform their task during their respective work-day.

Using our example, the team leader may import all proposals for the rest of the team to see, this will trigger a notification to all team members alerting them that they now need to take action. The team leader can then leave their feedback to the rest of the team and continue working on other projects. Meanwhile, other members of the team may be starting their workday, with a notification of proposals added and some feedback provided, and be able to provide their own feedback. This process can continue throughout the days as each team member is active at work. The use of real-time notifications allow users active at the same time to respond instantly to each other’s feedback. Users on the other side of the globe get the chance to review this activity and provide their response once they are active in the system.

VII. TRUST AND RELATIONSHIPS

CDM merges business intelligence with social software to facilitate in building a level of trust and relationships into the process. When collaborating together to reach a consensus it is
vital that one trusts the word and knowledge of the other. When working with distributed teams this trust is hard to come by and the relationship between people is often weak.

To attempt to rectify this it is important to implement functionality to gain details on those collaborating. This could be as simple as who they are and what their background is but could be expanded to include their previous work, a recommendation system so people have the chance to rate one another, their affiliations etc. (Jones, 1997). This information allows users to check if people providing feedback are in fact fit to do so and possess the required expertise and experience. The inclusion of acquaintances allows collaboration to form between people that can be used beyond the scope of the collaboration decision stage.

Using our example, one could imagine that when viewing others feedback a popup may show over people’s names provided information about their area of expertise and their position within the institution. This could be used when the decision is split by favouring the decisions of those with more expertise associated with the proposal.

VIII. SCORING

To ensure a final decision can be reached, quantitative data is needed. The simplest and most common is to use a scoring system, typically numerical, that allows users to rate how they feel about a particular category. While this solution does allow for a clear decision to be reached, simply by ordering by highest rating, there are some pitfalls that one must be aware of when using this type of system.

Unless an adjective is assigned to each score within the scale users may interpret the grade differently leading to unreliable scores. Although the use of descriptions can help to remedy this there is still room for variance in what people may consider “good” or “outstanding”. It is likely that people may choose to vote “safely” and rate all their decision around the 6-8 score (on a 1-10 scale) to avoid having to criticise too much or may simply choose random scores if they deem themselves too busy to assess the data (Guerraoui, et al., 2010).

Our example company may choose to use a ranking system, using the scale 1-10, with the addition of Reject and Resubmit, along with comments feedback that could be used to justify their chosen score. When reaching a consensus the ratings can simply be brought together and when there isn’t a wide split the final score can be the mean of the supplied. When a split in verdict is encountered the comments feedback could be used to determine which scores are more akin to the desired result and which could be ignored.

IX. WORKFLOW

A good system would allow for an uninterrupted workflow, allowing data to easily be imported in and extracted out. To this effect it should be desired that any CDM software should have the ability to pull in data from a prior system in the workflow and to communicate the results to the next system along the chain. This modularity adds a great amount of flexibility, allowing it to be moved from one collection of systems to another, but it does add a great deal of complexity to the design. As the input could be comprised of any format of data the system should be flexible in its presentation and allow the display of data to be manipulated in such a way as to best suit it. While the system may not necessarily need to communicate directly with the next system it is imperative that the results can be exported in such a way that another system may make use of them.

X. INTUITIVENESS

While it is true that any piece of software should bring with it a certain level of intuitiveness it could be seen as even more critical when working with CDM software. As CDM software is attempting to replicate some real-world activities there should be as little distractions as possible to ensure peoples focus remain on the task.

An attempt should be made to make interactions and objects seem familiar and so should take examples from the real world. The layout of data on the screen should resemble that of if it were laid out on a desk, a “booklet” of data should be shown in “pages” but an ability to quickly jump forward or backward is imperative to replicate the way users can quickly jump to a page by flicking through the page numbers.

Our example team would benefit from this level of intuitiveness so they are able to keep their focus on the proposals without the distraction of too many menu options or complex interactions. The users varying level of computer knowledge would also become less of an issue as operations should seem obvious if designed correctly.

XI. UPTAKE

One of the most damaging problems that can, and has, effected groupware software is a lack of uptake from the users. When designing such software it is important to think about who benefits from each feature and who has the extra workload (Grudin, n.d.). It has often been the case a single user gains the majority of the benefit while others are required to take up additional work. A prime example, as highlighted by Grundin, is that of a meeting scheduler where the organiser gets the benefit of being able to select the best time for everyone but all other users have the extra work of needing to maintain their personal calendars. When implementing a groupware product it is important that all users are aware of how it benefits them to help avoid it being seen as additional work.

XII. CONCLUSION

Designing software for groups is no easy task, there have been many failures in the past with only a few notable successes. A lot of the problems have stemmed from developers and designers approaching the problem like they have with single-user applications. This often meant that the social and contextual aspects of group work was overlooked or misunderstood. Using the points made in this article CDM software could stand a better chance of succeeding and become more beneficial for its users.
REFERENCES


Enterprise resource planning (ERP) systems for small to medium enterprises (SME’s)

Outsource or In-house?

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Abstract—This research paper will look at the acquisition of an ERP system for an SME, looking at the difficulties in terms of meeting the requirements of the business and the risk associated with the different approaches to design, implementation and maintenance of in-house development or outsourcing to a third-party. Whilst also showing cost-effective uses of growing cloud technologies such as software as a service.

Index Terms—SME, Outsource, In-house, SaaS, Cloud, ERP systems.

I. INTRODUCTION

The purpose of this research article is to examine one of the most difficult decisions that a Small to Medium Enterprise (SME) will inevitably face, which is to integrate an ERP system. An SME can be defined as ‘SMEs employ fewer than 250 persons and have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million’ (research, 2011). This choice will especially focus on the decision about whether or not to design, implement and maintain this in-house, or whether to outsource to a third party company.

Since the birth of computing, computers have shown great potential when it comes to business related tasks, from processing large amounts of data that would take thousands of man hours into mere seconds to the simplest of systems that stores stock levels, and spread sheets to documenting business finances. There are many factors that have to be taken into account when deciding how to best implement an ERP system for an SME and what kind of system needs to be implemented to best suit the business needs.

II. BACKGROUND

When deciding which route is best to take for a small business in terms of ERP systems, you have to initially decide what the requirements of the system will be at present and in the future. Two of the main routes that you can take, and one of the biggest decisions is whether or not to go in-house, which would require you to hire a member of staff or a small team that have knowledge and experience with designing implementing and maintaining a system. Or whether to outsource this to a third party, who could then implement and maintain a system whether it is a bespoke system or a generic system that gives you the tools to fulfill the requirements. ‘SMEs often have sophisticated and industry-specific business processes and IT needs, but must address these needs with relatively small budgets and IT staffs’ (MacCabe, et al., 2011).

III. IDENTIFY INFORMATION SYSTEM REQUIREMENTS

Firstly you need to analyse the current system that is in place with the SME, whether this is paper based or an old computer system. Then with this information you can identify what requirements the SME needs from the system. Some potential requirements that may exist could be:

A. Database

To store data, such as stock levels for a shop, or to store customers details for orders and deliveries. This is one of the most important uses of information systems within a business all businesses need to store at least some form of data. This is usually linked in with other aspects of the system such as tills in a shop or reading data from online input forms that read customer information.

B. E-Commerce

This area of an ERP system has some of the most potential benefits for an SME as it can facilitate, business websites, online sales and support, search engine results for the business website and most importantly advertising. Some of the benefits this would have for an SME are ‘expanding the scope of marketing, wider and richer communications, reaching new markets, reducing the cost of operations and partnering with suppliers and other collaborators.’ (Cohen and Kallirroi, 2006).

C. Local Area Network (LAN)

This implementation can provide the business with, internal email and local intranet. This can help with internal communication within the SME.
D. Processing

The system may need to provide the SME with the processing power to do large computations in the fastest possible time with the correct results

E. Computer aided design/Computer aided manufacture (CAD/CAM)

This kind of system would be used within a manufacturing environment such as building cars or making biscuits to manage, monitor and regulate the manufacturing process.

IV. IN-HOUSE

Once the system requirements have been identified the SME’s then needs to decide whether or not they want design, develop, implement and maintain In-House or Outsource the task to a third party. Both approaches have benefits and drawbacks, and depending on the requirements of the SME this can affect which approach is the best for that specific SME. Therefore it is essential to do a full risk assessment of each approach to check whether it will be cost-effective and has potential for business growth. Making the right decision is vital can be vital ‘The failure rate for ERP systems is impressive; it has been estimated at between 66 and 70 per cent (Carlo, 2002; Lewis, 2001). At the same time, successful implementation can generate substantial benefits for an organization (Shang and Seddon, 2000).’ (Poba-Nzaou, et al., 2008) So although the risk of failure is high, the benefits that can be gained from implementing an ERP system are highly desirable by any SME.

A. Benefits

Some of the main benefits of benefits of the In-House approach are:

• Inside knowledge, an internal team would have a better understanding of how the business operates and direct access to existing employees to identify their IT needs.
• Security, all data will be kept and maintained internally so no external parties have access to data that may be private or confidential especially where customers are concerned.
• Maintenance, this can be completed quickly and on-site as the maintenance team will usually reside within the same building.

B. Disadvantages

In-House development also comes with some problems such as:

• Cost, the business will have to pay the salaries of the development and maintenance staff, as well as any hardware that they require to operate and maintain the system including development tools. This undertaking would require an IT project manager with the average salary being around £50,000 (Watch, 2012).

• Limited skill set, the In-House team will only have a limited knowledge base compared with that of a third party company which may have experts in all areas of computing.

• Redundancies, if there was a small team to develop implement and maintain then the required number of people would fall after integration therefore leading to inevitable redundancies.

V. OUTSOURCE

Outsourcing the task of designing, implementing and maintaining your ERP system also has both advantages and disadvantages. However depending on the type of business that you manage these may or may not be applicable as you wouldn’t necessarily be concerned with the security of the system if you own a small sandwich shop that wants to implement a system where you store the amount of stock, then re-order the items once the stock level hits a certain point. However if you had an online shop dealing with card payments security would need to be heavily considered.

A. Benefits

Some of the main benefits of outsourcing the task of designing, implementing and maintaining a system are;

• Technologies, external companies are more likely to be taking advantage of newer technologies and have some form of internal learning process to learn the latest technologies, whereas an In-House team wouldn’t be able to learn those skills without increased business costs.

• Costs, The outsourcing approach would have less initial costs than that of In-House development as the costs of hiring an internal team could potentially be a lot larger as a third party company may be doing multiple projects at the same time therefore can charge less due to economies of scale.

• Time, Many third party companies may already have generic systems in place that may fulfil the business requirements therefore this would reduce the amount of time that it takes to implement a working system.

B. Disadvantages

There are also some drawbacks that need to be taken into consideration before deciding on an approach to take, some of these are;

• Security, by outsourcing, the SME will need to provide the third party company with their data so that they can implement the system therefore compromising the security of the data that the SME has. This can also include things such as research or patents that may want to be kept confidential. Also a lot of outsourcing is done abroad in companies such as China or India, this means that SMEs have to be careful with how data is passed as the data protection act states that personal information must be ‘not transferred to countries outside the European Economic area unless the information is adequately protected’ (Commissioner, 2010).

• Flexibility, the third party company may already have a system designed that roughly fits the needs of the
SME therefore they may choose to use that which may result in a less flexible system as certain constraints may already exist.

- Communication, by outsourcing to a third party it is highly probable that the third party company will never fully understand the business, therefore without constant communication this can lead to a system that doesn’t meet the requirements that are required by the SME.
- ‘Although ERP system suppliers have increased their focus on SMEs, current systems are still expensive.’ (Aloini, et al., 2007).

VI. ALTERNATIVES – CLOUD

With the rapid developments that are being made in cloud computing this has opened up a new door for businesses to use services that can provide them with the tools to create systems that suit the needs of the SME.

A. What is cloud?

‘Today the term cloud computing describes the abstraction of web-based computers, resources and services that system developers can utilize to implement complex web-based systems.’ (Jamsa, 2012) so effectively this means that the systems will be all be accessed via the internet with the hardware and software being remote. In terms of business this means ‘Cloud computing infrastructures enable companies to cut costs by outsourcing computations on-demand’ (Santos, et al., 2009) so the cloud option is almost a hybrid solution to the integration of an ERP system. This is because the SME will be able to hire a small team of lower skilled IT workers who would be able to use the cloud services available to outsource any tasks that may be too difficult to achieve in-house.

B. Software as a service (SaaS)

Rous defines SaaS as ‘a software distribution model in which applications are hosted by a vendor or service provider and made available to customers over a network, typically the Internet.’ (Rouse, 2010). This is the service that is most popular for businesses to use as it will encompass all of their computational needs that may be expensive to develop in-house the increasing popularity is evident in figure 1. ‘The software/service provider offers a range of services(computing, storage, security, etc.) for the end user to build, deploy, and run their applications’ (Stanoyska-Slabeva, et al., 2010). This option allows the SME to have a small team that will manage and maintain all the needs on the business end whilst all other aspects such as hardware, processing and security will all be managed by the service provider. One of the main benefits for an SME to adopt this approach is the ability to pay as you use, this would reduce initial costs without compromising the quality of the system as well as the ability to alter the package to suit the needs of the SME. This becomes extremely beneficial if the business grows and requires more storage or processing power, because most services providers will only charge for what is used which means that no expenditure on the system will go to waste.

VII. CONCLUSION

This paper has shown what steps an SME needs to take when deciding about how to integrate an ERP, showing the advantages and disadvantages of both doing all of the work in-house or outsourcing to a third party company. As well as looking at how growing technologies such as SaaS can be used to take both benefits from in-house and outsourcing. However each approach will ultimately be different depending on the type of business and what their specific requirements will be. And due to the extremely high failure rate for implementing an ERP it is important for anybody who is managing an SME to take the correct steps to ensure that they don’t fall into the ‘failure’ section of companies trying to implement these systems, as this can be very costly and a failure could eventually put the SME at risk. So in conclusion any SME that is thinking about going down the ERP route should heavily risk assess any decisions and consider moving towards the growing cloud market. This is due to the fact that it encompasses benefits from the alternatives whilst minimising the costs that an SME would incur should it be a failure.

Gartner has predicted that the global amount spent on Cloud technologies is due to continue to grow, with Software as a service (SaaS) due to increase by 60% over the next 3 years (Gartner, 2013).
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Abstract—Engineering projects increasingly involve globally-dispersed teams from multiple organisations. This paper examines how data can be shared effectively amongst these teams to enable successful collaboration. A case study is used to highlight the current issues and a new solution is proposed. The findings show that by moving away from a manually intensive method to a more technology focused method, these issues can be resolved.

Index Terms—Computer-aided design, data sharing, data exchange, virtual enterprise, collaborative design, concurrent engineering.

I. INTRODUCTION

Complex industrial product development typically involves multi-national engineering teams from multiple organisations. (Dong and Agogino, 1998; Bodington and Sims, 1999). These teams are formed to leverage the core competencies, resources and skills of each particular organisation (Goel, et al., 2009). This collection of organisations or ‘partners’, as this paper will refer to them as, are known as the virtual enterprise; a temporary collaborative network of independent enterprises, formed to exploit a particular business opportunity (Goel, et al., 2009).

Collaboration in the virtual enterprise is a highly complex and challenging task (Kalay, 1999). This paper will examine these issues, look at solutions proposed by related work and suggest a possible new solution. This paper will use as a case study, a virtual enterprise that provides jet engines for an aircraft manufacturer.

This particular virtual enterprise involves the engine supplier - Rolls-Royce, engine cowling supplier - Alenia Aermacchi, thrust reverser unit supplier - Goodrich, inlet/exhaust nozzle supplier - Boeing, and pylon supplier - Spirit Aerosystems, which all together form the whole engine power plant that is supplied to the customer (Boeing) for their aircraft (see Figure 1 for a summary).

II. COLLABORATION IN THE VIRTUAL ENTERPRISE

The virtual enterprise cannot work in isolation. Collaboration is required throughout the design process so each partner is notified of any changes that may affect them. This is particularly important in today’s world of concurrent engineering where product development is performed in parallel between design, manufacturing, purchasing and other functions to reduce the overall development time.

Critical to achieving this is the ability of the virtual enterprise to share product data at all stages (Bodington and Sims, 1999). One of the most important aspects for the jet engine virtual enterprise is the ability to share their 3D computer-aided-design (CAD) models. This is because the parts must fit together at agreed interface points without any spatial ‘clashes’ (see Figure 2).
A. Issues

All of the traditional issues associated with collaboration (Turban, et al., 2008, p.146) are present in this case study, making a potential solution difficult. In particular:

- Group members are located in different places and work at different times.
- Group members work for different organisations.
- The required data, information and knowledge are located in many sources, several of which are external to the organisations.

There are also cultural implications. (Munkvold, 1997) noted that cultural differences increase in importance as an enterprise becomes more global. Ostensibly the issue is the language barrier, but the nature and form of knowledge sharing also varies between cultures (Walsham, 2001, p.228). Not addressing cultural issues can lead to lack of understanding and sometimes conflict, which can seriously hinder a project (Walsham, 2001, p.232).

B. Current process

The current process goes some way to answering the first two issues. As the customer, Boeing mandates that all partners upload their data to their own CAD database – Enovia. Each partner then connects to Enovia via a virtual private network (VPN) so they can populate the database.

The third issue however is still a problem because even though there is a central repository, partners in this enterprise use different CAD systems that utilise different file formats. A common set of file formats are not mandated in a virtual enterprise because participating in such an environment is just one of many projects that an individual organisation will be working on (Bodington and Sims, 1999), consequently, each partner uses their existing CAD systems.

This means a data translation is required. This is causing a delay in the process as it is proving to be too manually intensive (see Fig 3).

III. TOWARDS A SOLUTION

The current process takes too long. Partners require quicker visibility of changes to give them more time to react. This leads to a loss of confidence in the process and results in a blame culture where partners refuse to redesign any clashing parts because the correct data wasn’t available in a timely fashion.

The problem can be highlighted by looking at the current CAD models of the contain detailed proprietary information which cannot be allowed to leave the enterprise in an uncontrolled manner.

TABLE IV. RECORDED METRICS FOR DATA EXTRACT, TRANSFER AND TRANSLATION OF RANDOM COMPONENT BATCHES. AN ENTIRE ENGINE DATASET IS IN EXCESS OF 10,000 PARTS.

<table>
<thead>
<tr>
<th>Batch</th>
<th>Model size pre-translation Megabytes</th>
<th>Model size post-translation Megabytes</th>
<th>Num of parts</th>
<th>Extract time secs</th>
<th>Transfer time secs</th>
<th>Translation time secs</th>
</tr>
</thead>
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<td>9000</td>
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<td>3000</td>
</tr>
</tbody>
</table>

A. Briefcase

A new data sharing product called Briefcase is a possible solution put forward in this paper. It is a tool that allows partners to share design data with each other (Siemens, 2012) and unlike similar solutions, it exists as a plug-in to the existing CAD database, Teamcenter. Teamcenter is already used by two of the virtual enterprise partners, but Briefcase has the benefit of being able to communicate between different CAD databases through the use of XML as an intermediate data exchange format (Siemens, 2012). This reduces the need for complex, bespoke software and enables all partners’ databases to communicate with one another.
Parts in Teamcenter are augmented with additional attributes, marking them as ‘shareable’. They are then automatically synchronised into Briefcase and can be seen by a partner immediately. In addition, there are translation plug-ins available that can convert the CAD geometry automatically, completely removing the need for the time consuming extract and translation stages of the process. Although still in the early stages of review, Briefcase looks like a potential solution.

One way of gauging user acceptance is through the use of the Technology Acceptance Model (TAM). This aims to define user acceptance by gauging the perceived usefulness and perceived ease of use of new technology (Davis, 1989). To quantify, the new technology is scored against a scale of salient questions. Briefcase should be subjected to such an acceptance test to evaluate its suitability.

As it is a plug-in for an existing CAD database, it will require new steps in the design process so parts can be marked as “shared”. When should this happen? Who approves this? Who adds the attributes? These are all questions that need to be addressed. Consequently, this solution will have a knock-on effect for designers, design approvers and managers, so any new solution needs buy in from these stakeholders to gain acceptance.

In a case study of Unilever, (Ciborra and Patriotta, 1996) noted that a change in hierarchical context is also important in collaboration. This prevents the traditional hierarchical aspects of individual objectives from coming to the fore, which can lead to knowledge hoarding and opportunism. This could, potentially, be an issue for Briefcase, because designers may feel that they are under ‘surveillance’, since the entire enterprise can immediately see the results of their work.

The adoption of Briefcase would radically change how the task is currently carried out. As such it is important to gauge the relevant stakeholder’s views on using this new piece of technology.

Unfortunately, it seems that these systems are not being utilised to their full potential. The findings show that the technology exists, but a mind-set change is required to let the technology do the work rather than relying on manually intensive tasks.

**IV. FUTURE CHALLENGES**

The benefit of potential solutions versus their implementation effort.

Solution A was to outsource the translation work and solution C was Briefcase. Briefcase would have the biggest benefit but would take the most effort to implement.

**V. CONCLUSION**

The paper shows that finding a solution to product data sharing in a virtual enterprise is not an easy task. This will be an increasingly important issue as more and more engineering projects are conducted in such dispersed environments (Dong and Agogino, 1998).

As well as the traditional collaboration issues, engineering projects have unique issues related to product data sharing that can seriously affect their outcome. There is a tendency for over-reliance on manually-intensive tasks to exchange data. This leads to delays in decision making, which affects collaboration and worst-case, can result in a serious feeling of mistrust amongst the partners. Although this is based upon an empirical perspective, the metrics recorded in this paper go some way to backing this up. As project timelines become even tighter, this will no longer be an acceptable approach.

The paper also put forward acceptance factors that a solution would have to answer to be successful. These factors focus on the end user, which is a vital consideration (The Standish Group, 2005).

In recent years, there has been much expenditure in industry on new CAD database systems (CIMdata, 2006). Unfortunately, it seems that these systems are not being utilised to their full potential. The findings show that the technology exists, but a mind-set change is required to let the technology do the work rather than relying on manually intensive tasks.
REFERENCES


Warning: Technostress Damages SME’s Productivity

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Abstract— Many SMEs believe technology holds the key to increasing their growth, productivity and efficiency. However, this report will illustrate the negative effects which can be caused by implementing new technology and software without adequate employee training and consultation. Technostress and technophobia are two terms used to describe the negative effects which new technology may cause. This report will examine the causes of technostress and the negative impact for SMEs in terms of productivity and efficiency. Current research on technostress and technophobia has been evaluated to determine the prevalence of these issues in the workplace. Strategies for reducing technostress and technophobia in SMEs will be presented.

Index Terms— Technostress, Technophobia, Productivity, SMEs, efficiency, impact on technology.

I. INTRODUCTION (CONTEXT)

In today’s society there is great emphasis on the development of technology and the benefits it can bring to any business by enhancing communication, speeding up business processes, information storage, multi-tasking and instant access to information via the internet. Advances in technology have expanded the business market place particularly for small to medium enterprises (SMEs) to a global market; this has meant companies have more competition from global competitors in the same industry. SMEs in Europe are defined as businesses having a work force of less than 250 employees, a turnover of less than 50 million euros or a balance sheet total of 43 million euros (EC, 2013a). Businesses look to the next generation of technology or the latest software development to give them a competitive edge in the belief that technology enhances business productivity (Oxbridge Writers, 2013). In 2013, 2 billion people have access to the Internet (EC, 2013a); this number is set to increase by 200 million per year (EC, 2013a). The Internet is a fast and inexpensive way of attracting new business customers and retaining existing ones (Offer, 2011). Over the past 15 years, the development of the internet for business use has been possible for the overall 10% increase in GDP growth in Europe (EC, 2013a); SMEs who embrace the use of the internet have been said to grow two to three times faster by the European Commission (EC, 2013a). This is just one aspect of how technology can improve businesses.

A. The problem of technology related stress

However, technology can have negative aspects; in the 1980s, corporate offices were being invaded by technology (Skeem, n.d.). Brod (1984 cited in Aghwotu and Owajeme, 2010), a psychotherapist noticed technology users were becoming more stressed in the workplace; he defined these issues as technostress. Brod (1984 cited in Aghwotu and Owajeme, 2010, p.713) stated technostress was “a modern disease of adaptation caused by inability to cope with new computer technologies in a healthy manner.” Brod’s 1984 definition was soon changed by Fine (1986 cited in Aghwotu and Owajeme, 2010) who described technostress as a phobia rather than an inability to adapt to new technologies. Technophobia is a growing concern; Table 1 demonstrates it affects 98% of employees to some degree in a survey sample size of 275 who use technology in the workplace (Pusey, 2013). This percentage has increased dramatically since technophobia was first examined by Rosen and Weil between 1987 and 1989; the authors reported levels between 33% and 50% of respondents experiencing technophobia (Self and Aquilina, 2012). This report will discuss the concepts, causes and symptoms of technostress and technophobia to explain how they adversely affect employee productivity in SMEs.

<table>
<thead>
<tr>
<th>Levels of Technophobia in 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
</tr>
<tr>
<td>----------------------------</td>
</tr>
<tr>
<td>High/Moderate</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>None</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Table 1 (Pusey, 2013)

II. DEFINITIONS OF TECHNOPHOBIA AND TECHNOSTRESS

Technophobia is closely related to technostress; both issues cause anxiety and stress in users. Technophobia is defined by Rosen and Weil (1990 cited in Rosen and Weil 1995 p.11) as “(a) anxiety about current or future interaction with computers or computer-related technology; (b) negative global attitudes about computers, their operation or their societal impact; and/or (c) specific negative cognitions or self-critical internal dialogues during actual computer interaction or when contemplating future computer interaction”. Technophobia has many similarities to technostress; the concept of technostress was first defined by Brod in 1984, this definition has been developed and refined over the years. For this report, the following definition will be used: “negative impact on attitudes, thoughts, behaviors or body physiology that is caused either directly or indirectly by technology”

III. WHAT CAUSES TECHNOSTRESS AND TECHNOPHOBIA?

In 1998, Clute gave the following reasons for technostress: “inexperience with computers, performance anxiety, lack of training/insufficient training, organizational factors, overwork/insufficient staffing, information overload, fast pace of change, language/jargon intimidation [and] multiple interfaces among others” (Clute, 1998 cited in Aghowotu and Owajeme, 2010 p.714). The majority of these issues which were found to be causing technostress were supported by a more recent survey carried out by Ennis (2005 cited in Skeem, n.d.). Ennis’ (2005) study suggested that although employees were beginning to find strategies to deal with these existing technological issues, new developments in technology were causing further issues in the workplace (Skeem, n.d.).

Technophobia is developed through past experiences with technology; if the person teaching is uncomfortable with or has negative feelings about technology, these negative attitudes will be transferred to the person being taught (Rosen and Weil, 1995). Rosenberg and Weil’s (1995) study found between 33% and 50% of teachers in surveys carried out between 1987 and 1989 had some degree of technophobia (Self and Aquilina 2012). Furthermore, Rosenberg and Weil’s study in 1995 stated 49% of Grade 7 and 48% of Grade 11 students indicated teachers had the most influence on their experiences of technology. These findings indicate that approximately half the students in the classroom would have a negative experience of technology due to teacher technophobia.

A. Information Overload

In a survey carried out by Kupersmith (2003), it was found 59% of people out of 92 had chosen information overload as one of their three options contributing to the major causes of technostress. Information overload is a “phenomenon where so much information is taken in by the human brain that it becomes nearly impossible to process it” (WiseGEEK, 2013a).

The impact of information overload and the mental process it requires is evident if Table 2 is examined; the table shows how much information is passed on in sixty seconds around the world using the internet (Hudson, 2012).

<table>
<thead>
<tr>
<th>What happens in 60 seconds?</th>
</tr>
</thead>
<tbody>
<tr>
<td>168 million emails sent</td>
</tr>
<tr>
<td>694,445 Google searches</td>
</tr>
<tr>
<td>695,000 Facebook status updates</td>
</tr>
<tr>
<td>98,000 tweets on Twitter</td>
</tr>
<tr>
<td>1,500 new blog entries posted</td>
</tr>
</tbody>
</table>

Table 2 (Go-Gulf, 2011 cited in Hudson, 2012)

For SMEs, time is money; on average business managers receive 150 electronic messages a day, this is the equivalent of an interruption every 4 minutes (Biseul, 2005). Concentration, decision-making and productivity are adversely affected due to these interruptions (Weil and Rosen, n.d.). Ayyagari (2012) conducted a study concerning the issue of information overload; the study tested 664 employees and found information overload increased their levels of technostress.

IV. SMES AND THE INTRODUCTION OF NEW TECHNOLOGY

In the current business market, SMEs accept that technology holds the key to successful business growth; this could be through social media or by utilising new technology/software as soon as it is developed to gain a competitive advantage (RIBA Insight, n.d.). SMEs in America increased their annual spending on technology from $152,000 in May 2012 to $162,000 in November 2012 (Gonsalves, 2012) in the hope of gaining a competitive advantage and increasing productivity and profit. The strategy of changing to new business technologies and software at such a rapid rate means employees are often not given time to learn how to use the new technology effectively (Weil and Rosen, n.d.). A report carried out by the Organisation for Economic Co-operation and Development (OECD) in 2011 shows 1 in 3 SMEs in the UK believe no employee workplace training is necessary (Green and Martinez-Solano, 2011); this leaves many SME employees feeling frustrated, unskilled and undervalued (Weil and Rosen, n.d.). The SMEs which do offer workplace training stated the higher skilled employees benefited more from training than the lower skilled (Green and Martinez-Solano, 2011). Shepherd’s (2004) study indicated the effects of technostress could be reduced if computer users took part in some form of regular training to update their skills to keep pace with the rapid advances in technology. Modern technology can complete tasks successfully and effectively in a short space of time; this can result in SME employees becoming more worried about job security and job skill set. Table 3 illustrates 57% people agree with the statement that computers are taking jobs away from people (Pusey, 2013); this reflects people’s fears about the advances in technology and adds weight to the case of employees experiencing technostress and technophobia in the workplace (Shu, Tu, and Wang, 2011).

<table>
<thead>
<tr>
<th>Computers are taking jobs away from people</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answer</td>
</tr>
<tr>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Agree</td>
</tr>
<tr>
<td>Neutral</td>
</tr>
<tr>
<td>Disagree</td>
</tr>
<tr>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Table 3 (Pusey, 2013)

V. NEGATIVE IMPACT OF TECHNOLOGY

SMEs believe technology holds the key to taking their business to the next step and increasing productivity. However, technology can have negative consequences in the form of technostress and technophobia; these issues will impact on SME businesses causing employees to be less...
productive and efficient (Shu, Tu, and Wang, 2011). Furthermore, these issues can impact on an individual’s health (Ayyagari, 2012). The health issues are an area of concern; technology is used for in the workplace and home; the divisions between home and work are becoming blurred by advances in technology (Thulo, n.d.). Emails, texts and mobile technology means that people are potentially on call for work 24 hours a day (Petrecca, 2013). Technology developed to help users work efficiently is now forcing employees into a state of digital depression; this increases stress levels which are made worse by the amount of time spent using technology (Thulo, n.d.).

<table>
<thead>
<tr>
<th>Employees are reluctant to admit to computer related anxiety stress</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>52</td>
<td>19%</td>
</tr>
<tr>
<td>Agree</td>
<td>141</td>
<td>51%</td>
</tr>
<tr>
<td>Neutral</td>
<td>68</td>
<td>25%</td>
</tr>
<tr>
<td>Disagree</td>
<td>11</td>
<td>4%</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>3</td>
<td>1%</td>
</tr>
<tr>
<td>Total</td>
<td>275</td>
<td></td>
</tr>
</tbody>
</table>

Table 4(Pusey, 2013)

VI. WAYS TO REDUCE TECHNOSTRESS AND TECHNOPHOBIA

If SMEs change their software and technology every time advance in technology/ software occurs, they force their employees to change the way they work. Changes in an individual’s working life whether negative or positive can produce stress (Aghwotu and Owajeme, 2010). Change is an issue which can be managed to ensure the stress created by it is reduced (ACAS, 2009) and productivity is maintained through the transition period (Anderson, 2013). To accomplish successful change, SMEs should try to adopt a bottom-up approach strategy; a top-down approach will often cause a reduction in productivity (Filev, 2008). Bottom-up change approach is defined “from the lowest level of a hierarchy or process to the top” (Collins Dictionary, 2013). By adopting this method of change, it helps employees support what they have created allowing them to embrace the change better as an issue and feel involved in the change process (Training ABC, 2010; Thomas, 2012). In SMEs, managers normally make the decisions about technology and software changes; these managers often do not use the technology. It is imperative employees are fully supportive of any changes to ensure productivity and efficiency are maintained; in the bottom-up approach those who use the technology are involved in the decision making about. It will ensure the changes have a positive impact on the business (IMB and Tivoli, n.d.). Past research (Aghwotu and Owajeme 2010; BBC News, 1997; Shepherd, 2004) has stated that technophobia is an issue which can be overcome; technostress can be reduce through training and ensuring that employees are familiar with the latest technology. However, more recent studies (Ayyagari, 2012; Prystanski, 2012; Tarafdar, Tu, Ragu-Nathan, T., and Ragu-Nathan, B., 2011) state information overload and technology fit for task are part of the issues which cause individuals to be stressed; in some cases these issues cause individuals to experience digital depression due to overuse of technology (Volpi, 2012). SMEs can overcome these issues by encouraging people to try to have more human interaction in the work place rather than just using technology to communicate. SMEs should adopt strategies for home and work life balances in the workplace.

VII. CONCLUSION

This report has examined the effect of technostress and technophobia; these issue are increasing due to information overload, overuse of technology and the increasing complexity of technology. The problems associated with technophobia and technostress should be addressed by SMEs to ensure technology brings the desired positive benefits of increased productivity and efficiency to the business. It is important for SMEs to recognise technology should be their servant and not their master (Rocha, 2001 cited in Shepherd, 2005)!


Abstract—The internet has brought about significant change in all industries and markets but also offers many opportunities for SMEs. Research to date suggests that SMEs, in general, are slow adopters of new technology. This article seeks to address the reasons for this and present a framework, based on current academic research, which SMEs can use to define their website and social media strategies.

Index Terms—E-commerce, social media, marketing, company learning.

I. INTRODUCTION

The rise of the internet over the past two decades has brought about massive changes to how companies do business. Daniel and McInerney (2005) note the common adoption strategy of new technology into small to medium sized enterprises (SMEs) is slow and phased. However, research has also shown that SMEs can be the leaders of the pack in times of change due to the greater freedom and speed with which they can make decisions compared to large companies (Daniel and McInerney, 2005). The fact that the average turnover of SMEs who adopted the internet early was averaged $1.09M higher than those who had not (Daniel and McInerney, 2005) proves that the internet, used correctly, has great potential for all SMEs.

This paper will discuss the benefits of the Internet in two focused areas: engaging a company’s customer base; and staying ahead of, or learning from, competing companies. These findings will then be presented in a framework for SMEs to leverage. The article concludes that SMEs can enjoy many benefits if they engage with the Internet correctly — especially as they know better than most the value of generating good customer relationships (Grey et al., 2012). This potential lies mostly in the domains of marketing and company learning.

II. MAIN

A. Engaging with Customers

In the past two decades the Internet has presented companies with a great opportunity to engage with their customers in a myriad of new ways. Initially the pinnacle of a company’s online presence was its website and this is the first area of Internet adoption that will be discussed.

A study by Daniel and McInerney (2005) comes to the following conclusions on SMEs adoption of e-commerce via the Internet:

- Twice as many SMEs use the Internet to purchase goods and services compared to using it to sell their own.
- In America, SMEs who adopted e-commerce early have an average $1.09M higher turnover than those who have not.

There are good reasons for these two extremes. Kenny and Marshall (2000) noted in 2000 that the total setup and online customer acquisition cost of an e-commerce system was an average 150-250% greater than in the physical world. They noted the benefits of such a system outweighed the cost - but only if the company utilised their online presence correctly. It is argued that this is one reason that has compounded the slow adoption of e-commerce systems into SMEs. Research conducted in Denmark and Australia in 2009 noted less than 25% of the respondents were selling over the internet, with management and employee attitude to technology being identified as another key factor to technology adoption (Scupola, 2009). Other factors such as: managing online customers; technological knowledge and competence and; reliability; were found to have little influence in a survey conducted by Dhokalia and Kshetri (2004).

Companies who overcome the initial hindrances of cost and attitude to adoption then require knowledge on how to really engage with their customers in an online environment. Kenny and Marshall (2000) state businesses need to stop looking at the Internet as a website and start using it to create a location that your customers want to come to. This applies to companies large and small. A good example of this is Amex (2013) who realised they needed their website to provide more value to the customer than just allowing them to pay their bill. Amex is a good example of the type of business who should create a destination website. They have a product that generates repeat visits and has the potential to create a relationship with their customer base. In the absence of these Kenny and Marshall (2000) advocate the company investing in contextual marketing and advertising their product with a focus on where it can be obtained. This will be referred to as the ‘non-destination website strategy’ from now on. This is in direct contrast with a destination website strategy where advertisements would be used to direct all web traffic to their website. Both strategies benefit from contextual marketing, which is the practice of getting advertisements to potential customers in the right place at the right time.
As can be seen by the citations above, this advice existed before the rise of social media. This is to highlight that the addition of social media to a company’s online presence changes none of the fundamentals of marketing online. Livingstone (2008) notes that the majority of content on social networking sites (SNS) was initially created by the younger generation. Today however, academic research indicates social media being used for purposes such as election campaigns (Barbara, 2012), advertising and obtaining customer feedback (Paglia, 2010). Trusov, Bucklin, and Pauwels (2008) conducted research that indicates online word-of-mouth marketing via SNSs can also reduce online customer acquisition costs. This may at least partially be due to advertising campaigns that offers prizes for displaying advertising in a customer’s personal feed. Gangadharbatla (2008) states this makes the advert more trustworthy, which results in more interest. Engaging in social media can therefore reduce the disparity between online and real world customer acquisition costs that was noted by Kenny and Marshall (2000).

Social media is also useful for search engine optimisation (SEO) purposes. Google themselves state that the best way to do this is to be generating content that is useful and compelling to the website’s user base (Google, 2012). Two potential avenues for this are blog posts and social media services. Research has shown these avenues have been able to produce value no matter the marketing strategy pursued by the company. Chau et al., (2009) note Facebook (2013) can increase traffic to, and the visibility of, a website which suits a destination website strategy. In contrast to this Geho et al., (2011) give various examples of SMEs using social media in innovative ways, such as to order a coffee, showing its value to a non-destination website marketing strategy as well.

Possibly the biggest change social media has brought is new avenues of communication. Mangold and Faulds (2009) note that whilst previously marketing was a one way street from company to customer, social media opens up new avenues: customer to company and; customer to customer. Evans (2012) notes these new channels are particularly daunting to companies primarily for two reasons:

- It creates an avenue for complaints to be publically aired.
- Customer to customer seems uncontrollable.

Indeed the first of these reasons will be the making or breaking of a company. Evans (2012) states no longer can companies operate in unprofessional or unethical ways - no one can outsmart the collective intelligence of social media indefinitely, and these avenues open up potential for a massive backlash should anything go wrong. However, it has argued these new channels have focused companies again on the importance of generating a good relationship with their customers. A survey by Grey et al., (2012) notes that the top three measures of year on year success for SMEs in the United Kingdom (UK) where:

- Greater customer satisfaction.
- Growth in business profit.
- Greater customer retention.

With two of the top three success factors involving the customer, this backs up the argument that SMEs have always known the importance of generating a good relationship with their customer base. As a result it lies with SMEs to discover innovative ways to translate this knowledge onto online mediums. This means social media offers SMEs great potential, and arguably less to worry about, in these new marketing avenues.

As mentioned before, the advice of generating good customer relationships existed before the rise of social media, and arguably before the Internet. It should also be an area that SMEs excel at given their need to stand out, be unique or excel in some way to attract customers from going to a large mainstream vendor. Take a small village paper shop as an example of generating customer relationships. It is not just the place a customer comes to in order to buy a newspaper and a pint of milk, and not even the most convenient if a supermarket is nearby. However, many remain in business by being the hub where people can catch up on the village news. Arguably it is this type of relationships that SMEs should seek to generate, just in a different medium of the Internet.

III. STAYING COMPETITIVE

A. Dealing with the Competition

Understanding a market, the companies within it and their strategies is the key to being competitive (Chen, 1996; Caves, 1984; Scherer and Ross, 1990). This knowledge can then be used to identify the options a firm has to compete. Porter (1989) states there are only really two options, lower costs or seek to differentiate your firm from your competitors by the quality of the products and services offered. Caves (1984) argues however, that there is also the option of establishing a niche within the market which cuts through both options. In an interview with Inc magazine, Levy (2010) argues that even though sometimes an entrepreneur may think they have no competition, every company does and gives the example of coffee from a supermarket competing with Starbucks. These details highlight the importance of a firm at least carrying out some basic competitor research tasks.

Of the six areas put forth by Garsombke (1989) it is argued that social media can give significant in-sight into the following:

- Analysing the strengths and weaknesses of your competitor.
- Investigating the goals and strategies of your competitor.

Given the “content is king” nature of SEO is it argued that companies are revealing more about themselves and their aims than ever before. A quick browse through a competitor’s social media activity will reveal a lot about their current strategies, whether it be competitions, offers or nearby activities that they are using to engage their customer base. This information can then be used to make informed decisions on either to compete with their offers or possibly focus on another area instead.
B. Learning

In 1998 Choueke and Armstrong (1998) noted that the amount of change and uncertainty existing in the SME marketplace was accelerating. It is argued that the change technology and the Internet has brought has continued this trend. Slater and Narver (1995) however, noted a strong correlation between companies who engage effectively in marketing and companies who were learning. The discussion so far supports the argument that the Internet and social media are primarily a marketing medium for businesses. This correlation can be extrapolated to assume that companies who are using the Internet to effectively market their goods and services are also those who will be benefiting from good organisational learning. Keeping up with Internet and social media trends enable companies to learn about their competitors, their customers and even technical advances that may be of use. Reyneke, Pitt, and Berthon (2010) note that a leading wine critic on Twitter has 24,000 followers and this is due to regularly ‘tweeting’ information these people want to be informed of. Following people like this online can remove much of the burden of discovering the latest trends of value in a marketplace.

IV. FRAMEWORK

In order to leverage the commercial benefits of the Internet to SMEs the following framework is presented based on existing academic literature.

If the SME has a product or service that generates repeat visits, or has the potential to create a meaningful relationship with the consumer, they should create a destination website. Contextual marketing and social media should then drive their web traffic to this website. Dutta and Segev (1999) note that companies in the software, media or marketing sector have the potential to do particularly well using this strategy.

If the company does not fall into this bracket then they are better investing online via contextual marketing highlighting where their product can be obtained. They should optimise the placement of their advertisements, aiming for them to appear at web location where their user base is known to frequent. Rather than pointing web traffic to their website it should point the consumers to where they can obtain their product, whether it be at the side of a road or in a supermarket.

All companies can benefit from following their competitors and leading critics in their marketplace. Evans (2012) book is entitled ‘Social media marketing: An hour a day’. Arguably this level of investment into social media needs to be experimented with. Depending on the SMEs marketplace other avenues of marketing may provide better value for money. However, the author argues that spending ten minutes catching up, daily or weekly, with what people and companies are saying in a given market can only be beneficial to a SMEs future strategy.

V. CONCLUSION

In conclusion engaging online is argued by Branthwaite and Patterson (2011) to be a necessity in order for a company to remain competitive in their marketplace. Many of the avenues may seem daunting but good examples exist of companies who have learnt how to successfully engage their customers and mould their conversations by contributing relevant experiences and news via various online mediums. Noted by many is the success of involving humour and entertainment in these marketing avenues (Smith and Zook, 2011; Mangold and Faulds, 2009; Evans, 2012). Correct integration and creative use has proven to lead to gaining customers, increased profits and lower the cost of acquiring customers (Vishwanath and Mulvin, 2003). Ultimately, for a company to avail of these benefits, they need to be focusing on their customers: creating relationships, making their lives easier and engaging them with content that gives them something to talk about.
REFERENCES


Enterprise resource planning systems for SME's

Research, Issues and Analysis

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Abstract—Managers and Owners alike of SME require tasks to be completed every day using Information Systems. Tasks such as database tasks, making orders, and checking email, are all examples of tasks that may not be easily accessed by people who do not know how to use computers. Through research it seems that a lot of the time SME's find that they can improve performance of the business with easy to learn interfaces for their separate tasks. This issue has been addressed in the past such as the addition of personalized Databasing to Access. This analyzes the idea of a program that encompasses different daily jobs that an SME faces into a singular interface; implementation refers to the modern day advancements of the technology world and particularly the release of Windows 8.

Index Terms— SME's, Ease-of-Use Interface, Software, Windows 8, Databases, Efficiency Improvement

I. INTRODUCTION

While many Small and Medium-Sized Enterprises (SME's) run fine using their old technology, there is almost always a way that one could improve the way a system works. Stale [10] states that because of the quickened rate of expansion of modern day lifestyle and technologies, that businesses and education centers have to adapt their systems to be up to date as well as educating the employees on these new systems, which are important in today’s “hype-competitive business ecosystems” (Stale, 2010).

There have been many different technology focused strategies implemented to address the problems and growing needs of SME's IT systems. The importance of improving technology systems by infusing all of a different companies systems into one has been highlighted multiple times (Stale, 2010). These systems are often known as Enterprise Resource Planning (ERP) systems (Vilpotta et al, 2007). I will evaluate the pros and cons of these existing systems against how well they address the problem, and how well they keep up to date with the modern day advancements of system specifications such as the; operating system, cloud-based storage, secure email, and hardware specifications.

I will apply this research to the idea of creating an ERP based system interface for SME’s that takes advantage of Windows 8’s new metro-style interface. I chose Windows 8 for its ease-of-use interface design which would desirably lower the technological knowledge requirements for employees using the software, saving SME’s on time and resources otherwise spent training employees (Vilpotta et al, 2007).

Research for this paper was found through searches on online academic databases, mainly IEEE and ACM. All data collected comes from relevant or similar studies mainly to do with SME’s, ERP and the combination of the two. Many of the statements I refer all have academic sources or evidence to back up the claims that I have applied to this work.

II. PROBLEMS OF SME'S

By far the biggest problem of IT Systems for SME's is that they consume far too much time and resources, meaning that the IT systems can become a burden on the business instead of fulfilling their modern day role of saving time and resources.

There are many reasons for the lack of IT performance in SME’s one of the main being the economic crisis, in which companies forced to spend less money have to sacrifice investment into IT systems which are fairly expensive depending on requirements. It is not just the interest of the SME at hand, with governments running schemes for increased IT productivity for the purpose of helping out with the respective countries economy (Ashekele and Matengu, 2008). It is also a growing need in developing countries who are at the stage where they require adoption of more efficient IT systems in order to succeed (Kapurubandara, 2008; Lin et al, 2010).

When evaluating the upgrade of its IT systems, an SME will have to look at the external resources such as; associate businesses, financial reach and technology available. Internal resources must also be evaluated in terms of employee skill and management capabilities (Ashekele and Matengu, 2008).

A. Expensive Costs

One of the big problems for SME's right now being the economic crisis, in which companies forced to spend less money have to sacrifice investment into IT systems which are fairly expensive depending on requirements (Ashekele and Matengu, 2008).

B. Management Difficulties

SME's may struggle or have management techniques impaired because of their reliance on dated and mixed systems, these systems can be tedious when trying to increase compatibility and speed of processes (Stale, 2010).

C. Change Management

Another reason, particularly applicable to the smaller enterprises, for lack of IT performance is the reluctance or
inability for the enterprise to function while it is implementing these systems, as well as the adaptation of existing management techniques, it can make it harder for the company to function (Kerimoglu and Basoglu, 2006).

D. User Training

When IT systems are improved upon, this usually requires the users who are involved in the change to be updated and trained on how to use the newly implemented system. This inconvenience can cause prove to cost the SME a lot of resources, as ineffective training of users is often a major reason for failure (Somers and Nelson, 2001; Mulazzani et al, 2009).

III. ENTERPRISE RESOURCE PLANNING

To combat these IT problems, a commonly suggested and implemented solution is the advancement and encapsulating of the existing technology, one of the well adopted architectures for helping business adopt this technique is Service-Oriented Architecture (SOA), it has been used by many SME's for “encapsulating software application in services”(Lin et al, 2010). SOA in simple terms runs a server that is capable of collecting information from databases, web applications and services.

While Enterprise Resource Planning has been present on a large corporation level for a long time, the idea of applying this to SME's wasn't implemented until 2003. The development of ERP for SME's became a greater need at this time for reasons such as; the need for SME's to modernize their IT systems, the potential for saving time, money and resources spent on separated processes (Mulazzani et al, 2009).

Perhaps a better defined and more widely adapted model than SOA, ERP systems is a methodology used to combine companies different information systems together. These types of programs are what is known as multi-module applications, because of their use of different programs to integrate desired functions and programs into one program that can be spread across an enterprise for use by different parties (Mulazzani et al, 2009). These systems vary and can be bought commercially, so there is a range of different systems. I highlight these systems to be the most appropriate solution to the identified problem of inefficient use of IT systems within an SME.

ERP systems have been described in the relevant situation of an SME to - “enhance [the SME's] processes, and to develop their competitive advantages.” (Vipolta et al, 2007) and to “save materials, reduce the backlog of inventory, reduce costs; improve on-time completion rate, thereby increasing the efficiency of enterprises and reduce business operating costs, improve enterprise competitiveness” (Changchun and Yang, 2010).

However, ERP applications are limited in that they simply cannot cater for all needs of an SME, sometimes they must be individually tailored for an SME, but most of the time the SME is instead encouraged to adapt their existing management processes to conform to the particular form of ERP that they wish to implement. Stress has been emphasized on the optimization of the Change Management used in this process.

ERP's are implemented into a system by systematically removing the incompatibilities from the existing processes. It has been said that effective Change Management should be applied to each of these stages, this is for the purpose of tying off any lose ends (Kerimoglu and Basoglu, 2006).

However there have been studies that have attempted to design an ERP that is possible of catering to an SME's varying needs. A case study conducted on an SME by Zach and Olsen (2011) outlines several success factors that are of importance with the competitive advantage of the implementation.

Researching Critical success factors of ERP's outlined in a previous study by Somers and Nelson (2001) include the need for extensive management support and the need for user training. However, one of the purposes of this project was to research whether an ERP implementation could be feasible for use with little to no user-training being required for employees to work with the software. Lack of user training has also previously been held accountable for the failure of ERP implementations on a frequent basis (Mulazzani et al, 2009; Somers and Nelson, 2001). However it should be noted that these proven failures were before the development and adoption of certain modern usability-focused technology and interfaces such as Windows 8.

As mentioned, ERP systems require very careful planning if they are to execute properly, incorrect planning can lead to the crash and compile of certain used structures. There exists however several functional structure models to be followed when planning an ERP to make sure that all the factors are accounted for (Changchun and Yang, 2010). The SME must first clearly define its specific requirements from the ERP, they do so usually by planning out a hierarchical diagram which shows what business sectors need to be accounted for, and how they are linked See Figure A.

![Figure A (Changchun and Yang, 2010)](image_url)

This isn't the only method used of planning the implementation, Reuther and Chattopadhyay (2004) discussed the use of defining primary and secondary business processes and information systems for the SME, primary being systems and processes that deal with the inner workings of the company, and secondary being the systems that deal with daily company tasks. The primary systems were as implied, highlighted to have a much larger success factor. This is where it starts to
become clear that a lot of EMP implementation requires the SME to have access to particular resources.

From all of this initial research on ERPs, I identified what the following issues as the major success factors when implementing ERP into an SME (in no particular order):

1. Effectively Training Users.
2. Effective Change Management of existing management processes to conform to an ERP.
3. Up to date IT management planning.

IV. ANALYSIS & CONCLUSION

Outstanding problems include the training of employees. As mentioned, I personally I think that a Windows 8's Metro-style interface is a refreshing and extremely easy one to get the hang of. Users can easily pick it up without documentation, let alone without the instruction of another person.

As discussed, some of my research shows that user training is a critical success factor that cannot be ignored, however I believe this is somewhat of a context sensitive success factor. This is because of the fact that SME's all run their own chosen and completely different forms of management techniques. For example some SME's may need to make crucial decisions terms of management structures and processes in order to accommodate for the desired form of ERP. But this isn't to say that some SME's may have simplistic management structures to which they could apply ERP without having to make any changes to. I would argue that in this case, where the users are already familiar with the structure, that the only training possibly needed for employees in order to resume their daily tasks, is a brief run-through of how to work with the application, they already know how to do the rest (Lin et al, 2010).

This idea of implementing ERP into a Windows 8 Store App has been successfully attempted before as part of a bachelor thesis however the results were not published so analysis of how it went isn't possible (Brüllmann et al, 2012), however the possibility of an implementation of an ERP for SME's using Windows 8 seems extremely feasible, and may be an effective way of helping or ensuring execution of the critical success factor of Effectively Training Users.

It should be noted that there are several problems with SME's that ERP just cannot solve, hence ERP can not be viewed as a sole solution to the outlined problem of IT systems consuming a high amount of resources. ERP should not be ignored however, as it has shown to be extremely useful in the aid of developing SME's although there are still some issues that should be addressed.

Some ERP success factors are not under the control of the SME, such as the control over what external resources that they have access to (Mulazzani et al, 2009). For example if an SME is in a developing country then they generally have outdated or cheaper technology making it hard for them to adopt an ERP that is compatible with the limited resources they have access to (Kapurubandara, 2008). System functionality requirements are so high a success factor that it can deem the whole ERP impossible to implement if all the specifications are not met (Reuther and Chattopadhyay, 2004).

Another outlying problem, which prevents the use of ERP in the first place, is that the implementation of an ERP requires the application of significant and often complex management processes. Retaining well-planned management of the systems is crucial to the project being a success, badly organized organisation of an ERP could have catastrophic consequences on the inner workings of the enterprise. This presents an issue for enterprises that lack in management skills or knowledge of IT, ERP implementation may prove too expensive, or present too much of a risk for the enterprise to go through with.

I believe that the biggest reason SME's face that particular problem of IT inefficiency is the unpredictable and flooded IT resource market, which means that technology and applications that they use vary greatly. Because ERP systems for SME's didn't get popular until 10 years ago, many SME's have been left with a mix of incompatible systems that were not designed with ERP ever being a factor (Mulazzani et al, 2009).

It does seem that slowly ERP systems are adapting with the extremely large amount of different case studies I have come across from all over the world, there is blatantly a huge demand for ERP and the value of the ERP market has been increasing steadily, showing that even if it doesn't solve the all the problems, it has greatly helped (Reuther and Chattopadhyay, 2004).
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3d Augmentation Application

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Abstract—A simple mistake could cost the reputation of an enterprise. As a result, this article discusses the merits behind an idea for a new software application that could eliminate errors. As more of our daily lives are impacted by complicated software applications, this new application has been specifically designed to be easy to use and require minimal training. Problems with current hardware architecture are discussed and possible solutions are presented.

Index Terms—SME, CAD, DMU, 3d Augmentation, Data Matrix.

I. INTRODUCTION

The launch customer of the Boeing 787 aircraft spotted incorrectly fitted components to one of the aircraft’s two engines. The mistakes were in essence, human errors, which could potentially cause disruption whilst the aircraft was in service. Issues caused by the mistakes include flights to be delayed or cancelled. Worse problems could arise if the aircraft was airborne. The incident was classed as a major quality failure event that could tarnish the reputation of the manufacturer. A new software application has been designed and is in the process of being written, that could help to eliminate human errors and over-sights, during the rigorous inspection procedures that each engine delivery must endure prior to dispatch to the customer. This article discusses how the ideas for the application came to fruition and the design of the application. Although the article is based around an event that took place at a large organisation, the application could be tailored to suit many other types of business models, whether the business enterprise is small, medium or large.

II. BACKGROUND

In the modern world the designs of many engineered components including cars, airplanes, and even vacuum cleaners, etc., are created with the utilisation of Computer Aided Design (CAD) software (Dassault Systèmes, 2013). The design software includes a multitude of features that allow many designers to work within concurrent design environments, which should eliminate problems with components colliding or close clearance issues that could cause component fretage due to thermal expansion or movement whilst in operation. When the design of each component is complete, a detail drawing of each component is created from the models created by the designer. The drawings and models are then used to manufacture every component to a high standard. A Digital Mockup (DMU) of the completed assembly is created so that anyone throughout the company can see what the final assembled product looks like. This DMU is in turn used to assist the fitters as a visual guide to help assemble each engine. It is during the assembly stage that errors and anomalies can creep in. This is primarily due to the complexity and the sheer number of components fitted to each engine. Each engine must be inspected several times before it is allowed to leave the manufacturing facility; sometimes inexperienced inspectors of a particular engine type may be asked to perform an inspection due to short staffing, either through holidays or illness, etc. The particular engine type where the problems occurred was a new engine type that was unfamiliar to most of the people working on assembling and inspecting it.

Due to the serious nature of the incident, a thorough internal company investigation was carried out. As a result of the quality failure investigation stringent processes were put into place that would stop another escape of quality from happening again. Quality auditors initially targeted the final assembly build areas where the engines are built. Eventually the auditors followed the trails back to the designers of the external engine dressings, to see what could be done to assist the fitters as a visual guide to help assemble each engine.

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people’s reluctance to change. Strassman (Strassmann, 1998) notes that:

“Resistance to change may come from hundreds of sources. Management may not be able to change operating procedures, despite best intentions. Implementation may run into difficulties in training the operators to the desired standards of performance.”

The assembly build line staff had to be trained to use the new software; a lot of these people had minimal computing knowledge. The new system replaces the drawings and photos with a 3d representation of the engine, utilising geometric models of each and every component that gets fitted to the engine. Unfamiliarity with the new computer system coupled with the fact that it was implemented upon a brand new engine type has compounded the problems.

III. APPLICATION IDEA

The idea for the application was personally conceived as a result of the quality investigation. Some people within the organisation may argue that the benefits provided by the application, could be outweighed by the requirement for further training and add additional complexity.

On the outside of the engine there are approximately 5000 individual components, a full representation of the engine scenery is already available in computer model format from within the existing Team Center software environment. Team Center utilises a variety of different model formats, including the native .prt heavy weight model file, through to light weight .JT file (Siemens, 2013). The application is designed and being written to run on a Windows based tablet device and utilises the 3d models in the lightweight JT format. To operate the application, the user would need to hold the tablet with the devices camera facing the engine. The models are overlaid on top of the physical representation of an engine by utilising a technique known as 3d Augmentation. The information is then analysed by comparing the physical and virtual images, checking that correct parts are fitted and parts are not missing or fitted incorrectly. Where possible due to size constraints, each component on the engine has a Data Matrix (ISO, 2013) etched onto it that contains its part number, as seen in figure 1.

![Fig. 6. A Data Matrix that contains information, for example part number, serial number.](image)

This information can be read by the application to assist with the comparison process between the Virtual representation and the Physical engine. The software application can datum itself against the part number in the DMU, when the part number has been read on the hardware. If the part number cross reference fails to find the part number then it’s flagged as a problem. Similarly the application can check what is attached to any particular component, and can flag any missing parts or incorrectly fitted parts. Primarily the application can be utilised as an inspectional tool when the engine has been assembled, although with some tailoring it could be beneficial to utilise this system as an aid to assist assembly & remove any anomalies before they are even created.

IV. EASE OF USE

The user interface has intentionally been designed to be clean, simple and easy to use. The benefits from this approach include keeping the training requirements to a minimum, helps to eliminate any additional problems with over complexity whilst using the application and it becoming yet another thing to learn. Figure 2 is a screen shot showing assembled components displayed upon the Windows Mobile device simulator.

![Fig. 7. An image of a DMU as shown in simulator.](image)

V. KNOWN ISSUES AND LIMITATIONS

Whilst working upon the design of the application, it was decided to do some trials with reading real Data Matrix markings that had been etched onto a component. The trials were initially carried out on a metal bracket, that is used for supported some of the engines wire harnesses. The scanner application tested is available from Google’s App Store (Google Play, 2012). The app was installed on a mobile phone (Samsung, 2013). Figure 3 contains a photo taken of a metal bracket that was used for the initial trials.

![Fig. 8. The photograph shows the Matrix markings on a physical component.](image)

The position of each Data matrix is situated on a designated flat surface; Figure 3 shows a close up view of the chemically
etched markings. The software scanner application that was tested, struggled to read the Data Matrix. This is due to the grain of the metal that the bracket is manufactured from; also the etching process produces a red/golden matrix as can be seen from the photograph. Recreating the Data matrix on a white background with a black matrix yielded positive results with the Data Matrix being read straight away without any problems. A direct comparison of the two matrixes is figure 4.

Fig. 9. The same Data Matrix shown side by side clearly highlights the problems that the guns have with reading markings.

Following further investigation, concerns were raised further when trying to read the matrix on a pipe. The pipes are round, with the majority of them being below 25mm in diameter, the matrices are etched cylindrically around the pipes. The scanner application could not read the matrix markings on a selection of pipes tested.

This discovery lead to making enquiries with various areas that deal with part markings. A specialist in component part marking was contacted and a meeting was arranged. During the meeting, it soon became clear that the problem reading the Data Matrix markings was already understood. Although every component that is manufactured, where it is physically possible due to size constraints, has a matrix etched upon it. Only the components that are classed as ‘critical’ are scanned to record the individual serial numbers. The scanners that are used are hand held scanners manufactured by Cognex - 8500 Autofocus (COGNEX, 2013) and Motorola Symbol DS3578 (Motorola, 2013). The range of the guns is quite a short, which could pose additional problems during scanning complex assemblies. The range of two types of guns is 0 to 11.18cm (Motorola, 2012), before the matrix markings become unreadable. The guns themselves are very similar to those in supermarkets that read standard bar codes. During the meeting the purpose of the application was discussed and considered to have good potential, although the limitations of the current scanner technology would impact the design of the software. A decision was made to arrange a meeting with the manufacturers of the scanners to see if they could help with an improved gun. Blue ray technology (Rouse, 2005) was discussed as a better solution. Other issues that came to light during the conversation included the ability of the guns to read the markings, if the components were fitted with the markings facing inwards into the engine, or if the markings were obscured by other components. Cylindrical surfaces like tubes also caused problems for the ability of the guns to read the markings.

A possible solution to overcome the shortfall in capabilities of the guns is to adapt the software to use shape recognition until the guns had been improved. This area is the topic of many research papers and articles (University of York, 2011). Utilisation of a shape recognition algorithm as proposed by one of the research papers is computationally heavy and slower. The technique utilises the GPU to create a point cloud from the scanned image for each model, a comparison between the point cloud and the models within the DMU is performed until a match is found.

Another form of shape recognition involves the use of pixel colour checking. This method has been discounted due to the fact that very few of the physical engine components are painted and are the colour of the particular material used, i.e. metallic. The colour pigment of the metallic components can change due to heat treatment and manufacturing processes, i.e. welding, none of which can be represented by a digital model. As you may have noticed from the image of the DMU within the simulator, the models are colour coded to match the particular system that they represent, for example the blue coloured pipes, the colour blue represents Air, whilst yellow signifies Oil, etc.

VI. CONCLUSION

From the analysis of the initial problem, there is a strong belief by many people within the organisation that the 3d augmented software application has great potential, and the benefits would far outweigh the requirements for additional training. The application has been designed to be easy to use, and require minimal training. Unfortunately, due to hardware limitations with the scanners technology within the tablet and the guns constrain the initial idea, compounded with the fact that holding both a tablet and a scanner gun would make the concept unwieldy and potentially unusable. As the ever improving cycle of technological advances, within the mobile devices, cameras built into the devices are also improving; this would assist with the current limitations of the application.
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Failure Risks When Introducing IT to a SME

Enterprise Systems

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Abstract— Trillions of dollars are lost each year due to failed IT projects. If companies made changes in the way they introduce IT into their organisations, less money would be lost.

Index Terms—Information Technology, IT, Failure, SME, Small to Medium Enterprise, Risk, Company, Organisation

I. INTRODUCTION

This article will cover the main elements that cause IT projects to fail, analyse these key issues and propose recommendations to minimise the chance of project failure.

The Standish Group gave the main reasons for the success, challenge, and failures of system projects; some of these reasons are:

• Incomplete requirements
• Lack of user involvement
• Lack of resources
• Unrealistic expectations
• Lack of executive support
• Changing requirements and specifications
• Lack of planning
• No longer needed
• Lack of IT management
• Unrealistic timeframes
• Unclear objectives (The Chaos Report, 1995)

Understanding these reasons for failed projects will in turn give a greater understanding of how to avoid the pitfalls and increase chances of success.

II. HISTORY AND STATISTICS

In 1995 the Standish group wrote a report called The Chaos Report, this report outlined the percentage of failed, challenged and cancelled projects, approximations of how much these failed projects costs, and broke the statistics down according to the size of the organisation. The Standish Group regard a project as challenged when it is over budget, over time estimate, and reduced features and functions than originally specified (The Standish Group, 1995).

The Standish Group reported in 1995 that project success were 16.2%, projects challenged were 52.7% and projects failed were 31.1%. The Standish Group also reported that a small business would spend on average $434,000 and a medium company would spend on average $1,331,000 on development projects (The Standish Group, 1995).

In 2008 The Standish Group reported that project success was 32%, projects challenged were 44% and projects failed were 24% (The Standish Group, 2009).

It was suggested that $500 billion was being lost worldwide each month in 2009 and that amount was increasing (Sessions, 2009 p.1).

III. FAILURE RISKS

A. Incomplete requirements

Dey et al (2007) wrote that one of the most crucial phases of a project is the requirements phase, if this is not exact then the project will not fulfil the user’s needs, in a recent case study he found this had the second most crippling effect on the project development.

In short, you must make sure that all the requirements are known and taken into account, if all the requirements are not known they will not be implemented and the project will not do what is required.

B. Lack of user involvement

Smith et al (2009) found that generally in regards to the project manager, a lack of support (team members, sponsors or users) impeded project progress. In another study Better projects results are said to come if you properly identify stakeholders and manage them well, you should also identify their requirements and what you need from them (Little, 2011) this includes the users of the project. Dey et al (2007) identified that effective communication between client/customers and developers throughout the project development helps to achieve success. He also added that this had the most likelihood of occurrence and severity in regards to project failure.

This is what had resulted in a failure Pan (2008) found when doing a case study. Because a project manager underestimated the need for end-user participation in the development stage of a project, and just assumed that because the project was fairly comprehensive he would receive full cooperation. This in turn turned into an unanticipated coalition
between the users and managers in resisting the project, which was one of the key factors that led to the partial abandonment of the project. However if the project manager had included the relevant end-users early on in the project, this would have helped enhance their enthusiasm and commitment towards the project.

To summarise, if the users are not involved it is harder to know whether the system is going to do what is required, and works as required.

C. Lack of resources

During the course of your project, Dey et al (2007) suggested loss or unavailability of key personnel can be a risk. The Standish Group (2005) identified each position having key players, a cohesive team and proficient coaches as key elements without these it is doubtful the project will be a success. The Standish Group (2005) also went on to say that, competent developers, stakeholders that act as a team and management that communicate strategy and goals are essential.

To summarise, key personal need to be available, if people are missing jobs may not get done and this can interrupt the whole process, which then affects timescales and milestones. This is an important consideration when a risk assessment is done.

D. Unrealistic expectations

Because of ambitious projects repeatedly failing, The Standish Group (1999) said that a project manager should not be Santa Claus and learn to say “no” which is the hardest lesson for project manager. The project manager should be looking at the features and functions, projects scope and other factors involved within the project, this should all be measured against business value, project quality, resources, risk and schedule.

It has also been suggested that complexity tracks nicely with system failures as it is harder and more costly to work on a more complex system (Sessions, 2009)

To summarise a project that is as simple as possible is key for preventing many risks. If a system is more complex than it needs to be, it will take longer and cost more to develop, it may be harder to use and maintain, it may not even be possible to achieve, which is sometimes only found out later in development.

E. Lack of executive support

A sample of project managers surveyed said that top management support would improve their performance and performance on projects (Sauer and Cuthbertson, 2003). The Standish Group (2001) said that lack of executive support and input can put a project at a severe disadvantage.

In short lack of executive support can lead to lower moral, and sluggishness with progress. It can also lead to nasty little surprises if there is lack of communication between the development team and management.

F. Changing requirements and specifications

Little (2011) said that “few projects go through their life-cycle without change” Pan (2008) found in one of the studies that frequent changes to the system requirements specifications is another problem that can be underestimated by project manager. In a conference it was stated:

“Once management structure requirements have been met, the project users, who have different priorities and no financial responsibility for the project, push revisions and project redefinitions to get back what they wanted in the first place. Thus the seeds for future failure are shown.” (Ward G., 2001)

Little added that changes must be controlled and you must not allow the changes to control you (Little, 2011).

Therefore, little changes/additions are ok, but too many cause major problems with project development, with the initial requirements well gathered, considered and risk management planned, there may be less changes needed later. Too many changes required later on can lead to many problems, time, cost, complexity issues, and may ultimately lead to a cancelled project, as you cannot put a square shape in a round hole easily.

G. Lack of planning

Planning is an important part of a number of types of projects and this is also true with IT projects. Massis (2010) wrote in a report that the implementation of the project without the proper planning means the project does not work out as planned or completely fails.

Methodologies are also used by some project managers and are found by number of people to be an integral part of the planning procedure of the project.

Therefore, planning is very important, with a good plan in place, people know what they are doing, when they are doing it, and what needs to happen next; small steps are also recommended.

H. No longer needed

When The Standish Group (2005) conducted a focus group with IT executives, one of the examples given of a failed project was a one that was 2 years late, and 3 years into development and the company had stopped selling the product over a year before.

Therefore, if a project goes over the estimated timeframe it can lead to the project no longer being required or no longer up to date. Also consider if you have ear marked a certain timescale for the project, for example two years, will it still be required in two years?

I. Lack of IT management

A number of reports and studies have been written in regards to the impact project managers and team leaders have on the success or failure of a project. The Standish Group (1999) said that most projects fail due to project management with lack of skills. Little (2011) says projects need careful planning, skilful managing and a bit of luck, successful
projects don't just happen, and there is more to completing a project than just doing it and completing it. Little (2011) also went on to say successful project management principles should be learnt and relearnt.

As well as the necessary skills, Nixon et al (2011) suggests that leadership style is an effective tool used by project managers to influence a project outcome, and therefore a lack of leadership performance monitoring can be directly associated with project failure.

Therefore, lack of management skills, both soft and hard skills, can lead to a project not being completed competently and/or lower morale within the team.

J. Unrealistic timeframes

Timeframes are important when planning a project; unrealistic timeframes can also lead to other elements that can cause project failure.

Burkard (2001) stated that objectives should use milestones which would mean that the project would be delivered on time rather than early, but this can also influence the tendency we all have a problem with which is what he regarded as, the “student syndrome” which means if we have enough time we will procrastinate and do other things until we put under pressure by the deadline. That after Murphy's Law has struck, we will start work at the last possible moment and in turn significantly diminish the chance of finishing on time. Lautiner (2001) also argued that executing a project according to plan is the exception rather than the rule. Also Little (2011) said that unexpected things happen which derail many projects, therefore it would seem working towards an early finish would be more ideal than an on-time finish and therefore gives more time for unexpected happenings.

To summarise timeframes need to be established realistically and then they need to be met, if this is not done, it can lead to many other issues also mentioned in this report and then there is a good chance of project failure.

K. Unclear objectives

In a report that surveyed a sample amount of project managers, they agreed that a key aspect was clarity of objectives, and that misunderstanding scope, objectives and requirements were one of the highest risk factors associated with project success. (Sauer and Cuthbertson, 2003)

Therefore making clear and manageable objectives not only helps the team know what they are doing and when they are doing it, make timeframes more manageable, it also helps when communicating with top management and clients so everyone knows exactly what is happening.

IV. Risk Management

A number of sources have indicated that a risk management plan is vital in the initial stages of project development planning. Baccarini et al (2004) said that projects are unique undertakings that involve a degree of uncertainty and therefore are inherently risky; he also added that the achievement of a successful delivery of an IT project includes risk management as an essential practice.

Dey et al (2007) suggested a strategy of effective risk responses that include principles of avoidance, transferring, absorbing and reduction.

V. Conclusion

There are a number of elements that can cause a project to fail, whether it is just one element or a number of them, the chances of a project failing or becoming challenged is uncomfortably high.

One simple mistake can lead to a sequence of events that makes it harder to claw back your project from failure, for example, lack of planning can lead to the project taking longer than expected, then the cost of the project is increased, and then the project could either be too expensive to complete and has to be abandoned, or the project is completely with less functionality than what was originally asked for.

This was how one case study that Pan (2008) had analysed, the conclusion he came to on why the project failed. It was stated that due to an unrealistic deadline and projects scope, the project was started with very little planning due to a lack of time. Then as well as the poor planning within this project other key issues happened, not including the users in the system requirements specification, the poor process of contract bidding and poor negotiation of the contract.

In this report I have explained the key elements that are generally associated with why projects fail. If these elements are taken into consideration as well as a clear risk management plan when introducing IT into your business, the chances of failure will be reduced.
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Public Versus Private Cloud for Small to Medium Size Game Developers using a Photorealistic Game Engine

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Abstract— Methods of simulating photorealistic lighting, such as global illumination, have traditionally been restricted to the domain of expensive High Performance Computing (HPC) clusters. HPC is increasingly more accessible due to the proliferation of computing-on-demand cloud services and general-purpose GPU (GPGPU) architectures. To create realistic games, SME-size game developers can use a game engine designed to work on a cloud computing cluster in order to produce a game for a cloud gaming service. This paper analyses the benefits and liabilities associated with private and public clouds in connection with a game developer’s enterprise architecture.

Index Terms— HPC, GPGPU, SME, global illumination, cloud computing, cloud gaming, strategic alignment.

I. INTRODUCTION

There is a demand for increased realism in three-dimensional computer games developed by game developer companies in the small-to-medium enterprise size range (SME) (Ritschel et al., 2012). 3D scenes in a game are made up of environments, props and characters whose surfaces are represented by a mesh of triangles. The mesh is rendered by the game engine using shading information and textures to depict a virtual scene. Realism has been traditionally improved by increasing the detail of the triangle meshes and images used as textures, but recent Graphics Processing Unit (GPU) architecture has been developed to provide a programmable shader to give programmers more control over the rendering pipeline (Lindholm et al., 2008). The pixel-shader component, for example, allows a programmer to simulate advanced lighting effects.

The GPU must render the scene many times a second (60 frames per second is optimal) for animation and interactive gameplay. To do this the architecture makes use of hundreds of parallel streaming processor cores executing thousands of threads (Nickolls and Dally, 2010). Areas that traditionally use High Performance Computing (HPC), such as medical imaging, computer-aided-design, filmmaking and other forms of computer visualisation, exploit the power of parallel processing as well (Nvidia, 2013). Graphics hardware companies such as NVIDIA and AMD recognised that the programmable shader architecture could be adapted for general computing problems traditionally in the HPC domain and created standardised architectures for general-purpose computing on GPU devices. This created a new domain collectively known as general-purpose GPU: GPGPU (Nickolls and Dally, 2010). CUDA is a GPGPU development toolkit and architecture by NVIDIA (Nickolls et al., 2008). OpenCL is a GPGPU programming library by AMD (Kindratenko et al., 2009).

<table>
<thead>
<tr>
<th>Year</th>
<th>GPU</th>
<th>Transistors</th>
<th>CUDA Cores</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>GeForce 8800a</td>
<td>681 million</td>
<td>128</td>
</tr>
<tr>
<td>2008</td>
<td>GeForce GTX 280b</td>
<td>1.4 billion</td>
<td>240</td>
</tr>
<tr>
<td>2012</td>
<td>GeForce GTX 680c</td>
<td>3.54 billion</td>
<td>1536</td>
</tr>
</tbody>
</table>

a, b. (Nickolls and Dally, 2010). c. (Weller, 2012).

Multiple GPU devices can be installed in a single computing node, as is the case with NVIDIA’s Tesla Personal Supercomputer (Gurney, 2009). Because each GPU can be seen as a distinct computing node, a single workstation can be treated as a computing cluster. If an SME has a computing problem that is conducive to GPU parallel processing, then the domain of HPC becomes more affordable and maintainable as the HPC cluster would require far fewer individual machines (Nickolls and Dally, 2010).

A method of creating highly realistic lighting in a game environment is global illumination (GI), which uses a physics-based model of light to compute realistic light scattering over a scene. This has an advantage over rasterising techniques currently employed in games in that it easily simulates realistic light effects such as reflection, refraction, colour bleeding and caustics (Ritschel et al., 2012). The downside is that it requires vastly more parallel processing power in comparison with rasterisation and it has therefore not been considered as an interactive rendering method until recently (Kadir and Khan, 2008). Now GPUs are an essential component of private HPC clusters as well as some notable public IaaS cloud providers such as Amazon EC2 (Amazon.com, Inc, 2013) and NVIDIA GRID (Nvidia, 2013).
HPC computer visualisation techniques such as GI are more available to game developers and players (Kindratenko et al., 2009). Cloud gaming providers such as OnLive offer the infrastructure to serve realistic games to many players simultaneously (Red Bull Computer Limited, 2013). A company wanting to develop a game for a cloud gaming service needs an IT infrastructure with the capability of running a GI-based game engine. Two options are available to the company: create and maintain a private cloud computing cluster or subscribe to a public cloud computing service. Private computing clusters are often connected via Gigabit Ethernet and remain a popular method for HPC (Sadasiv and Kumar, 2011). Public cloud services come in three forms: Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS) and Infrastructure-as-a-Service (IaaS) (Dillon et al., 2010). While a cloud gaming provider might one day offer a preconfigured game engine as PaaS or SaaS, no such offering currently exists, so it is assumed that a game developer will subscribe to an IaaS model in order to install their own operating system (OS) and game engine. In the Strategic Alignment model for business-IT alignment, IT governance roles such as the Chief Information Officer have a duty to make sure the elements of the Information and Technical Architecture such as software, hardware, networks and data management are cohesively aligned with business objectives and with the interests of stakeholders involved (development staff, game publishers, and managers) (Chebrolu, 2011). It is important to compare these two options and determine their aptness for integration in a game developer’s enterprise architecture.

II. DISCUSSION

A. Demands of a Photorealistic Game Engine

GI techniques often involve “firing” rays around a scene to traverse objects within the 3D scene and return lighting information (Reinhard, 1999). A single render requires millions of rays to be scattered via message-passing throughout the distributed system. Each machine on the network contains a subpartition of the overall scene and receives a batch of rays to process with its GPU. The game engine will therefore have a high demand on the available bandwidth in a distributed system in order to maintain an interactive frame rate (Wald et al., 2001). It is easy to benchmark the available bandwidth in a public cloud and in a private cloud, and therefore predict their capability of running the engine (Wragg, 2013). The massively-parallel shared-memory architecture of the GPU is highly conducive to the GI rendering problem, and when included in a distributed system cut down the number of machines required for interactive results (Ross, 2009). Using any more than two machines on the distributed-memory layer of the network hierarchy causes the computing efficiency of each machine to decrease due to increased latency over the Ethernet connections (Pasek, 2012). There is, however, a use for having more than two machines: redundancy, a principle of cloud computing (Chebrolu, 2011). The game engine can use dynamic load balancing in order to redistribute tasks: the same scene subpartition can be allocated on two separate machines (Reinhard, 1999). This way bounced rays can be redistributed to another machine for further processing, while the GPU can process queued tasks suited for synchronous batch processing (Karunadasa and Ranasinghe, 2009). Exploiting such asynchrony is a method of hiding latency by keeping each machine on the system as busy as possible. A GI-based game engine system architecture would therefore require a very small cluster of GPU-enabled computers, but with the flexibility to add more computers for the benefits of redundancy and latency hiding.

B. Demands of a Game Developer

1) Technical Infrastructure

Public cloud computing services share the paradigm of IT-as-a-Service: the ability to rapidly provision IT resources and be able to offer these resources to a client under a standardised on-demand payment model (Chebrolu, 2011). To allow for flexible rescaling of resources to many clients, public cloud computing services tend to make use of virtualisation software. This creates a layer of abstraction between the system software and the underlying hardware and allows both aspects to be modified independently of each other. Because public cloud services cater to the demands of many clients, they operate on an economy of scale: the price of commodity hardware decreases as more components are purchased (Catteddu and Hogben, 2010, p.17). Private clouds do not experience the same benefit of predictable and scalable pricing, and so would be out of bounds for a game developer unless they use a very small cluster. Cloud gaming services need many computers in their cluster in order to meet the demand of many gaming customers connecting to play at the same time. A much smaller cluster would be able to run a single instance of the game engine for development purposes and in turn produce a finished game fit for a cloud gaming service.

A small private cluster might be an appealing investment, but public clouds offer safety in numbers: while a game developer might be able to afford a cluster of two machines for a private cloud, duplicating the resources to create redundancy would double the expense of the investment. The benefit of a public cloud computing service is that the provider has a specialised architecture and business model to rescale resources on
demand which a game developer would not have access to (Chebrolu, 2011).
Not all the benefits of public clouds are necessarily attributable to the IaaS model. The cost of implementing the physical hardware and networking in the game development company are reduced, but IaaS is similar in function to a colocated server. The game developer will still have to hire staff to install and administer the operating system and game engine, unlike PaaS which typically provides an API the developers can use directly (Dillon et al., 2010). IaaS public cloud services are not as cost-effective as PaaS in this regard. Using a public cloud would require a great deal of internet bandwidth to transfer the ray-traversing tasks data back and forth each frame, as well as the cost of synchronising scene resources (like high-resolution textures) each time the developers want to test the gameplay. Instead of investing in network and hardware resources for a private cluster, the game developer would have to invest in an Internet connection which allows for large and frequent data transfer.
2) Data Confidentiality & Security
An SME developing a game owns data assets such as software code, game art and other documents pertaining to their development process and staff. The management would consider it a competitive disadvantage if these assets were to escape their control and be exploited by other organisations or individuals. The risks in using a public cloud concern the cloud provider’s governance and infrastructure (Catteddu and Hogben, 2010).
Data confidentiality concerns the extent to which a public cloud provider’s governance is able to guarantee privacy. The public cloud provider may have more financial resources available to hire better technical security staff than the game developer, but a third-party security agency would not share the same terms and conditions the game developer agreed to and therefore not be held to the same accountability for data that goes astray. The cloud provider’s own staff may also be a liability: because the provider is known to host a number of clients’ work, employees are a target for social engineering and manipulation as part of a ploy to release data.
Data security concerns the technical aspects of infrastructure penetration. Other users of the cloud might exploit vulnerabilities in the virtualisation software in order to gain unauthorised access to virtual machines owned by other clients. Login data may be intercepted in transit by a body outside of the cloud service via packet sniffing. These risks are negligible for a game developer using a private cloud: the data is never in transit over the Internet, and the hardware is not shared by unrelated organisations. The public cloud service provider may have the resources to hire better security staff for their hardware, which could be a benefit for a game developer. Data confidentiality, on the other hand, will always be at a greater risk with a public cloud.
3) Service Availability
Because one computer in a cluster might be shared among multiple clients, if one client uses the cloud for malicious purposes the hardware may be confiscated for police investigation (Catteddu and Hogben, 2010). This would not only put the data in the hands of an unauthorised third party, but would also prevent the company from being able to work on the game at least temporarily. Game developers often work for a deadline imposed by a publishing company. Removing the company’s ability to quickly respond to reduced functionality is a risk created by using a public cloud. A public cloud provider is more apt at rescaling resources for a game developer’s needs. The speed at which this can be deployed is a point to consider for game developers working under deadlines. Investing in a private cloud would give the company more control over the speed at which they can deploy new hardware, even though it will incur a greater one-off payment (Sadashiv and Kumar, 2011).
Vendor lock-in has been pointed out as a risk for clients using PaaS and SaaS systems, as there is currently little standardisation in the APIs and environments making it difficult for a company to easily port their data (Chebrolu, 2011). Because it is assumed a game developer will use IaaS and install their own OS and game engine, there is little risk of vendor lock-in. The speed at which they can re-upload their OS and game engine to another cloud provider in time to meet a deadline remains a risk.

III. CONCLUSION
The question of whether a game developer should invest in setting up a private cloud versus subscribing to a public cloud service can be seen as weighing up the risk of data security and service availability with that of financial cost. It has been shown that utilising a public cloud service would create considerably more risks than a private cloud: copyrighted and undisclosed game assets are more of a target on public systems. Even if the public cloud provider can afford better security staff, the shared environment creates more vulnerabilities and might expose assets to third parties. It has been shown that the game engine works best on a small cluster of computers with GPU devices. The public cloud model makes economic sense if a company needs access to dozens of machines. If the game company can invest in a private cluster of two-to-four machines, then the public cloud service would not be worth paying for on a regular basis. Therefore public cloud services should be reserved for cloud gaming-based publishers who will stream finished games to many players simultaneously, and are not suitable for use by a game developer working on a game in development. The cloud gaming service NVIDIA GRID, for example, uses virtualisation technology for its GPU resources which would allow a game developer to more readily transfer their developed game from a private cloud to a public cloud gaming service.
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