Exploring the development of a framework for agile methodologies to promote the adoption and use of cloud computing services in South Africa

by

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THESIS SUMMARY

The emergence of cloud computing is influencing how businesses develop, re-engineer, and implement critical software applications. The cloud requires developers to elevate the importance of compliance with security policies, regulations and internal engineering standards in their software development life cycles. Cloud computing and agile development methodologies are new technologies associated with new approaches in the way computing services are provisioned and development of quality software enhanced. However adoption and use of agile and cloud computing by SMMEs in South Africa is seemingly constrained by a number of technical and non-technical challenges. Using Grounded Theory and case study method this study was aimed at exploring the development of a framework for agile methodologies to promote the adoption and use of cloud computing services by SMMEs in South Africa. Data was collected through survey and in-depth interviews. Open, Axial and Selective coding was used to analyse the data.

In tandem with its main objective the study, besides exploring the development of the envisaged framework, also generated and made available valuable propositions and knowledge that SMMEs in South Africa using agile development methodologies can use to work better with cloud computing services in the country without compromising on software quality. The findings of this study and the emerging insights around the development of the framework, which in itself also constitutes an important decision making tool for supporting adoption and use of cloud computing services, are a substantial contribution to knowledge and practice in the ICT field of information systems in South Africa.

Key terms:

Migration; Adoption; Cloud Computing; Cloud Computing Services, Software Engineering; Agile Development Methodologies; SMMEs; Adoption Factors; Grounded Theory; Diffusion on Innovation; Technology, Organization and Environment; Technology Acceptance Model.

DECLARATION

Name: Mr G Mwansa

Student number: 34208704

I declare that "**Exploring the development of a framework for agile methodologies to promote the adoption and use of cloud computing services in South Africa**" is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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SIGNATURE   DATE

ACKNOWLEDGEMENTS

LIST OF ACRONYMS

AM	Agile Modelling
ARPANET	Advanced Research Projects Agency Network
ASD	Adaptive Software Development
AUP	Agile Unified Process
CAD/CAM	Computer-aided design/Computer-aided manufacturing,
CRM	Customer Relationship Management
DOI	Diffusion on innovation
DSDM	Dynamic Systems Development Method
EDI	Electronic Data Interchange
ERP	Enterprise resource planning
GORE	Goal-Oriented Requirements Engineering
JCSE	Johannesburg Centre for Software Engineering
ICT	Information and Communication Technology
IITPSA	Institute of Information Technology Professionals South Africa
ISO	International Organization for Standardization
MoSCoW	musts, shoulds, coulds and won't
MRP	Material requirements planning
R&D	Research and Development
RUP	Rational Unified Process
SAIPA	South African Institute of Professional Accountants
SDLC	Systems Development Life Cycle

SMMEs	Small, Medium and Micro Enterprises
SOA	Service-Oriented Architecture
TAM	Technology Acceptance Model
TOE	Technology, Organisation and Environment
XP	Extreme Programming

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Chapter 1 : RESEARCH CONTEXT

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1.1 Background to the problem

The emergence of cloud computing is influencing how businesses develop, re-engineer, and implement critical software applications (Marston, Li, Bandyopadhyay, Zhang & Ghalsasi 2011). The cloud requires developers to elevate the importance of compliance with security policies, regulations and internal engineering standards in their software development life cycles (Buyya, Yeo, Venugopal, Broberg & Brandic 2009). The Agile movement looks at alternatives to traditional software development project management such as the waterfall model (Pressman 2010; Mnkandla & Dwolatzky 2007). These alternatives are allow development teams to react to unpredictable requirements through incremental, iterative work cadences called sprints (Highsmith, Consortium & Cockburn 2001; Beck, Beedle, van Bennekum, Cockburn, Cunningham, Fowler, Grenning, Highsmith, Hunt, Jeffries, Kern, Marick, Martin, Mellor, Schwaber, Sutherland & Thomas 2001). Cloud computing and agile development methodologies are examples of new approaches in the use of technologies and as a result new approaches are needed in the way computing services are provisioned to support software development.

Cloud computing has shown a very robust and rapid growth in the recent past and many experts believe that it will reshape information technology processes in the next few years (Armbrust, Fox, Griffith, Joseph, Katz, Konwinski, Lee, Patterson, Rabkin, Stoica & Zaharia 2010). Cloud computing allows not only users with personal computers but also users with ubiquitous smart end user devices such as tablets and mobile smart phones which are connected to the Internet through Web 2.0 in order to use computing services that include accessing applications, storage facilities, processing and application development (Leavitt 2009). These resources are shared and maintained by providers who are remotely situated. There are generally three cloud deployment models: *private cloud* - the company owns and controls the infrastructure and applications running behind a firewall with virtualization, tools and policies including deployments; *public cloud* - resources and applications are offered as services on a subscription basis by providers; and *hybrid cloud* – a mix of public and private clouds. Each of these deployments have their own advantages and disadvantages (Dudin & Smetanin 2012.).

The cloud computing model is attractive to diverse users because it provides benefits such as cost saving in operation, development and fast deliveries (Marinescu 2012; Zhenlong, Zhonghui & Youlan 2012). For instance resources such as data, applications and tools can be accessed anywhere and by any Internet ready device with Web 2.0. Cloud computing offers customized computing infrastructure with convenient task-centric, on-demand way of sharing configurable shared pool of resources; facilitates collaboration; and provides good conditions for green computing; (Mell, Grance & Grance 2011; Talreja 2010).

Despite being endowed with benefits, cloud computing has challenges or drawbacks. Some of the challenges can be identified as security concerns; data ownership concerns; lock-in and interoperability concerns; enterprise support and service maturity; requirement for online connectivity and; anxiety among developers about a new cloud computing platform without appropriate guidance and understanding of how to effectively utilize cloud computing standard architecture (Conway & Curry 2012; Venkatraman & Wadhwa 2012; Jaeger, Lin & Grimes 2008).

In spite of significant challenges that the technology platform faces, many users, vendors and industry observers predict an optimistic future for cloud computing (Leavitt 2009; Buyya et al 2009). Worldwide, some agile developers have migrated to cloud computing environments and are now taking advantage of its wide range of services and benefits. This is evident from the 2008 Research and Development (R&D) report of Salesforce that motivated the migration of all software development to the cloud environment (Salesforce 2008). Salesforce is one of the world's leading companies dealing in enterprise cloud ecosystem and Customer Relationship Management (CRM) software.

However, this migration, adoption and use of cloud computing has mainly involved large scale companies who have the capacity to create private cloud infrastructures of their own with easy access to resources and tools. Small, medium and micro enterprises (SMMEs) have challenges in adopting and using private cloud computing for reasons such as a lack of capital base for investing in private cloud infrastructure that will accommodate all resources needed for their development activities. This confines SMMEs to adopt only one possible option which is to subscribe to public clouds. This puts them at a disadvantage and subjects them to the challenges of cloud computing associated with public clouds.

The South African Government currently considers SMMEs as vital enterprises for a sustainable growth in the economy (SAIPA 2013; Berry, von Blottnitz, Cassim, Kesper, Rajaratnam & van Seventer 2002). SMMEs contribute approximately 56% of private sector employment and 36% of gross domestic product (Fatoki & Smit 2011). According to the National Small Business Act (1996), an SMME in South Africa's finance and business services sector is an organization of micro-businesses which employ up to 5 employees, or a very small business employing up to 10 employees, or a small business employing up to 50 employees, or a medium sized business employing up to 100 employees.

Hinde and van Belle (2012) observed a significant migration and adoption of cloud computing solutions in South Africa, especially in businesses where the owners are technologically proficient. These adoptions have mainly been in web hosting and e-commerce (94%), email hosting/archiving (75%), customer relationship systems (58%), configuration and data backup (58%) and application development with 40%. An interesting consequence of this study was that it allowed an exploration of application methodologies, programming environments and tools used by organizations who have adopted cloud computing as it was not included in the research scope of Hinde and van Belle's study. A possible reason being that, certain development methodologies such as agile, emphasize specific practices that may bring about issues in the form of non-technical and technical problems associated with the cloud computing environment (Khajeh-hosseini, Greenwood, Smith & Sommerville 2012; Pallis 2010). User or developer communication limitations and programming environment lock-in are examples of non-technical and technical problems respectively (Lawler & Joseph 2011; CollabNet Inc. 2011; Brynjolfsson, Hofmann & Jordan 2010; Shimba 2010). It is against this contextual background that this research is aimed at exploring the development of a framework based on apparent factors, practices and contexts that are considered influential in the way SMMEs in South Africa are adopting and using cloud computing services.

1.2 The problem statement

The current rate of emergence of cloud computing poses a big challenge for its migration and adoption. Accordingly and as pointed out by the European Commission (2013); Conway et al (2012); Venkatraman and Wadhwa (2012); Arutyunov (2012); Armbrust et al (2010); Marston et al (2011); Brynjolfsson et al (2010); Pallis (2010), the lack of uptake and adoption of cloud computing is an obvious indication that there could be a number constraining factors embedded

within the information and technology industry. Most important to note is that despite the launch and access to cloud technology, there has been no clear contextual framing of cloud computing. It is not only crucial for one to understand what cloud computing entails in order to fully benefit from its services (Pallis 2010). The consequence of this observation is such that agile development proponents tend to emphasize characteristics of cloud computing that meet their requirements. The absence of a clear framework to support ICT users to adopt and use cloud computing services effectively have remained a problem in South Africa, more so for SMMEs.

Without a contextually responsive framework and a clear understanding of cloud computing, it is most likely that SMMEs will continue to face challenges when they decide to migrate and adopt the cloud environment. Such challenges, as already alluded to earlier include anxiety within developers about a new cloud computing platform without appropriate guidance and understanding of how to effectively utilize cloud computing standard architecture. These problems emerge from the perspective of technical and non-technical limitations (Khajeh-hosseini et al 2012; Lawler et al 2011; CollabNet Inc. 2011; Pallis 2010; Brynjolfsson et al 2010). The current adoption frameworks do not adequately address issues related to agile development methodologies and adoption of cloud computing services for SMMEs within the South African context.

1.3 Research Objectives
Based on the above context and inherent challenges, this research sought to:
- Investigate factors influencing migration to and adoption of cloud computing services by SMMEs that are using agile development methodologies;
- Explore the interactions amongst the identified factors;
- Generate knowledge and insights needed to shape the development of the envisaged framework for agile development methodologies and;
- Provide guidelines to promote and support adoption and use of cloud computing services by SMMEs in South Africa.

1.3.1 Research question
The central research question is:

What are some of the factors influencing adoption of cloud computing services by SMMEs using agile development methodologies in South Africa?

In order to answer this question, the following sub-research questions were generated and explored:

- What are the agile development methodologies being used by SMMEs?
- What are the factors influencing migration to and adoption of cloud computing by organisations using such agile development methodologies?
- How do the factors interact with each other?
- How do their interactions impact on adoption and use of cloud computing services?
- What does this impact mean for the development of the anticipated framework?
- What propositions (guidelines) can be put forward to promote and support adoption and use of cloud computing services by SMMEs in South Africa?

1.4 Significance of the study

The significance of this research is that it will contribute to the knowledge needed to promote and support adoption and use of cloud computing services in South Africa, thereby promoting the country's use and benefits of ICT innovation and technologies for economic development. The research will provide;

- Theoretical knowledge and perceptions of technological innovation adoption frameworks as applied to agile development methodologies and cloud computing environment.
- Determine effective interactions among the factors that contribute to increased adoption and use of cloud computing services and
- Guidelines to SMMEs in South Africa who are using agile development methodologies to work better and benefit from services offered by the cloud environment.

Hence, this study is of value to any individual, institution and or government department with interest in ICT and how this technology can be harnessed to support economic development of South Africa

1.5 Delimitations

The research will be conducted in South Africa and will involve software development organizations in the category of SMMEs using agile development methodologies.

1.6 Research design and methodology

In trying to answer the main research question, the study employed a qualitative research design approach underpinned by interpretivist and constructivist methodological philosophies. Interpretivist research endeavours to give an understanding to the meaning of observable facts while a constructivist research methodology accepts that there is an objective reality with a concern on how knowledge is constructed and understood (Glaser 2001; von Glasersfeld 1996). In consistence with the two research methodologies and associated epistemological approaches, the researcher used Grounded Theory coupled with a case study method to better evaluate the nature and validity of the question underpinning this research (Charmaz 2006).

A case study method was used together with interviews, focus group discussions, document analysis of previous research reports and literature review. For the focus group discussions experts were chosen using purposive sampling. This was guided by preliminary interview questions as outlined in Appendix I. The experts were taken from the sample of participants who are involved in software development using agile development methodologies within SMMEs in South Africa.

A preliminary survey was initially conducted and made use of a questionnaire that was administered to companies identified from the Information Technology directory of software development companies around the country. This survey was quantitative in orientation and as shown in Figure 1.1 was conducted in the form of a case study.
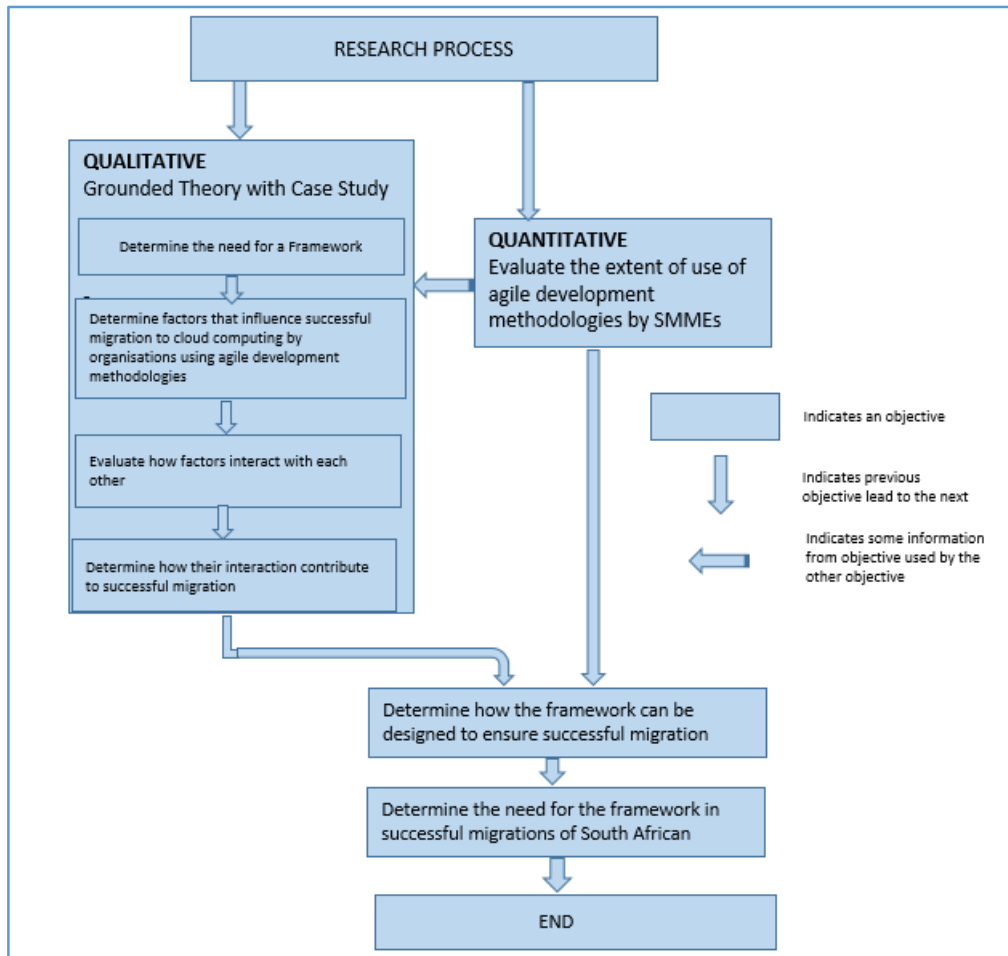
Figure 1.1: Research Process by objectives

1.7 Structure of the thesis

This thesis consists of seven chapters structured as follows:

Chapter one

Chapter one provides the background of the study. It sets the context and highlights the challenges inherent in the ICT field, with specific attention to how SMMEs in South Africa grapple with successful transition into use of cloud computing environments. Therefore this chapter also provides the reader with research objectives and research questions. The chapter also mention in passing the research methodology used to conduct the study. Chapter one is thus an orienting chapter.

Chapter two

In Chapter two, relevant literature reviewed is presented. The chapter therefore presents a review of literature on cloud computing, agile development methodologies, and current technological innovation adoption models and the existing frameworks. The discussion on

cloud computing is based on the contemporary technological implementation of cloud computing environments and services offered by the providers. Agile development methodologies such as Scrum are reviewed and their current practices are evaluated. In summary, Chapter two provides the reader with literature that is necessary to connect agile development methodology practices with cloud computing and technological innovation adoption frameworks.

Chapter three

Chapter three discusses key aspects of research methodology used in the study. The research paradigm used in this study in line with information system research design philosophical lens is carefully presented. The chapter discusses two approaches used in the study; the quantitative survey and most importantly the overview of the qualitative approach of the case study research design. It shows how the case study integrates Grounded Theory methodology such as constant comparisons of data to form categories of concepts for analysis. The chapter discusses issues relating to research ethics validity and reliability as employed during the course of the study. In short, this chapter helps the reader to better understand how the research was designed and how the data was collected and analysed.

Chapter four

Chapter four presents the survey data analysis and its findings. The analysis and findings are grouped according to demographic information about the organisations that participated in the survey, their experience in agile methodology and cloud computing, their general cloud computing experience and finally their perceived usefulness and ease of use towards cloud migration. This presentation and analysis of data crosses over to chapter five.

Chapter five

In this chapter data generated through the case study method is presented, and analysed. The chapter also outline and discuss the emerging findings in relation to the research focus and questions as pointed in chapter one. Drawing on the Grounded Theory techniques of constant comparison, a substantive framework is developed and presented in this chapter for further discussion in Chapter six.

Chapter six

Chapter six uses results of the survey and case study in order to further refine and develop the emerging framework, which is at the central to the purpose of this study. In this chapter, the researcher also presents five propositions before presenting the framework.

Chapter seven

Chapter Seven concludes the entire study. In this chapter the researcher provides a critical reflection and highlights some of the limitations of the study. The chapter thus highlights the main findings and results of this study. The chapter also explains the contribution of the study to the field of information system within the context of SMMEs in South Africa. The chapter closes by putting forward a few recommendations to guide future research into ICT and particularly cloud computing innovations and practices in South Africa.

1.8 Conclusion

In chapter one the context, background, problem statement and rationale for the need to conduct this research was discussed and explained. The current trend in computing with its shift to cloud environment was highlighted and the absence of a framework to guide SMMEs using agile development methodologies to successfully migrate to cloud computing was also problematized. Chapter one also outlined the structure of the thesis. Building on this background to the study, the next chapter, Chapter two presents a review of literature on cloud computing, agile development methodologies and current technological innovation adoption models and frameworks.

Chapter 2 : LITERATURE REVIEW

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2.1 Introduction

Chapter two, as pointed out in section 1.9 of chapter one is dedicated to giving the reader adequate information against which to understand some of the theories, knowledge and practices that currently shape and influence ICT use and practices. The also chapter defines and explains all the key terms and this reflects the researcher's grasp of his field and focus of study i.e. use of agile development methodologies in migration to cloud computing environments.

2.2 Cloud Technology

Cloud computing has over the last decade become a _buzzword_ in the computing circles escalating the promises of a new paradigm shift in the manner in which computing services are provisioned to individual and organisational users (Chui 2010; Pallis 2010; Buyya et al 2009). Cloud computing use currently involves users using services on different levels of its architecture (Marinescu 2012; Mell & Grance 2011). Users get access to services that include storage, access to application software, processing and application development by using various devices such as smart phones, laptops, personal computers only to name a few (Leavitt 2009). In addition to these applications, there are other benefits, e.g. cost savings and increased capacity to information technology departments that uses cloud technology (Marston et al 2011; Buyya et al 2009).

Important to note is that some of the software engineering companies especially those that operate on a large scale have opted to adopt cloud computing platforms for software development activities (Salesforce 2008; Yau, S & An 2011). While there have been an apparent significant benefits in the use of cloud computing, adoption of cloud technologies is still perceived with doubts by many would-be users due to inherent challenges such as those of security, privacy, lock-ins and uncertainties in the regulatory frameworks (Conway et al 2012; Venkatraman & Wadhwa 2012).

On the other hand it is also important to note that, there has also been substantial research in this area, with much of these studies, as discussed later in this chapter, focusing on addressing the inherent challenges of the technologies on offer.

The dawning age of cloud computing spans long before the advent of the internet where researchers had a vision of what was termed as computer utility. For instance, in 1961, Professor John McCarthy predicted that computing would in future be structured like any other public utility e.g. a telephone or electricity (Arutyunov 2012). The cloud computing ideology can also be traced back to Advanced Research Projects Agency Network (ARPANET) in 1969 when Joseph Carl Robnett Licklider visualized a network of data and programs interconnected for everyone to use globally (DARPA 1981). All these ideas had a theoretical concept of commoditizing computing services by providers who would make available services according to user requirements. This type of service requirement has led to the rise of cloud computing which in essence evolved from technologies such as grid and utility computing, Application Service Provision (ASP) and Software as a Service (SaaS) (Dudin & Smetanin 2012; Currie 2003).

Conceptually cloud computing creates an environment where a user application accesses computing resources through a type of service and not necessarily directly by talking to the specific central processing unit (CPU) for processing or hard drive for storage. A precise definition of cloud computing is difficult to generate due to the fact that different technology specialists and scholars emphasise different aspects in their definition as compared to those of most end-users. Thus there are a wide range of definitions of what cloud computing is.

Gartner (2013) defined cloud computing as a style of computing where massively scalable information technology (IT) related capabilities are provided "as a service" across the internet to multiple external customers. On the other hand Staten (2008) defined cloud computing as a pool of abstracted, highly scalable, and managed infrastructure capable of hosting end-customer applications and billed by consumption whereas IBM (2008:7) considers "cloud computing a potentially cost-efficient model for provisioning processes, applications and services while making IT management simpler and increasing business responsiveness." To further illustrate the difficulty of defining what cloud computing is, the world's developer of international standards, the International Organization for Standardization (ISO) was by 2011 interestingly still grappling with crafting cloud computing definition paradigms (ISO 2011).

Currently, the National Institute of Standards and Technology (NIST) is the only institution that have made attempts to provide what is widely perceived in the ICT field as a succinct definition of cloud computing. NIST defined cloud computing as a model for enabling

ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Dudin & Smetanin 2012; NIST 2011; Hug 2008). Building on NIST's definition, and in relation to the user's perspective it means that cloud computing is dynamically scalable, device-independent and provides task-centric resources that are accessed from the internet at a charge as per use basis from service provider's infrastructure (e.g. Google Apps, Amazon EC2, or Salesforce.com.

With the advent and evolution of the web to 2.0, it is prudent to speculate that cloud computing technology is geared to achieve the philosophical objective of making computing services the 5th utility after water, electricity, gas and telephony (Buyya et al 2009). This is partly because cloud computing entails a radical move from the traditional client-server architecture into web service. In fact Werfs, Baxter, Allison & Sommerville (2013), drawing on Christensen and Bower (1996), classified cloud computing amongst disruptive technologies because it has the capability of making a big difference in the way organisations associate and work with ICT. Cloud computing is with no doubt influencing the changes being observed (e.g. change from client-server to cloud computing model) in relation to models used to harness and access services and benefits that are tied to ICT

Figure 2.1 below shows the difference between a traditional computing (client-server) model and the cloud computing model. The first part (1a) in Figure 2.1 shows traditional client-server settings where local software is installed and data stored on personal computers. Users of these personal computers have access to enterprise applications, data storage including processing power from corporate servers (data centres). In case of software development, all the development tools and necessary databases are either stored on the local server or personal computers. The Internet is not a critical requirement until deployment time or only if there is need to access some websites and communication in terms of emails.

The second part (1b) of Figure 2.1 shows the cloud computing model. In this scenario, software applications and data are not stored on user's or corporate computing devices but in the cloud. In this case, internet connectivity is critical to have access to the required resources. Unlike in the traditional architecture, the cloud computing model requires third parties in order to facilitate access to resources. That is, you need an internet service provider and a cloud services

provider. Challenges of cloud services provision emanates from around these third parties (Ren, Wang & Wang 2012). For example; trust on how secure a connection is and not to allow intrusion.
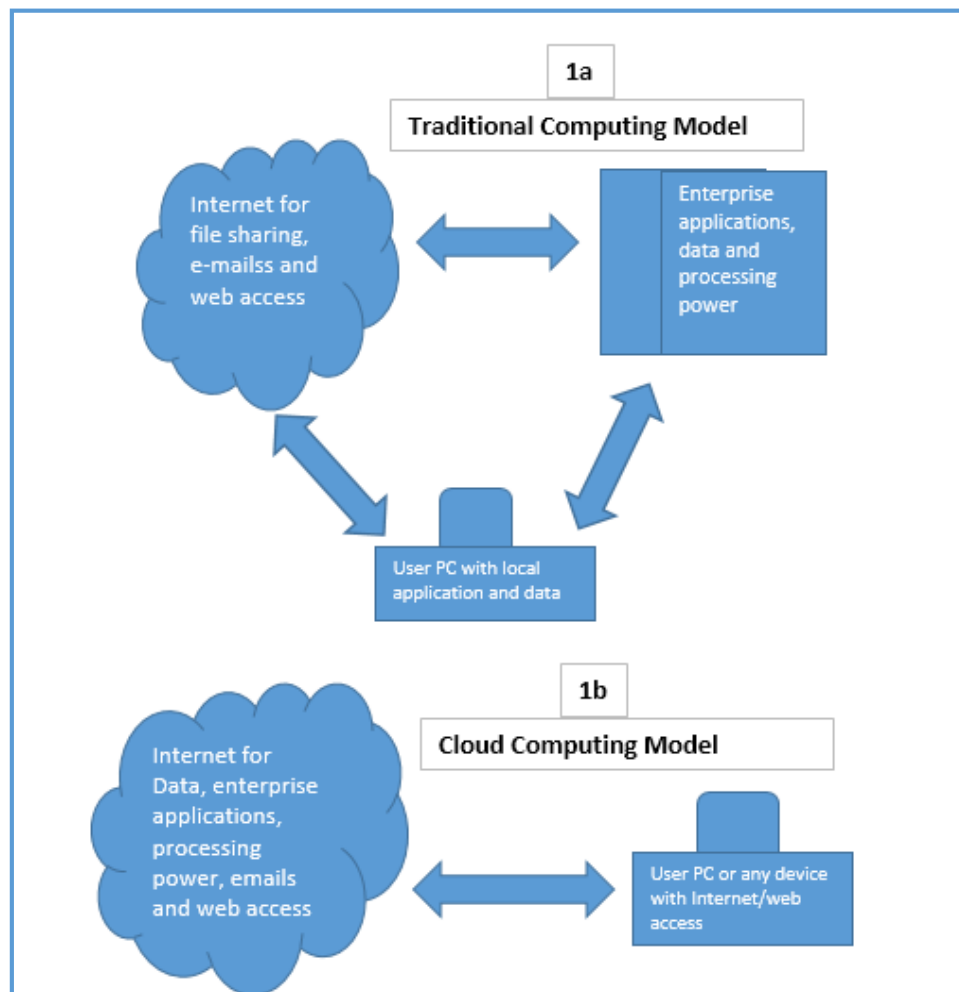
Figure 2.1: Comparison of Traditional and cloud computing models (Adapted from Barnatt 2010)

When describing cloud computing further it is important to note that it has essentially five characteristics that are embedded in its infrastructure, namely; on-demand self-service, broad network access, resource pooling, and rapid elasticity and; measured service (Sitaram & Manjunath 2012).

On demand self-service aims to reduce the configuration tasks from the user's point of view where resources such as the compute, storage or platform are self-provisioned or automatically configured. Other than creating accounts on a service provider, a user may not interact physically with the service provider's staff to have access to resources. Broad network access is a ubiquitous characteristic that allows access to resources using any device such as phones and PCs as long as these devices are connected to the internet and running a web browser.

Against the above observation cloud computing can be viewed as a clear motivation for ubiquitous storage and computing power on demand.

Resource pooling helps to implement virtualization and multi-tenancy by supporting many concurrent users. Rapid elasticity creates a service platform or resource that increases or decreases according to user requirements. It is possible to declare the number of servers that one needs. This significantly aids cost saving in capital investments where organization would not invest in computing resources that are often idle. Measured service is a "pay as you go" facility that literally removes the element of computing equipment being a fixed cost (Sitaram & Manjunath 2012; Barnatt 2010). One specific observation by Cloud.com (2015) is that in order to effectively exploit the on-demand and elastic features to constantly meet customer's requirement, the cloud need to be workload- and resource-aware. This is more of a challenge in adaptive scenarios of agile development processes and gives added significance to this study's objective of providing a framework to support SMMEs in their efforts to migrate to cloud computing environments.

2.3 Cloud Deployment Models

There are four different ways in which cloud services can be deployed depending on the structure of an organization and the provisioning location. NIST (2011) described cloud computing deployment models as either private cloud, public cloud, community cloud or hybrid cloud.

According to Armbrust et al (2010) private cloud is the most secure and risk-averse cloud that has the whole cloud infrastructure belonging only to a single organization. Normally, private clouds are considered a step to the growth of a corporate data centre where the organization shares in-house infrastructure for cloud services. Mainly targets virtualization solutions for mission critical applications with demands for high security and low latency, and custom service levels. The main advantage is that the organisation has full control over its data, security aspects and performance. Ideally, the cloud user owns this infrastructure. This implies that such organisations should have the necessary capital outlay to host such infrastructures which in some cases results in poor economies of scale. Usually SMMEs in South Africa do not have such capability, making this option unfeasible for them.

Public cloud are in real sense the early manifestation of cloud computing. The cloud infrastructure is owned by a service provider who offers cloud services to the public on commercial basis. These services are available through a public network and the internet. In this case cloud services are usually sourced from very large resource pools that are shared by many other clients specializing in elastic workloads such as software development and testing application. They are synonymous to plants or factories that cater for services or utilities to clients on as demand with size of requirement arises. Structurally, they are distributed systems consisting of one or more data centres. Public clouds are normally considered an attractive option for SMMEs because they provide an economical plan for organizations to reduce IT costs and capital expenditure. SMMEs are capable of starting up or running a business with a rent an infrastructure option without an upfront capital investment in IT services.

However, since public clouds are meant to serve many users on the same infrastructure, a multitenancy characteristic is created. A number of issues such as security and QoS performance management are associated with this multitenancy effect (Ren *et al* 2012). Other concerns evident in the public cloud are issues of data ownership, lock-ins, interoperability, support maturation and connectivity (Sitaram & Manjunath 2012). Most popular public cloud providers are proprietary overlooking the challenges mentioned due to lack of cloud computing standardization. Examples of some well-known public clouds are the Amazon Web Services (AWS) comprising of the Elastic Compute Cloud (EC2) and the Simple Storage Service (S3) which form an IaaS cloud offering and the Google App Engine which offers PaaS to its clients. Community cloud provides an infrastructure shared by more than one organization that has similar interests for serving a particular community. Interests can be of an industry or a business sector nature. According to NIST (2011), the infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g. mission, security requirements, and policy or compliance considerations). Community clouding can be managed by organizations or third parties and may exist on premise or off premise. It differs from public cloud in the sense that cloud services are provided for a certain need of end users rather a multitude of needs to different users as in the public cloud. It also differs from the private cloud due to the fact that cloud services are not provided and owned by one organization. Architecturally, community clouds are usually implemented over various administrative domains. An example of a community cloud would be a scientific research community sharing a large distributed infrastructure. Another example would be a community of SMMEs sharing common infrastructure in application development. However, the problem is that community

clouds require standardisation of software hosted and this may be a challenge when you have different organizations with different approaches to software development.

Hybrid clouds are a combination of different deployments (Armbrust et al 2010). For example, a company may decide to run its software applications on a public cloud but make storage on its private cloud. This arises in cases where private clouds are unable to meet user's quality of service requirements. Hybrid clouds allow organizations to exploit their own IT infrastructure for maintaining sensitive information within locations at the same time be able to grow and shrink by provisioning external resources which they are able to release when not needed. Common workloads are those of regulated data that require elasticity and agility such as Business Intelligence solutions. They are sometimes referred to as heterogeneous cloud due their heterogeneity nature in distributing integrated services or resources from one or more clouds (Buyya *et al.,* 2013). Being hybrid make them inherit problems associated with all the other deployment models.

2.4 Cloud Technologies

In order to replace the traditional client-server approach with cloud computing, there are basically three options or service types in which services can be provisioned. These are: 1. Software as a Service (SaaS); 2. Platform as a Service (PaaS) and; 3. Infrastructure as a Service (IaaS) (Marinescu 2012; Lenk et al 2009). Although there is still lack of uniformity, these three service types form what is referred to as a Cloud Computing Reference Model (Buyya et al 2013). Figure 2.2 below shows the services types and their relationships.
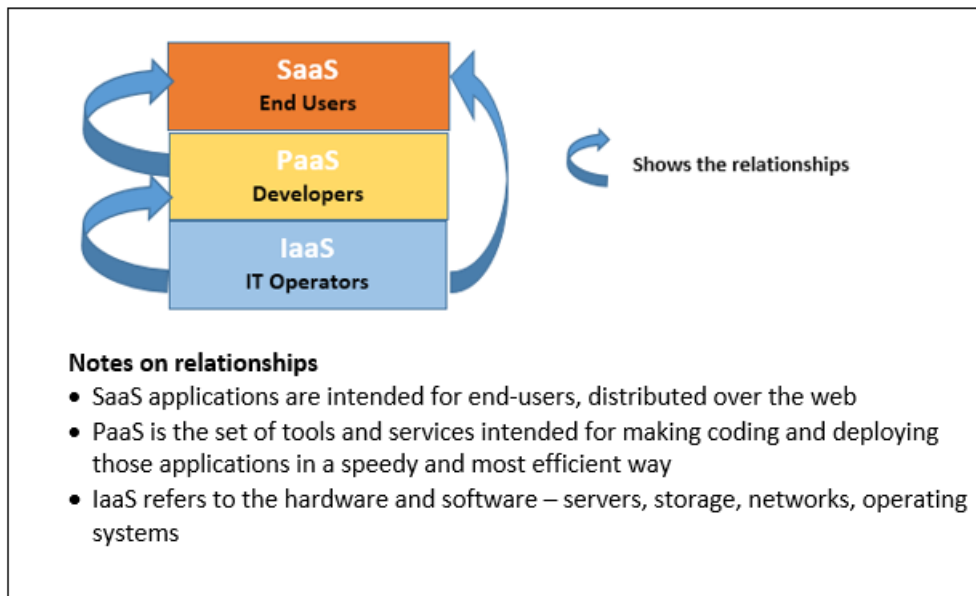
Figure 2.2: Relationships between Service Types (Adapted from Sitaram & Manjunath 2012; Lenk et al. 2009)

SaaS is designed to provide applications as a service to end users. The approach is to provide off-the-shelf and existing web applications. Users can access the applications and still be able to customise it to their conditions and requirements. In case of off-the-shelf application not being present in the cloud infrastructure, then the SaaS becomes unsuitable. Then the user may have to use other service types that allow application development. SaaS is currently the most noticeable and widely used in the cloud as it deals mostly with end user software packages such as word-processing and spreadsheets. Examples of SaaS services are those from Google and email services such as Gmail, Hotmail and Yahoo mail (Sitaram & Manjunath 2012; Barnatt 2010; Lenk et al 2009). In addition Enterprise Resource Planning (ERP) and CRM systems from Salesforce are all examples of SaaS deployments.

PaaS is designed to provide a platform service mainly for online application deployment for developers. The platform entails that the operating system and the hardware associated with it and distribution to the lower virtualised hardware infrastructure is normally a responsibility of the cloud platform operator. The end-user has no control in the management of this underlying infrastructure that include operating systems, network servers or storage facilities. The platform operators support this service with open or proprietary language to assist in communication, monitoring, and service billing and as well as many other tools meant to facilitate start-up or enable application's elasticity.

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Within PaaS an environment is created to allow software development including test runs using development tools that are present within that particular service provider's cloud infrastructure (Sitaram & Manjunath 2012; Barnatt 2010; Lenk et al 2009; Wang et al 2008). PaaS also facilitates speed of programming by automating some coding tasks and allows programmers to work on their programming languages and associated tools. It also has features that allow multiple developers with their users to swiftly collaborate and facilitates automated deployment and testing. However, Marinescu (2012) pointed out that PaaS is not mostly worthwhile for applications that must be portable, or when a proprietary language is used or when underlying platform may require customization to improve its performance.

In the Hinde and van Belle (2012) study, 53% respondents used the service type of PaaS and IaaS; and 40% were adopting cloud computing for application development. Working with this service type, technical programming knowledge and skills are necessary for most for its use. Therefore PaaS is suitable for companies that choose to cloud compute or do development of software even though it can be restrictive in terms of resources provided by the cloud provider leading to the problem of vendor lock-in. A vendor lock-in is a situation created when a user of a service or product fails to easily change to another competitor's service or product due to incompatible proprietary technologies (Sitaram & Manjunath 2012; Barnatt 2010). This is why recommendations into standardization of the service type across all providers or data replication to other service providers were made.

The other negative restrictions of PaaS service type include programming language support, programming model and also the capability to allow access to resources other than those provided by the provider. An example of PaaS is the App Engine offered as service by Google which can allow any user to write new cloud applications and be able to deploy them to the web using the Google's cloud infrastructure (Sitaram & Manjunath 2012; Barnatt 2010; Lenk et al 2009; Wang et al 2008).

The IaaS service type is a major cloud computing development meant for IT operators. It has a capability of offering services of processing, storage, networks and many other vital computing resources where a user is able to deploy and run arbitrary software (Mell et al 2011; Lenk et al 2009; Wang et al 2008). It includes services such as operating systems and applications. Without control of the underlying hardware in the cloud infrastructure, the user has control over the operating systems, storage, deployed applications and some limited control

over networking components. Cloud providers of this service rent out servers using a process called virtualization. Server virtualization involves masking and pooling of server resources. For example, one physical server may be configured using special administrator software into multiple virtual servers (machines) and each act like a distinctive physical device, capable of running its own operating system (Barnatt 2010). In cloud computing, these virtual servers are mostly referred to as instances. The IaaS service provider can either offer dedicated physical servers or virtual server instances. Although, these two services can perform the same functions, virtual instances are sometimes regarded as insecure especially by users who do not want to share server hardware with others. For this reason, some customers may choose to use specific deployment models like private cloud only or a combination depending on the security requirements of their services or products. One example of IaaS vendors is the Amazon Web Services (Sitaram & Manjunath 2012; Barnatt 2010; Wang et al 2008).

2.5 Cloud Computing Adoption and Use

Considering current demand from work and personal needs for online engagements and growth of the web, cloud computing could be a manifestation of a new paradigm of a large-scale distributed computing utility for business and society solutions (Pallis 2010). The South African e-government initiative strongly supports IT research in development of solutions that are directed to the future IT trends and offering (Department of Public Service and Administration, Republic of South Africa 2001). Research studies on SMMEs using cloud computing have been conducted widely in southern Africa and at an international level. In this chapter some of these studies were reviewed. Two of the studies were, because of their similarity in scope and approach, reviewed in detail. Furthermore the two studies, even though conducted in a different context, produced findings that of relevance to this study.

The first study was conducted by Hinde and van Belle (2012) on cloud adoption by SMMEs in South Africa. The study showed a potential growth in cloud computing and that slightly over 52% of respondents accept cloud adoptions. In the same study, 65% were aware of the existence of cloud computing, 25% thought it was for bigger companies and 34% had an adoption model in place.

The second study by Schofield (2013) was conducted by the Johannesburg Centre for Software Engineering (JCSE) team. JCSE is an organisation based in Johannesburg in partnership with government, academia and industry. It runs various programmes focussing on software

engineering projects. The JCSE research team summed up observations made through surveys conducted in the last two years. These included IT Web 2nd Online Cloud Computing Survey done in 2011 (IT Web Surveys, 2011) (279 respondents); SME Survey in 2012 (Goldstuck, 2012) (2000 respondents); Deloitte Cloud Computing conducted in 2012 (Deloitte, 2012) (Unstated respondents); Microsoft SMB Cloud Adoption's 2011 Study, and the IDG Cloud Computing Survey of 2013 (IDG Enterprise, 2013).

Most important for this study is that the majority of companies who participated in these two studies belonged to the SMME category (employing up to 100 employees). Interestingly results from Schofield's study agreed with Hinde and van Belle (2012)'s findings on trends and patterns in cloud computing adoptions. The study concluded that company owners, who were technologically capable, appreciated the value of cloud computing in usage and economical use as compared to those who did not understand it. More challenges inherent in cloud computing such as security, bandwidth connections were also highlighted by the two studies as impediments to making adoption decisions.

Also of interest for this study is that another study done in the United Kingdom (UK) showed that SMMEs stand to benefit by way of reducing costs, improving flexibility and scalability when they migrate to cloud computing. However, issues relating to security, vendor lock-in, and technical hitches with data privacy and data protection reported as still needing to be fully addressed (Alkhalil, Opara-Martins & Sahandi 2013). In another report, the European Commission's 2013 technical report on ICT a call was made to strengthen software and services technologies by exploiting internet-based services such as cloud computing. The same report also recommended that adoption of cloud computing should be taken up in combination with careful consideration of legal, socio-economics and technical issues. In conclusion, the report indicated that the potential of cloud computing and its models has not yet been fully exploited in terms of development and research to the degree of full utilisation by stakeholders (European Commission 2013). Another international project that involved SMMEs is the PRocess Improvement for Small to Medium Software enterprises (PRISMS) process model. The project involved a consortium of researchers and managers of participating SMMEs with the purpose of evaluating the effectiveness of the software process improvements (Allen, Ramachandran & Abushama 2003; Mishra & Mishra 2009)

Following ICT industry commentaries, it is interesting to note that although organizations in South Africa have approached the adoption of cloud computing with scepticism, South Africa as a country has however taken a leading role in cloud computing adoptions in Africa. This was confirmed by Sudarshan Roongta vice-president of Oracle's Industry Strategy and Insight programme for Europe, the Middle East and Africa (EMEA) http://www.itweb.co.za/index.php Accessed 12 July 2015) .

In South Africa it is noted that SMMEs have taken a leading role in adoption of cloud computing services and technologies followed by large enterprises. Roongta also reported that 66% of enterprises in South Africa have shown "very high" confidence in the security aspect of the cloud services and only one in 10 of the decision-makers have no trust in cloud security. This has made the security concern drop to the third ranking on the list of challenges associated with cloud computing. The recent investment in the Telecommunications and access to international bandwidth has improved the reliability of cloud computing. Roongta's report further noted that by end 2014, adoption rate in South Africa will increase from the current 56% to 66% being led by the retail and mining sectors. According to him, the Compound Annual Growth Rate (CAGR) of 35% and an investment worth $215 million would be realized in 2017. Some other useful statistics that Roongta also reported are:

- Globally, cloud computing is taking the mainstream with 82% adoptions in SaaS; 52% cloud storage; 36% IaaS; and 21% adopting hybrid cloud;
- In terms of cloud usage, most organisations (57%) are using it for human resources; 54% for e-mail collaboration; 52% for sales and marketing; 51% for customer care; 42% for supply chain; 41% for finance; 36% for sourcing; and 35% for operations management.
- 70% of the respondents indicated that cloud computing is providing tangible cost savings.

On an international arena of industry analysis, statistics from North Bridge (2013), an active partner for early-stage entrepreneurs providing seed-to-growth financing for innovative companies looking to disrupt big markets in America, indicated that SaaS has taken the main role in cloud computing adoptions although the fastest in terms of growth is the IaaS. This implies providing ways to growth in the PaaS. The report indicates that SaaS is the most popular with current (year 2013) 63% from 55% a year before. However, IaaS recorded a 29%

annual increase making it the fastest while PaaS is forecasted to grow fastest in the next five years. A growth in IaaS or PaaS indicates application development activities.

IDC (2013) predicted that cloud computing services will have a CAGR of 23.5%; five times that of the IT industry as a whole over the 2013–2017 periods. Another study on current adoption rates done by TheInfoPro (2013) predicted an average growth rate of IT cloud services to be 36 % from 2013 until 2016. This study was conducted during the first six months of 2013 and involved IT management and primary decision makers of medium sized to large organizations in Europe and North America. Some of the notable findings in that study were:

- That 60% respondents believed that cloud computing is a natural evolution of IT service delivery and does not need to allocate a budget to it. Out of those with a separate budget for cloud computing the majority believed that their spending will increase in 2013 and 2014 as compared to previous years.

- Iaas and SaaS activity has doubled to levels between 35% and 33% on projects declared, with 35% respondents indicating that private cloud activity are dominating.

- Despite increased cloud computing activity, 83% of the respondents had challenges in deploying their cloud computing initiatives. Mostly the challenges are non-technical but lie with the domain of processes, people, policy and organizational issues.

Jacobs (2013) of IT Web, indicated that Gartner's (ibid) predictions have positioned cloud computing to number four out of the top ten technological trends for 2014. The study also anticipated more funding and budgets allocation for cloud computing by 2016.
Considering Schofield (2013), Hinde and van Belle (2012) and Roongta's (ibid) report, it can be easily concluded that there is a positive trend in the growth of cloud computing in South Africa. However, the levels of cloud adoption of PaaS services specifically for software development purposes are not yet clear.

The observed positive trend in cloud computing adoptions and use can only be substantiated by the following observations:

- Cloud computing is being perceived as a new paradigm or next generation platform for future practices and philosophy of computing (Marston et al 2011; Buyya et al 2009).

- Cloud computing helps users to achieve cost savings in operation, development and fast deployment of software with less failovers. There is no consideration for hardware or software for cloud services (Talreja 2010).

- Resources such as data, applications, tools and web services can be accessed from anywhere on the internet and offers a one-stop facility for software development. Cloud computing also offers easy integration of these resources with other enterprise solutions (Talreja 2010; Sobel, Subramanyam, Sucharitakul, Nguyen, Wong, Klepchukov, Patil, Fox, & Patterson 2005).

- Cloud computing offers highly customized computing infrastructure online using the Web 2.0 strategy. These are provisioned in a convenient, task-centric, on-demand manner to a shared pool of configurable computing resources such as networks, servers, storage and applications. (Marinescu 2012; Mell et al. 2011; Sobel et al 2005).

- Cloud computing is collaborative, facilitating software development practices such as those of agile development methodologies (Mell et al 2011).

- Cloud computing offers legal and good conditions to use less energy and waste fewer resources (Berl, Gelenbe, Di Girolamo, Giuliani, De Meer, Dang & Pentikousis 2010).

Contrary to above positive observations some studies on cloud computing user experience has also highlighted concerns regarding security threats, dependence on reliable and fast internet, involuntary version updates, data ownership; and just user behaviour monitoring (Oza, Karppinen, & Savola 2010). The absence of a cloud computing adoption framework, as already pointed out earlier compounds these drawbacks. The drawbacks are elaborated below:

Security and privacy concerns

Due to the fact that organizations do not own the cloud infrastructure, security issues such as confidentiality, secrecy and protection of data rises. Although cryptographic tools can be used in transit, data still need to be decrypted in memory during virtualization process. This can allow other users in a multi tenancy environment to have access to it. As consumers demand for transparency, many questions related to how the service provider manages their data are asked. For instance even though Google for has over 250 IT security specialists who only deal with customer security issues questions are still being asked on how the internal audit and engineering compliance teams deal with security issues of clients. Gartner (2008) stipulates

seven aspects to consider in relation to security issues when selecting the cloud option. These are:

1. *Privileged user access*

   When external processing of information is practiced, there is a possibility of intrinsic level of risk associated to it which could have likely escaped organizational security controls. It is therefore necessary to ascertain access before taking a decision especially where sensitive information is concerned.

2. *Regulatory compliance*

   Consumers take full responsibility for security of their information within the service provider. This calls for the need to inspect service providers by consumers.

3. *Data location*

   There is a possibility that consumers may not be able to know the exact location where their data is stored and processed. Depending on need, consumers should be allowed to sign SLAs with an option of knowing about data location.

4. *Data segregation*

   The multi tenancy arrangement allows data in a cloud environment to be mixed with other consumer's data. However, encryption is critical in these circumstances in order to secure data from other consumers. Evidence is necessary to show encryption schemes used and limitations in their use.

5. *Recovery*

   Recovery measures should be ascertained in order to restore information in case of disaster.

6. *Investigative support*

   In case of fault detection by the consumer, it could be problematic to legally conduct an investigation because multiple consumers are co-located.

7. *Long-term viability*

   This refers to the ability to withdraw a contract and all the data in case where ownership of a provider has been taken over. The data should be in a format that can easily be compatible with other systems.

Privacy issues are a major concern in many hosted environments. For example Facebook users criticised Facebook on the way it solicited consent from them using a Data Use Policy which stated that Facebook "may use the information it receive about you for internal operations, including troubleshooting, data analysis, testing, research and service improvement". Usually, when accepting to this, users hardly read fine prints in the privacy policies and terms of website use (https://www.linkedin.com/pulse/article/201406-Accessed 13 August 2015)

Data ownership concerns

Although consumers take data compliance responsibilities, there are concerns on what happens to it when it has been hosted in the cloud. Some consumers speculate a certain degree of losing ownership especially in terms of control (Armbrust et al 2010; Buyya et al 2009; Kaufman 2009; Conway & Curry 2012).

Lock-in and interoperability concerns

Currently, there is lack of standard open architecture for cloud services. Most major providers have their own architectures which are different from others creating problems when migrating from one provider to another. Most cloud computing consumers have difficulties in removing their data and programs stored at one proprietary cloud provider to go and run on another one using probably the same tools. This is a challenge that lead to customer lock-in and thereby subject them to price increases and other provider related problems such as reliability (Armbrust et al. 2010) (Buyya et al. 2009).

Requirement for online connectivity

Online Internet connectivity is critical to the use of cloud computing services. This would be a very big challenge to consumers who normally have erratic Internet connectivity (Armbrust et al. 2010; Conway & Curry 2012).

Hidden Costs

An element of hidden costs is eminent in cloud computing. Hidden costs concerns were investigated in a research conducted on 468 CIOs from Asia, US and Europe of which 79% agreed to hidden cost challenge. These costs range from subscription fees, system and staff setup, training and latency associated costs (Research in Action 2012). Other hidden costs can be attributed to network charges from consumer Internet Service Providers for large data sets (Dillon, Wu & Chang 2010).

Anxiety within developers

A new cloud computing platform without appropriate guidance and understanding of how to effectively utilize cloud computing standard architecture is a challenge to consumers (Conway et al 2012; Venkatraman & Wadhwa 2012; Patidar, Rane & Jain 2011). For instance, although agile system development ecosystems consist of proper planning, the fact is that in a turbulent environment, plans are never predictable (Highsmith, 2002). As a result there could be challenges in determining when resources should be requested for different services during the project scope.

In contrast to utilities such as electricity, cloud computing is still in the limelight of innovative research from service provision to technology developments. This compounds the problem of identifying appropriate tools and practices in cloud environments (Pallis 2010; Brynjolfsson et al 2010). Some companies that adopted cloud computing without much consideration have ended up losing out on some benefits such as those of new technology for reasons such as lock-ins. With cloud computing, there are opportunities and risks that need careful analysis (Brynjolfsson et al 2010). Cloud computing adoption and use also requires revisiting service-level agreements for services such as application development tools when issues of interoperability are to be addressed (Vaquero, Lindner, Rodero-Merino & Caceres 2009). However, in an effort to embrace growth and challenges of cloud computing, a number of companies have already built high performance systems and other internet applications such as social networks, collaborative software development and e-commerce applications (Vaquero et al 2009).

2.6 Software Engineering and Agile Development Methodologies

Software can be classified as a product of a design process by software engineers. It is a systematic amalgamation of programs that are made to run within a computer system that can be of any size, and architecture. Today's business can hardly optimally be operational without a presence of software in their systems. The choice of software by companies varies depending on their requirements. This also has a direct influence in the way the software is developed. Pressman (2010) defined software as one that consists of three pillars, namely: 1. instructions consisting of programs that when executed provide function and performance, 2. data structures that enable the programs to adequately manipulate information, and 3. documents that describe the operation and use of the programs.

The basic characteristics of software are that software systems are abstract and intangible. As a product software is developed, does not wear out and is mostly custom built. These characteristics are different to those of hardware engineered products. A software system is usually developed for a particular customer and features such as re-usability are always encouraged.

The early software applications until the 1960s were largely developed devoid of an explicit information system development methodology (Avison & Fitzgerald 2006). These practices brought about a number of challenges in user satisfaction ranging from cost, time and scope perspective (Davis, Bersoff & Comer 1988). After this era a number of thoughtful efforts such as Systems Development Life Cycle (SDLC) have been made to understand the software development process. These efforts were mainly done in order to improve the quality of software during and after its development by addressing challenges of the previous unconventional era (Pressman 2010; Ruparelia 2010; Davis et al 1988).

The result of these efforts has been value addition to the final software product and improvement in delivery times. However, the same achievements could not preclude technical challenges and as well as development process skills that continue to affect functionality of SDLCs (White & Leifer 1986). In South Africa, it is common for developing organizations to experience problems such as software failures, budget over runs and late delivery. Mostly, these problems are related to incomplete user requirements (Friedrich & van der Poll, 2007). In concurrence with above BMC Software (2004) also reported that most software projects in South Africa fail due to the problem of incomplete or incorrect requirements. Recently, there has also been studies that has used Grounded Theory as a way of describing the way an organisation develops its software products artefacts including supporting documentation (Coleman & Connor 2007). In 2012, the same methodology of Grounded Theory was also used for study that investigated factors such as necessary conditions for the success of a software project (Adolph, Kruchten, & Hall 2012).

Newer approaches such as agile methodologies were introduced to software development in order to address issues of software quality although the quality aspect has been and continues to be subject of research in the software engineering domain. In agile development, the quality aspect is inherent in the development process. Agile methodologies are an alternative to

traditional waterfall approach of software development. It can be defined theoretically as a group of software development processes that are iterative, incremental, self-organizing, and emergent (Lindvall et al 2002).

Agile software development methodologies are based on the philosophy that emphasize the following work culture or processes: Individual and interactions over processes and tools; working software over comprehensive documentation; customer collaboration over contract negotiation and responding to change over following plan (Beck et al 2001; Highsmith 2002; Cockburn 2002; Pressman 2010). With agile methodologies, prescribed values, principles and practices are recommended for successful software project implementation (Mnkandla & Dwolatzky 2007; Keith 2002). Agile development requires distinctive tools such as feedback, transparency in communications, and time-boxing (CollabNet Inc. 2011). Therefore, organizations that adopt agile methodologies need to implement an environment with an integrated toolset comprising tools for measurement, bug tracking, design, analysis, testing, coding, business intelligence and critiquing, just to mention a few. In addition, open source tools and proprietary tools need to be carefully coordinated to deliver successful projects (Sillitti & Succi 2004). Success in this context means delivering a software product within the agreed time and budget constraints and at the same time meeting the anticipated user requirements from the project sponsor (Mnkandla, 2008).

Below is a list of some agile development methods mostly used:

- *Adaptive Software Development (ASD)*

  Highsmith III developed ASD (Highsmith 2000) based on iterative development methods. It focuses on continuous prototyping on complex or large systems with an emphasis on incremental and iterative development. Its process involves three repeating cycles namely *speculate*, *collaborate* and *learn*. *Speculate* refers to the enigma of planning, *collaborate* is an aspect that deals with the harmonising work activities based on environmental factors such as requirements, technology and all stakeholders. *Learn* refers to issues of all stakeholders arising from short iterations in the design, build and test cycles.

- *Agile Modelling (AM)*

  AM (Ambler 2002) is the process of conducting modelling activities that also involves documenting practices and cultural principles. The developers can then have adequate

models to address issues of design. Normally AM comes as an additional activity to other agile methodologies such as Extreme Programming.

- *Agile Unified Process (AUP)*

AUP modelling is a combination of Rational Unified Process (RUP) and the AM (Christou, Ponis & Palaiologou, 2010). It is designed to offer an iterative-incremental approach to software application development. When this model was created by Scott Ambler of IBM, the idea was to have a solid framework that can be used in all kinds and sizes of software development projects. It comprises of seven workflows and four phases as indicated in figure 2.3 below:
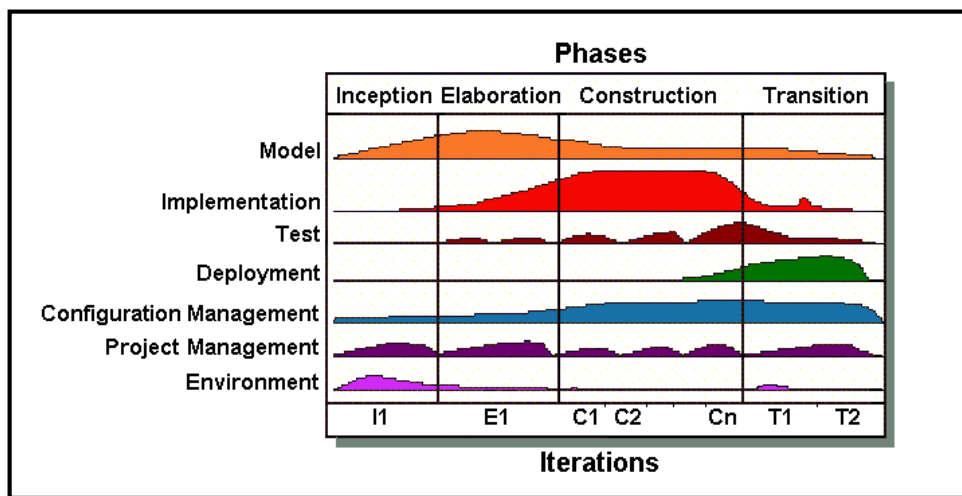
Figure 2.3: Agile Unified Process Workflows and Phases, Source (Ambler 2005)

AUP has been tested and found to be a flexible methodology on a Service-Oriented Architecture (SOA) project. However, it was noted that in order to have a successful implementation, institutional culture and management need to adhere more to agile methods and practices than what was experienced (Christou et al 2010).

- *Dynamic Systems Development Method (DSDM)*

DSDM is an agile software project provision framework. In order to address issues of quality, cost and time, DSDM is structured around the *MoSCoW* prioritisation of scope into *musts, shoulds, coulds* and *won't* haves for it to project manage deliverables within time constraints. The implementation of DSDM requires a philosophy of assuming collaborative attitudes from all stakeholders and technology implementers (Stapleton 1997).

- *Extreme Programming (XP)*

  Developed by Kent Beck, Ward Cunningham and Ron Jeffries, XP promotes the values of community, simplicity, feedback, and courage. It also advocates short development cycles in form of "releases" meant to enhance productivity. It involves programming in pairs of all codes through refactoring and test-first development. It has also been known to bring about a system of dynamic practices (Beck 1999b).

- *Lean software development*

  Based on the restructuring of the Japanese automobile manufacturing industry, lean software development has a focus on software project management aspects specifically directing at the cost and return on investment issues. Overall, it has a main focus on people and demands learning professional skills and applying them in a creative way in a team setting (Womack, Jones & Roos 1990).

- *Scrum*

  Scrum is an iterative and incremental project management framework that targets development in 30 day-day sprint cycles. In these cycles backlog features are provided. The major practice is the use of 15-minute team meetings for the purpose of coordination and integration. It also recognizes that during the project, customers can change requirements as need arises. It therefore calls for maximizing team's capability to deliver quickly but still being able to react to emerging requirements.

Considering the benefits of cloud computing, SMMEs who use agile software development methodologies can enjoy faster production, improved quality and more flexible and collaborative processes that embrace change. Although world-wide agile development in cloud environment has been successful it is important to note that the successes are mostly to do with large companies (Cocco & Concas 2012; Salesforce 2008; Vaquero et al 2009).

Some of the benefits of cloud computing includes:

- Automated build in the cloud. Development organizations would reduce costs by using virtualization in accelerating their work through existing images residing on multiple platforms. This reduces utility pricing on servers as compared to the use of dedicated servers.

- In the cloud environments, access to production environments is quicker and supports automated production deployment. This results in reduction of feedback cycle within the technical team and business owners.

- Development teams are able to use virtualization aspect of cloud computing for unlimited number of servers and be able to do parallel work within the agile philosophy. Successful Agile development projects depend on strong and extensive communications.

- The virtualization aspect of cloud computing will facilitate quicker provisioning and testing of code while at the same time developing and testing a new version. Cloud testing allows substantial advances in speed and agility by using multi-platform testing on virtual images. Unit tests can be done in parallel on cloud machines which also results in cost serving as compared to using dedicated servers.

- Exploration and innovation within a team by trying new ideas on server working environments (CollabNet Inc. 2011 Brynjolfsson et al 2010).

While cloud computing has the capability of facilitating agile development practices in theory, the actual adoption and use processes, as pointed out earlier in this chapter has challenges arising from non-technical and technical assumptions and constraints. These challenges, as put forward by Stafford (2013) include non-technical problems such as inadequate training, poor leadership, and rigid adherence to agile principles that do not fit into the project. Technical problems arise from Internet access and its assumptions about co-locations, latency and that error cannot be easily made. As a result, problems such as not having required meetings, inadequate documentation and issues related to short iterations are experienced. In addition and due to the fact that computing resources can shrink and grow on demand proper planning is required if the benefit of cost saving are to be realised and good qualities of service maintained (AZURE 2013; Lawler et al 2011; Armbrust et al 2010; Armbrust et al 2009).

Ramesh, Cao, Mohan and Xu (2006) also identified five specific challenges that apply to agile distributed software development as follows: 1. Communication need vs. communication impedance, 2. Fixed vs. evolving quality requirements, 3. People- vs. process-oriented control, 4. Formal vs. informal agreement, and 5. Lack of team cohesion. These challenges are further discussed below:

Communication need vs. communication impedance

As indicated earlier, agile development methodologies do not depend on formal documentation but informal interactions within the team of developer and users. The distributed software development environment however requires that formal mechanisms such as designs are put in place for geographically separated locations. This raises a question on how you can balance formality of communication in agile distributed software development platforms.

Fixed vs. evolving quality requirements

Distributed software development will normally require fixed and upfront agreements on quality requirements because of limited capability to control activities of distantly located teams. On the other hand agile requires an ongoing negotiations environment between developers and users as in the process of arriving at acceptable levels of quality on different phases of development. The issue of balancing between fixed and evolving quality requirements need to be addressed in these circumstances.

People- vs. process-oriented control

The question of concern here is how you apply a suitable balance between people and process-oriented control in agile distributed development. The reasoning behind this question is based on the nature of distributed environments that are process oriented while agile is more of people oriented.

Formal vs. informal agreement

Agile development environments normally involve informal contracts while distributed development requires formal agreements especially on targets, milestones and requirement specifications. This situation requires a balancing act between levels of contract formality appropriate in the agile environment.

Lack of team cohesion

Team cohesion in distributed development where developers and users are in different locations is not as binding as in co-located environments. This even makes it worse when agile development processes are used because they emphasises on continuous collaboration on all stages and aspects of the development project.

2.7 Agile methodologies and adoption of Cloud Computing in South Africa

In South Africa, especially after the democratic dispensation, SMMEs have been regarded as important contributors to job creation as well as economic growth (Visagie 1997). However, SMMEs in South Africa continues to face challenges in the areas of management, financial and infrastructural support from both internal and external stakeholders (Olawale & Garwe 2010). According to Department of Trade and Industry (DTI), the classification of SMMEs does not specifically indicate that these SMMEs are involved in software development category of IT (DTI 2008). This makes it even more difficult for researchers to easily get categorised information. Singh (2014) notes that there is limited research studies both from the academia and Government about South African Software development within SMMEs. Singh (2014) further claims that major Government departments such as DTI and South African Revenue Authority (SARS) seem to have not been able to contribute accurate statistics.

On the other hand research shows an increase in the adoption of agile methods by developers in South Africa (Noruwana & Tanner 2012). However, there is little evidence to show which specific agile methodology is being used to promote adoption and use of cloud computing. The development platform has mostly been on stand-alone and traditional client-server architectures. A study by Hinde and Van Belle (2012) indicated that application development processes within the cloud environment are being used by SMMEs within South Africa. However, this study did not clearly indicate if these adoptions were directly influence by agile methodologies.

A search on internet revealed that there is an agile community within the South African developers that regularly offer training and workshops on agile development methodologies. Such can be found on websites; http://www.agilesa.co.za/ (Agile South Africa) and http://agileafrica.jcse.org.za/ (Agile Africa under the Johannesburg Centre of Software Engineering). Although the latter is involved in research activities, it was found that no research project has been conducted specifically on agile cloud computing adoptions in South Africa. Professor Barry Dwolatzky, director of the JCSE, claims that scrum and EXtreme Programming (XP) and the other agile methodologies are present in South Africa., Interesting to note is however that many local developers have not put agile to test mainly because of inadequate appreciation of it. A further search posted on Bizcommunity.com: (http://www.bizcommunity.com/Companies/196/ Accessed 9 October 2015l) revealed that

there are about 200 companies in South Africa that are associated with software development. Now interesting to investigate was what type of development methodologies and platforms are these companies using especially if these falls within SMMEs group.

2.8 Technology Adoption Theories

Technology may not be essentially an artefact but knowledge-based tools that are closely associated to the cultural and social settings in which they exit (Tornatzky & Fleischer 1990). Hence, the element of social context plays a major role in the distinction between the technological content and the embedding content of an innovation. Any technology as a knowledge-embedded tool is a mixture of social behavioural elements and physical elements (Eason 2008; Dobson 1992; Tornatzky and Fleischer 1990:11; Yin 1982, 1979).

Analysts have developed models that define stages of technological innovation. These stage models either focus on the creation of new technology or how technology gets used or adopted. These two perspectives are difficult to combine in a single sequence (Dasgupta, Gupta & Sahay 2011; Tornatzky & Fleischer 1990:11). In this research, the focus is on the latter. Oakes, Smith and Morris (1992) state that in order to make an informed decision in adopting a CASE tool, an organization should have both short-term and long term awareness on the consequences of the tool adoption. Short term awareness requires that organizations know about a potential decrease in productivity, displeasure of some employees, variations in process and methods, possible extensive training and related expenditure. Long term awareness addresses issues such as maintenance costs of tools in their life cycles, recurrent releases of new technology, continuous training costs for new staff including retraining of existing staff and a possible change in frameworks that lead to restructuring of tools.

Considering this same focus, also referred to as a post-delivery perspective, the five stages identified from the works of Tornatzky and Fleischer (1990) are as follows:

1. Awareness-problems;
2. Matching-selection;
3. Adoption-commitment;
4. Implementation; and
5. Routinization.

These stages involve how users perceive adoption of new technology innovations. Oakes et al. (1992) further modified these stages to six for the CASE adoption strategy namely awareness, commitment, selection, trial implementation, implementation strategy, and routinization. As depicted in Figure 2.4, the cycle provides input for the subsequent stage and depending on prior adoption preparedness of an organization, some of the initial stages may already have been completed.
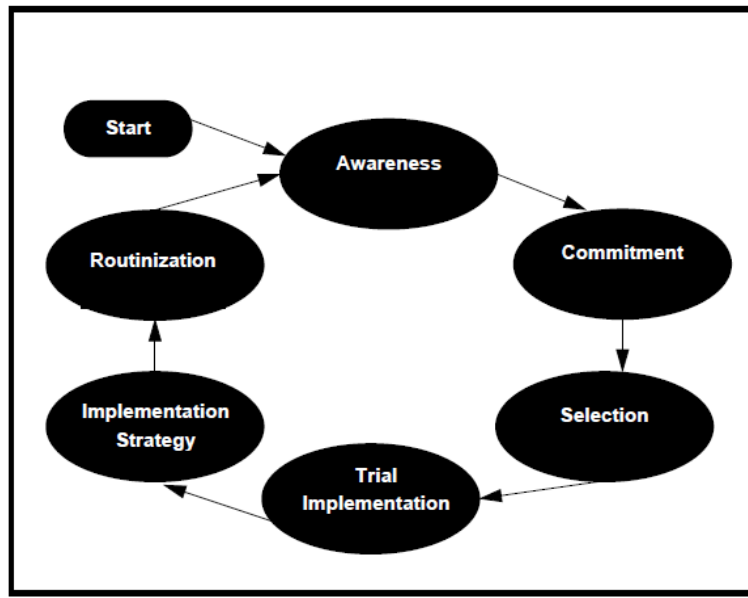
Figure 2.4: Stages in CASE Adoption (Oakes et al. 1992)

- *Awareness and Commitment*

  Undoubtedly, organizations undertake some basic research on the new tools before making any decision of commitment of adopting the technology. It has been recommended that at least 50 percent of people involved in this study would be aware of the strengths and weaknesses of the new technology. To avoid eventual tool technology impact, it is always recommended to solicit management and end user commitments before adoption. It has also been noted by Forte (1998) that this stage is critical as in most cases, management is normally very unwilling to disrupt existing practices and this constitute a major hindrance to enhanced software productivity. A substantial motivation is required in such circumstances.

- *Selection*

  The selection stage involves a process and criteria for choosing a technology option. In many cases, options are readily available on the shelf and no development activities take place. The chosen option should address both short-term and medium term requirements of an organization in all aspects and associated processes.

- *Trial (Implementation)*

  It is always advisable to conduct preliminary trials in form of a pilot project before final implementation in order to determine effectiveness and weaknesses of a tool before commitment of full scale resources. Successful trials are usually taken forward to the next stage. At the trial stage it is also important to be sensitive to management expectations which in some cases may be somehow unrealistic especially when positive results start emerging during the transition. It is also recommended at this stage to conduct an objective analysis throughout the development cycle using simulation effects on critical elements such as database sizes and multiple users' scenarios. You may need to start with small projects to easy experience for large scale projects. Feuche, (1989) claims that successful pilot projects usually are a tool to secure organizational commitment.

- *Implementation Strategy*

  The implementation strategy is normally met with challenges such as resistance to change. Most personnel involved are often undecided and sometimes negative about change unless positive assurances of their role in the new technology are made clear. A good implementation strategy is therefore needed and may involve rewarding individuals that make the project work.

- *Routinization*

  Routinization mainly refers to the maintenance phase involving routine activities such as periodic upgrades, training and general support of life cycles.

A number of studies have already been done in this area of information system adoption theories and frameworks. Issues related to understanding and crafting of conditions under which information technology systems will be embraced by the human organization remains a high-priority in the IS research community. Below are some of the theories and frameworks that have been developed at individual or firm level of information systems adoption.

Diffusion on innovation (DOI)

DOI marked as one of the oldest social science theories focusses on individual characteristics, internal characteristics of the organizational structure and the external characteristics of the organization as important prerequisites to organizational innovativeness (Rogers 1995). It was originally meant to explain how an idea can over time be able to gain momentum that allows

diffusion or spreading into a specific population or a social system and ends up allowing people in the same population to adopt a new idea, behaviour or a product that includes cloud computing. Diffusion is made possible due to the fact that people perceive the idea, behaviour, or a product as innovative.

As the process of adoption does not take place at the same time in any social system setting, some researchers have found out that early adopters have different characteristics to those of late adopters. Therefore it is critical to understand characteristics of target population that may be of assistance or obstacle in adopting the proposed innovation. Rogers (1995) recommended segregation of individuals into five categories of individual innovativeness. This spans from the early to the late adopters and he categorized them as innovators, early adopters, early majority, late majority and laggards.

It even becomes more complex when these categories are considered at organizational level because an organization has different individuals (who play a part in innovation adoption decision making). Some could be in support and others in opposition of the innovation. At organizational level, Rogers (1995) applied the DOI theory and came up with some independent variables such as individual (leader) characteristics, internal organizational structural characteristics, and external characteristics of the organization. Figure 2.5 below demonstrates the relationships amongst these variables.
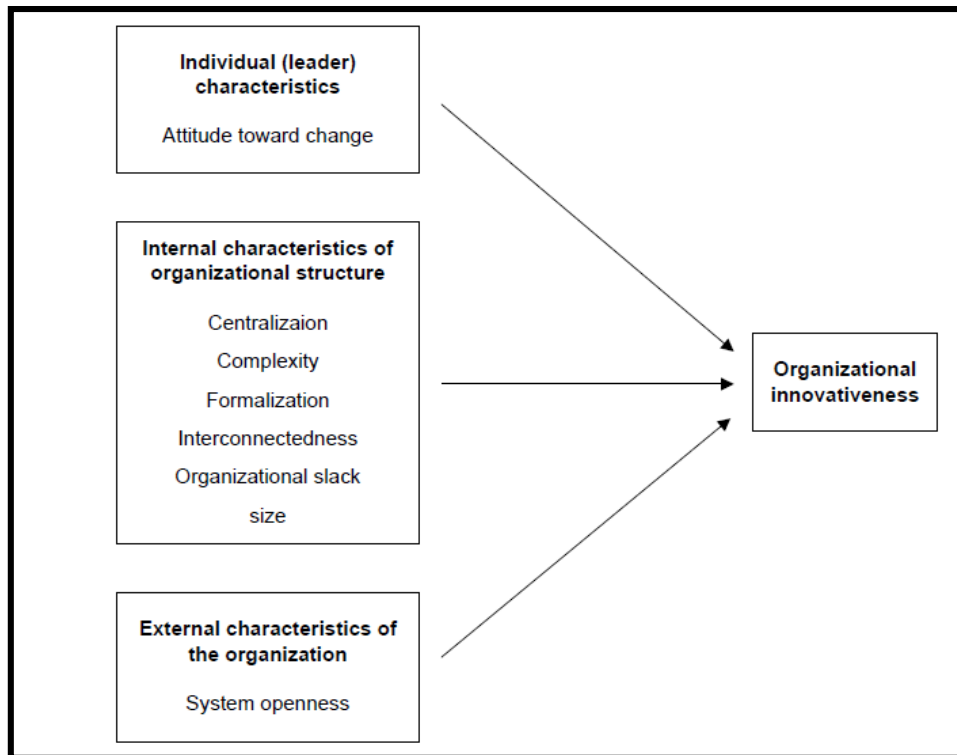
Figure 2.5: Diffusion of Innovation (Rogers, 1995)

1. *Individual characteristics* refer to the leader's attitude toward change.

2. *Internal characteristics of organizational structure* refers to, as put forward by Rogers (1995) *centralization*, which is the degree to which power and control in a system are concentrated in the hands of a relatively few individuals, *complexity*, which entails the degree to which an organization's members possess a relatively high level of knowledge and expertise, *Formalization-* the degree to which an organization emphasizes why its members' must follow rules and procedures, *Interconnectedness-* the degree to which the units in a social system are linked by interpersonal networks, *Organizational slack* which he defined as the degree to which uncommitted resources are available to an organization and *size* which is basically the number of employees in the organization.

3. External characteristics of organizational denotes system openness.

DOI, as evidenced by observations from agriculture and medical practice background has received some criticisms especially in dynamic cases. One of the criticisms relates to the communication process which is often a one way directional flow not supporting the important element of participation in information systems.

Technology, organization, and environment (TOE)

The TOE framework was originally developed by Tornatzky and Fleischer in 1990. The framework focusses on three aspects of an organization's context that influence the process of technological innovation adoption such as cloud computing.   These three aspects are technological context, organizational context, and environmental context (Tornatzky & Fleischer 1990; Hage 1980; Starbuck 1976; Khandwalla 1970; Thompson 1967). Figure 2.6 below illustrates the three aspects.
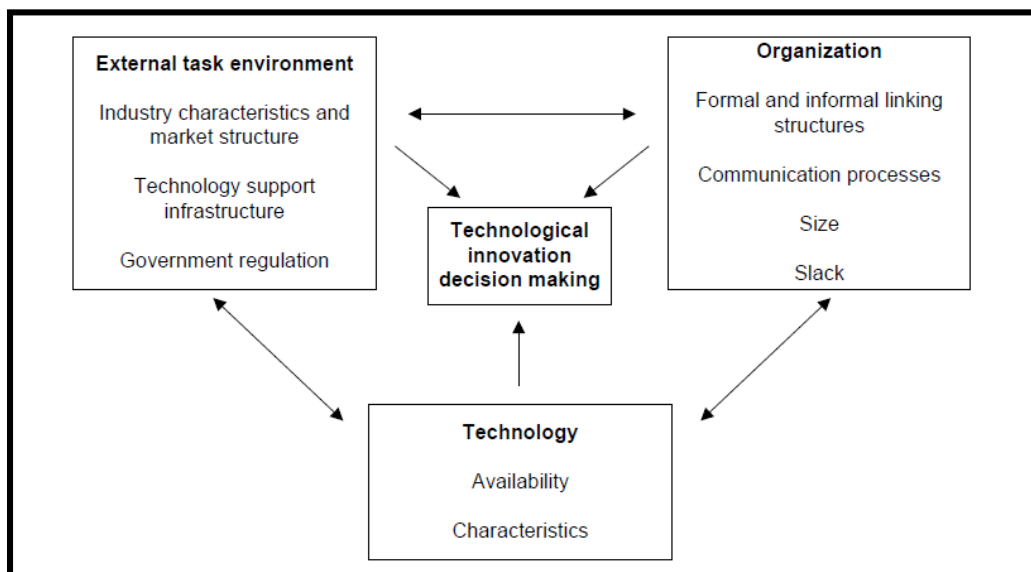
Figure 2.6: Technology, organization, and environment framework

Technological context describes both the internal and external technologies applicable to the organization. This includes existing practices in use and equipment which are internal to the organization as well as available technologies external to the organization (Thompson 1967, Khandwalla 1970, Hage 1980). Before any adoption process takes place it is critical that internal technologies that form most of the existing operational work are considered (Collins et al. 1988; Iacovou et al. 1995; Kuan & Chow, 2000). The chances that the organization will allocate more technological resources to the adoption project depend on the perceived benefits. Technology opportunism which is according to Srinivasan et al. (2002). The organization's ability to sense and react to new technologies has also been observed in the adoption processes *Organizational context* is an element that deals with the characteristics and resources of an organization. This forms a linkage between employee structures, intra-organization communication processes, and organizational size including the extent of slack resources. The

organizational context affects adoption and implementation of decisions in many ways. These include stimulating innovation through internal mechanisms that link subunits within an organization (Galbraith 1973). Organizational factors such as IT expertise are some of major concerns in adoption project as observed by Iacovou et al. (1995) in their study of EDI in small companies.

Environmental context forms the environment in which the organization ventures its business such as the industry where it belongs. It also includes competitors, presence or lack of technology service provision and regulatory framework (Tornatzky and Fleischer 1990). Thong (1999) found out that competition within the environment stimulates the likelihood of technology adoption. Smaller companies are usually affected by such factors (Iacovou et al., 1995).

Technology Acceptance Model (TAM)

TAM focusses on Behavioural Intention to Use, System Usage, Perceived Usefulness and Perceived Ease of Use (Wixom & Todd 2005; Venkatesh et. al. 2003; Davis 1989; Davis 1986). TAM has achieved substantial progress in explaining information technology adoption acceptance (Davies 1989; Davies et al. 1989). TAM compares well with other models such as Theory of Reasoned Action (TRA) and the Theory of Planned Behaviour (TPB) (Venkatesh 1999)

Opitz et al (2012) found that TAM, with model adjustments can be used in cloud computing adoptions. In explaining the factors that affect cloud computing adoptions, they found out that actual system use can be described by the intention to use which can also be categorised as perceived usefulness and perceived ease of use. Further to that perceived usefulness which is described as output quality was found to be a stronger dominant factor cloud computing adoptions. However Opitz et al (ibid)'s study only applied to the Germany conditions.

Despite being a robust theory, TAM has not been without criticisms. It is a theory that regularly undergoes revision into extended models. For example in Venkatesh and Davis (2000), TAM was extended to TAM2. This normally is as a result of adding extra constructs in order to meet expected use.

2.9 Other studies on theories of adoptions

Regarding cloud computing adoption frameworks, recent work by Chang, Kuo and Ramachandran (2016) demonstrates a security framework for business clouds. In their work, a security framework for a cloud computing adoption framework (CCAF) was explored. The CCAF framework was presented and integrated with three layer security features namely firewall, identity management and encryption. The study found out that blending a CCAF multi-layered security with policy, business activities and real services can be useful for volume, velocity and veracity of big data services that are operated in the cloud environment. Further on, research by Chang, Ramachandran, Yao, Kuo and Li (2016) shows that an approach can be used to develop resilient software systems. The researchers argue that the use of CCAF framework provides software resilience and security improvements for enterprise security. These innovations on frameworks such as this one on security are ideal and critical only after the adoption and use of cloud computing has ensured.

Kimberly and Evanisko (1981) also identified three other clusters of predictors of innovation adoption which are: characteristics of organizational leaders, characteristics of organizations and characteristics of environmental context. Based on these models, research has been done on many information systems projects.

Some research projects have further combined characteristics of these models to come up with more categories. For instance, drawing on Cooper and Zmud (1990) Oliveira and Martins (2011) outlined these as:

- Material requirements planning (MRP)IS adoption (uses at least one major software application: accounting; inventory control; sales; purchasing; personnel and payroll; CAD/CAM; EDI; MRP), and extent of IS (number of personal computers and the number of software applications) (Thong 1999);
- Intranet (Eder & Igbaria 2001);
- Web site (Beatty et al 2001)'
- Enterprise resource planning (ERP) (Bradford & Florin 2003);
- E-procurement (Li 2008);
- E-business (Zhu et al 2006a);
- E-business (Hsu et al. 2006);
- Electronic data interchange (EDI) (Kuan & Chau 2001);

- Open systems (Chau & Tam 1997);

- Web site (Oliveira & Martins 2008);

- E-commerce (Martins & Oliveira 2009; Oliveira & Martins 2009; Liu 2008);

- Enterprise resource planning (ERP) (Pan & Jang 2008);

- Business to business (B2B) e-commerce (Teo et al 2006);

- E-business (Zhu et al 2003, Zhu & Kraemer 2005, Zhu et al 2006b, Lin & Lin 2008, Oliveira & Martins 2010a); and

- Knowledge management systems (KMS) (Lee et al 2009).

Finally Misra and Mondal (2011) looked at adoption of cloud computing based on services rendered and return on investment. They considered a number of characteristic of organizations such as size of IT resources, utilization pattern, and sensitivity of data and criticality of work done which clearly include software development. However, their work had some limitations. The model they used did not address software development technical issues such as interoperability of development tools, reliability and security. It also uses an index that determines return on investment in making a decision to adopt cloud computing which is not an emphasis by agile developers.

As indicated earlier, in most of these models, an element of social context has been considered very critical Tornatzky and Fleischer (1990). More recently, Werfs et al (2013) argued that adaptive social-technical issues can inform adoption processes of disruptive technologies such as cloud computing. He further pointed out that adoption processes involve complex interaction among humans, technology and the environment.

Coming back to the focus of this research it is observed that there is a lot of literature and tools on cloud computing adoptions which may also be applicable to SMMEs in the South African context. Examples include the Cloud Computing Toolkit though it has not yet reached its maturity (Khajeh-Hosseini et al 2012) and the cloud adoption Goal-Oriented Requirements Engineering Approach (GORE) (Zardari and Bahsoon 2011), an interactive process of adoption; a six step process model that does not pay much attention to organisational issues (Bidgoli 2011) and finally the analysis of the TOE based on the SMEs in the United Kingdom (Alshamaila and Papagiannidis 2013).

In this research the cloud computing adoption based on Alshamaila and Papagiannidis (2013) analysis was used. The reason being that Alshamaila and Papagiannidis (2013) analysis of TOE is more recent, involved SMEs and their process framework addresses most of issues associated with information technology companies. Based on this analysis of TOE the main factors which were found to be influencing the adoption process are relative advantage, uncertainty, geo-restriction, compatibility, trialability, size, top management support, prior experience, innovativeness, industry, market scope, supplier efforts and external computing support. These factors are explained below

- Relative advantage: referred to as "the degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers 2003: 229). It is considered as a central indicator to adopting a new technology in information systems innovation. The probability of adoption is enhanced when a business realizes a relative advantage in an innovation (Thong and Raman 1994; Lee 2004).

- *Uncertainty:* referred to as the level at which the results of using an innovation become insecure (Alshamaila and Papagiannidis 2013; Low, Chen, & Wu 2011; Fuchs 2005). This indicates knowledge deficiencies on an innovation by stakeholders. In the case of cloud computing lack of knowledge and expertise in areas such as security, privacy and lock-ins are evident amongst many SMMEs in South Africa.

- *Geo-restriction* is the uncertainty factor about data location. There is a possibility that consumers may not be able to know the exact location where their data is stored and processed. Depending on need, consumers should be allowed to sign SLAs with an option of knowing about data location (ibid).

- *Compatibility:* referring to: "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (Rogers 2003: 240). Compatibility is considered an important factor of an IT innovation (Rogers 2003).

- *Trialability:* relating to: "The degree to which an innovation may be experimented with on a limited basis" (Rogers 2003: 258).

On the other the organisation context has the following factors:

- *Organisation Size:* relating to the organisational size in terms of number of employees and investment magnitude (Alshamaila and Papagiannidis 2013). Small businesses are more motivated to adopt cloud services.

- *Top management support***:** referring to the plan of action that dedicates time for ICT program in relation to cost and potential, plan reviews, results follow-ups and coordinating integration of ICT with management processes of business (Young and Jordan 2008).
- *Prior technology experience:* which is the degree of a user's know-how with previous comparable technologies" (Alshamaila and Papagiannidis 2013; Lippert and Forman 2005).
- *Innovativeness:* is a characteristic of innovation. Innovation refers to an act of introducing a new product into the market (Aronson 2008). Rogers and Schoemaker (1971) referred to it as a degree at which innovations are adopted before other members of the same social setting.

Finally, the environmental context relates to the following factors:
- *Industry***:** refers to business sector to which the organisation is classified (Goode and Stevens 2000).
- *Market scope***:** is the extent at which the organisation spreads its operations (Zhu *et al,* 2003).
- *Supplier efforts and external computing support:* referring to activities performed by a supplier that have a substantial impact on the innovation that needs to be adopted (Frambach et al, 1998).

2.10 Conclusion

Reviewing of current literature made it possible to explore and gain insights into the evolution of cloud computing adoptions and use; from both the philosophical and conceptual points of view. This included getting a better understanding of cloud computing paradigm and its technological models of deployment and service types, including cloud adoption and use. Chapter 2 also reflected on software engineering practices and common agile methodologies in use, linking these methodologies to contemporary South African context. Lastly, the chapter reviewed some of the technological and innovation adoption theories applicable to the cloud computing environments.

It is from the literature review processes that it became clear that the challenges around use of agile development methodologies in adoption and use of cloud computing are closely linked to

technology, organisational and environmental factors. For instance, the technology, which in this case is cloud computing, is very dynamic and inflicted with a lot of challenges that need to be mitigated before and after adopting cloud computing solutions. Furthermore, that organisational issues such as support, communication and knowledge is critical for development practices such as agile development methodologies. And finally that environmental aspect such as positioning within the industry spectra whilst at the same time meeting market demands often presents more challenges. These problems can partly be addressed by exploring factors that can be used to inform the development of a framework to support increased adoptions of and a working better with cloud computing services. Such a framework is arguably very useful in promoting and supporting adoption and effective use of cloud computing especially where it involves SMMEs in the South African context. Most fortunately pointers to some of the factors affecting use of agile methodologies in adoption of cloud computing are already known. This observation coupled with the fact that the South African agile development community already exists forms a good basis for gathering and in-depth analysis of data as to be presented in chapters three, four and five of this research report.

Chapter 3 : RESEARCH METHODOLOGY

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3.1 Introduction

In order to answer research questions or attain research objectives, a researcher needs to carefully formulate a research strategy (Blaikie 2001). The strategy provides a methodological framework within which data is collected, processed and analysed.

In this chapter an outline and description of the research methodology and methods used to conduct this study is presented. The chapter also discusses the research philosophies and paradigms that are often used in Information Systems research. From outlining and discussing the paradigms the chapter moves on to talk about the case study method and how it was used in this research. An outline of the sampling (selection of participants) techniques, research ethics and finally the data collection processes is also given. Issues around validity and reliability are also mentioned and explained in chapter three. Chapter three provides the necessary and adequate information on how this research was designed and conducted.

3.2 Research philosophies and paradigms: Implications for the design of research methodology

All research is informed by an explicit ontology, epistemology and methodology. The researcher's ontology or world view shapes and influence his or her choice of a research paradigm. Knowledge of the different ontologies and paradigms is therefore crucial in helping a researcher to come up with a comprehensive research design. Terre Blanch and Durrheim (1999:6) described a paradigm as *"all-encompassing systems of interrelated practice and thinking that define for researchers the nature of their enquiry along three dimensions: ontology, epistemology and methodology"*.

Similarly Weaver and Oslons (2006:460) also defined paradigms as "patterns of beliefs and practices that regulate inquiry within a discipline by providing lenses, frames and processes through which investigation is accomplished". It is important to also point out that ontology stipulates the nature of reality and what can be known about it while epistemology specifies the nature of the relationship between the researcher (the knower) and what can be known; and that methodology specifies how the researcher may go about practically studying whatever he or she believes can be known (ibid).

The relationship between and amongst ontology, epistemology and methodology was also clarified by Hay (2002) as illustrated in Figure 3.1 below. This includes methods and sources of data and demonstrates that these elements inform one another.
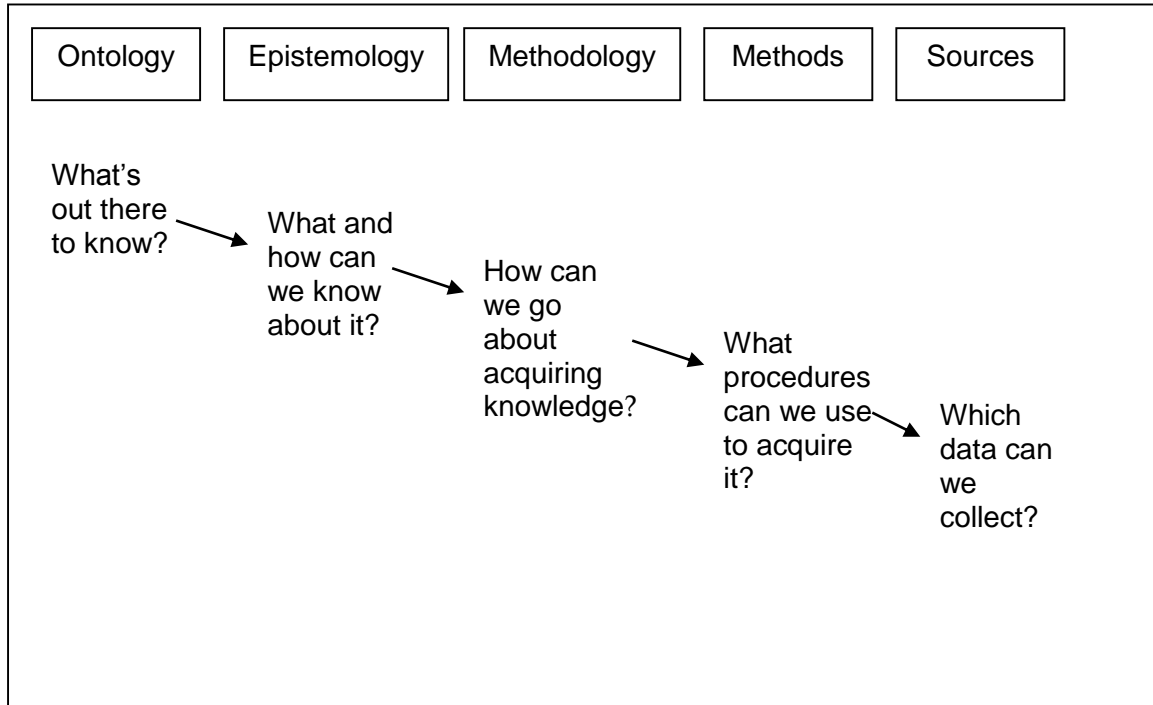
Figure 3.1: Research Perspectives (Adapted from Hay, 2002)

Hence in designing the methodological framework the researcher was aware of the need to achieve coherence amongst the different methodological elements and processes. It is against this understanding that, and because of the qualitative nature of this research, that Grounded Theory methodology, coupled with multiple case study method was used. It is also for the same reason that data collection in this study was done using unstructured interviews and focus group discussions.

Table 3.1 adopted from Crotty (1998) further classify options and provide major examples of how a research methodological framework can be developed using the relationships between different world views and epistemological orientations.

Meta-paradigms	Research paradigms: ontology and epistemology	Research design/Methodology	Methods
Objectivism Constructionism Subjectivism *(and their variants)*	Positivism Post-positivism Interpretivist - Symbolic interactionism - Phenomenology - Hermeneutics Pragmatism Participatory - Critical inquiry - Feminism Postmodernism *(etc.)*	Experimental research Survey research Ethnography Phenomenological research Grounded Theory Heuristic inquiry Action research Discourse analysis Feminist standpoint research <u>Case Study</u> *(etc.)*	Sampling Measurement and scaling Questionnaire Observation - Participant - Non-participant Interview Focus group Life history Narrative Visual ethnographic methods Statistical analysis Data reduction Theme identification Comparative analysis Cognitive mapping Interpretative methods Document analysis Content analysis Conversation analysis *(etc.)*

Table 3.1: Examples Classification (Crotty 1998)

3.3 Information System (IS) and research paradigms

IS involves addressing or serving the needs of organisations and individuals through the use of software created with means of databases, application programs and procedures. March and Smith (1995) confirms that the IS field is promulgated with the study of information systems and their characteristics and how information systems and programs support human purposes. In essence Information System is both a qualitative and quantitative orientated field of practice and research. It has aspects which required qualitative analysis and some that are purely quantitative. This observation has had a bearing on the paradigms and methodologies that are often used to conduct IS research.

There are basically two major paradigms of interest for most information systems researchers namely positivist or post positivist and the interpretive and or constructivist (Falconer and Mackay 1999; Probert 1999; Probert, Rogers, and Moores 1999). Positivist studies in IS have tended to dwell more on the quantitative aspects whilst interpretive and constructivist approaches put more emphasis on qualitative analysis and meaning making. In this research

the survey phase of data collection was mainly quantitative whilst the case study method used sought to elicit qualitative information regarding SMMEs experiences of working with agile development methodologies in cloud computing migration. In the main this study therefore employed a qualitative research paradigm.

3.4 Qualitative Research Paradigm

Qualitative research is considered a scientific type of enquiry that generally employs an investigation to seek answers to a question through a systematically predetermined set of procedures. It is mostly effective in obtaining answers for the *whys* and *hows* of human behaviour, opinion, experience and social contexts of particular populations (Merriam, 2009, p. 13). Additionally, it seeks to understand a given research problem or topic from the perspectives of the local population it involves. Parkinson & Drislane (2011) describes qualitative research as "research using methods such as participant observation or case studies which result in a narrative, descriptive account of a setting or practice. Sociologists using these methods typically reject positivism and adopt a form of interpretive sociology". Qualitative research helps in developing theories or frameworks when, as in the case of this study, existing ones do not adequately answer the current problem at hand (Creswell 2007).

Qualitative research has been used in many fields such as anthropology, Information Systems, education, nursing, psychology, sociology, and marketing all with the purpose of addressing questions about people's ways of organizing, relating to, and interacting with the world. Although there have been a lot of debate on the application of approaches and methods of qualitative research designs, it has also been found that some methods are more appropriate to certain types of inquiry than others. There is a variety of research methods commonly used in qualitative research. These are namely phenomenology, ethnography, and case study.

Phenomenology concept originates from the Greek word "*phainomenon*" meaning "that which appears". It is concerned with the study of consciousness and lived experiences of individuals who are the subjects of research. It is normally applied in research studies that seek people's experiences based on their perceptions, perspectives, and understanding of a phenomenon. *Ethnography* comes from the Greek "*ethno*" denoting ethnic group of people and *graph* meaning a way of representing or writing. Ethnography literally means "to write about a group of people" (Guest, MacQueen & Namey 2012). It originates from the studies which were

undertaken in anthropology by Bronislaw Malinowski and Alfred Radcliffe-Brown. It normally employs exploring of cultural phenomena, where the researcher is wholly engaged within the community under study for an extended period of time.

Case study, which is actually the method used in this research, is usually employed in studies that evaluate or explore a phenomenon within a real life context (Yin 2009). The aim is to understand some phenomenon unique to the people, in the case of this study SMMEs' lived experiences. Cases are normally chosen based on their uniqueness e.g. each of the participant and SMMEs that were involved in this study were chosen because of the need to elicit their unique experiences of using agile development methodologies in migration to cloud computing. More information regarding the use of case study method is given in section 3.4 of this chapter.

3.5 Theoretical framework

Drawing on Gill and Johnson (2002) it can be argued that a theoretical framework helps a researcher to explore in-depth issues around the cause and effect relationships between two or more variables. Similarly, Sutton and Staw (1995), Whetten (1989) argued that the use of a theoretical framework addresses relationships with a plausible and coherent explanation of what should be in the data. Choice and use of theoretical frameworks is arguably shaped and influenced by the researcher's ontology and epistemological orientation.

Ideally, theories differ in complexity, abstraction and scope. Most research projects address a theory either deductively or inductively (Saunders, Lewis & Thornhill 2012). Deductive inquiry involves theory testing. A theory is assumed and guides the researcher on what observations need to be taken in order to test the applicability of that theory. Accordingly prepositions are made at the beginning of the research in order to test correctness. From the preliminary investigation during literature study, the researcher was informed by the TOE as a theoretical framework and this framework guided the data collection and Grounded Theory was used for data analysis. The TOE has been explained in section 2.8 under literature review.

Inductive inquiry entails theory building and or inductive reasoning. It entails examining phenomenon and understanding it better by collecting data and analysing them. After analysis, a theory or framework is formulated. The most critical part of the either enquiry is the

consideration of the human factor in interpreting facts from their social world of reality. In this study the theoretical framework helped the researcher to think through the research focus and questions in order to develop a theoretical vantage point for carrying out the entire research project.

3.6 Grounded Theory: Definition(s) and application

Grounded Theory is primarily a qualitative research method for gathering and analysis of data. Glaser (2010) defined it as a study of a concept and not a descriptive study of a problem. Historically Grounded Theory was promulgated by the seminal works of Glaser and Strauss (1967) in *The discovery of Grounded Theory*; Glaser (1978) in *Theoretical sensitivity*; Strauss (1987) in *Qualitative analysis for social scientists*; Strauss and Corbin (1990) in *Basics of qualitative research: Grounded Theory procedures and techniques;* Glaser (1992) in *Basics of Grounded Theory analysis*; Strauss and Corbin (1994) in *Grounded Theory methodology: An overview' in Handbook of qualitative research (1st Edition)*; Charmaz (1995) in *Grounded Theory in Rethinking methods in psychology*; Strauss and Corbin (1998) in *Basics of qualitative research: Grounded Theory procedures and techniques (2nd Edition)*; Charmaz (2000) in *'Grounded Theory: Objectivist and constructivist methods' in Handbook of qualitative research (2nd Edition)*; Clarke (2005) in *Situational analysis: Grounded Theory after the postmodern turn* and Charmaz (2006) in *Constructing Grounded Theory: A practical guide through qualitative analysis*. Hence it is a theory that has evolved over time but is still being widely used in social sciences studies.

An important feature of Grounded Theory is the way in which data is collected and analysed. Data collection and analysis are interrelated and iterative. A Grounded Theory design is a systematic, qualitative procedure used to generate a theory that explains, an action, or an interaction about a substantive topic (Creswell 2008). As the name refers, it is a theory generation process of induction from corpus data. Grounded Theory is therefore based on a method that supports theory building as opposed to testing existing theory, a common practice in the social science. The following are the four distinguishing characteristics of Grounded Theory:

1. It aims at theory building (inductive inquiry)
2. Expert knowledge prior to commencement of the study is strongly discouraged as this can lead to pre-formulated hypothesis. Emergence of ideas rooted in data could easily

be influenced. This is why in this study literature review was also considered as a process of gathering data more than developing a predetermined theory for explaining the phenomenon under study.

3. Analysis and conceptualisation are propagated through the process of joint data collection and constant comparison. This is achieved by comparing generated data with all existing concepts and constructs to determine how it adds value to an existing category. Categories are a bases of framing a theory.

4. Slices of data of all type are selected through a process of theoretical sampling. Theoretical sampling is data collection process that the researcher uses to analytically decide where to find the next sample.

One major criticism of original grounded theorists is that they did not characterise Grounded Theory as a methodology package but rather they only presented various strategies and techniques or methods that could be employed. However, the Corbin and Strauss's (2008) book started to address this issue by aligning it to philosophies of pragmatism and symbolic interactionism as the ones that methodologically underpins the Strauss's iteration of Grounded Theory methods. The evident methodological gaps in seminal texts by originators of Grounded Theory have however encouraged contemporary theorists to develop methodological frameworks of Grounded Theory methods that are underpinned by various philosophies.

It is, as pointed out by Birks and Mills (2011).also encouraged that researchers decide their underlying assumptions about the world and decide how to position themselves philosophically and methodologically even as they decide to employ Grounded Theory. In this research the researcher considered the nature of the problem area that evolved from two disciplines: Software engineering (Agile Development Methodologies) and Virtualization (Cloud computing environments). The two disciplines need to be investigated using IS research strategies as they are applied in IS domain. The researcher's interest into these two areas was influenced by his interest in working within constructivism and interpretivist research paradigms under laboured by symbolic interactionism and coupled with Grounded Theory. Data collection methods such as interviews, questionnaires and literature review were employed.

3.6.1 When to use Grounded Theory

Grounded Theory is broadly used in research studies that require theory or framework building such as those in information systems, organisational change and leadership. In concurrence Creswell (2008) pointed out that Grounded Theory can be of great value when current theories about a phenomenon are either inadequate or non-existent. Grounded Theory can also be used when a researcher wishes to study some process such as how students develop as writers (Neff, 1998). In this study Grounded Theory was used mainly because the ultimate objective of this study is to generate knowledge that can be used to inform the development of a theoretical framework to guide use of agile development methodologies in cloud computing adoption by SMMEs. This is because existing frameworks are arguably not fully responsive to the needs of SMMEs in the context of South Africa. Also important to highlight is that Grounded Theory was used as an analytical framework for data analysis. Hence what comes out is that Grounded Theory was used in this study in two different ways.

3.6.2 Versions of Grounded Theory

From the time ground theory was developed by Barney Glaser and Auselm Strauss in 1967, it has evolved and unfolded within different two schools of thought. These two schools of thought are related to the world views and perceptions of two notable proponents of Grounded Theory who are named above (Stern 1994). There are similarities as well as differences between the two schools of thought making it not an easy task to choose which one to use without an in-depth study of both.

Both methods characterize a qualitative analysis research approach as they utilize a systematic set of procedures to inductively develop a theory about a substantive area. Both methods also assume theory building as one that emerge from data and consequently result into a hypothesis. However, Stern (1994) observed that they are differences. The Glaserian method maintains a closer look on data by considering questions such as "What do we have here?" while the Straussian method stops at each word in data and asks "What if?"

The Glaserian approach aims at generating concepts and relationships that explain, account for and interpret the variation in behaviour that are related to some problem discovered in an area of study. The research process starts with an empty mind and the emerging theory develops with some neutral questions (van Niekerk & Roode 2009). The theoretical sensitivity comes

from the immersion in the data and the theory is grounded in the data. The Glaserian approach has two coding phases; i.e. the simple (fracture the data then conceptually group it) and substantive (open or selective, to produce categories and properties (Stern 1994; Jones & Alony 2011).

However, the Straussian school of thought has a slightly different approach were the focus is to describe the full scope of behaviour occurring in the area under study (Onions 2006 & Stern 1994). The researcher need to have a general idea of where to start from such as having a research question about the phenomenon to be studied. It is a general practice to force a theory with structured questions. In this case, the theoretical sensitivity comes from the methods and tools and the researcher's ability to give meaning to the data requiring professional expertise in the discipline under study. Therefore, data is structured in a way that reveals a theory (Stern 1994). Coding is more rigorous and three types of coding is recommended as follows: open (identifying, naming, categorizing and describing phenomena), axial (the process of relating codes to each other) and selective (choosing a core category and relating other categories to that) (Onions 2006).

3.6.3 Conducting a Grounded Theory Study

Steps in conducting a Grounded Theory study are illustrated in Figure 3.2. The researcher begins the study with ideational constructs such as conceptual framework or "hunches" (Miles and Huberman, 1984) which are subjected to further investigation. The hunches can be derived from other sources apart from data (Glaser and Strauss, 1967). The conceptual framework is considered as a "seed" concept and not a preconceived theoretical idea before commencement of the research. In essence this is done to assist the researcher in selecting a substantive area of enquiry and be able to address the specific research topic.
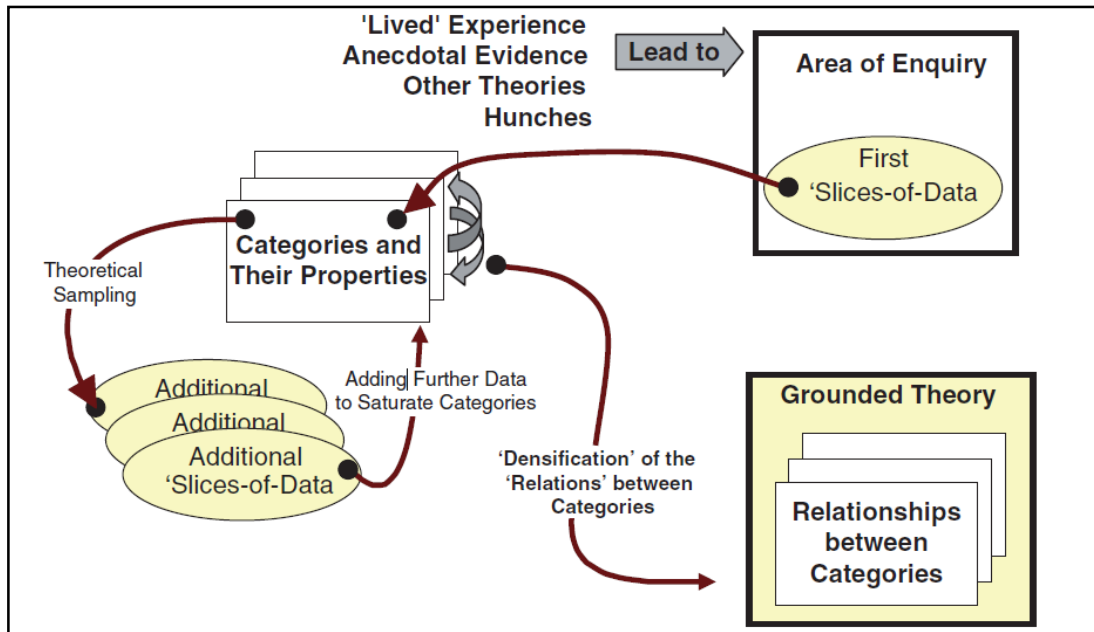
Figure 3.2: Cycle of data collection and analysis in the Grounded Theory method [after Lehmann (2001) and Fernandez]

After the first stage, the researcher picks "slices of data" from the substantive area and codes them into conceptual categories. It is also possible to get these slices of data from other sources using various data collection methods. This process of using other methods supports the concept of triangulation and enforces validation of the research process. The initial open coding is considered the first step in data analysis. Important words and groups of words in data are identified by labelling them into codes. *In vivo* codes represent verbatim quotes from participants and are labelled as they are. Categories are also introduced as groups of related codes (Holloway 2008). When new data analysis starts to bring in codes that already fit in the existing categories, then a theoretical saturation is attained.

The main feature in the Grounded Theory design is the presence of concurrent data collection and analysis. Additional data collection is performed only when the initial data is coded from a purposive sample. Thus; continual comparison with preceding data categories, concepts and contents is cardinal in Grounded Theory.

As shown in Figure 3.3, they are generally three levels of theory in the Grounded Theory method namely narrow, substantive and formal theories (Urquahart, Lehmann and Meyers, 2010).
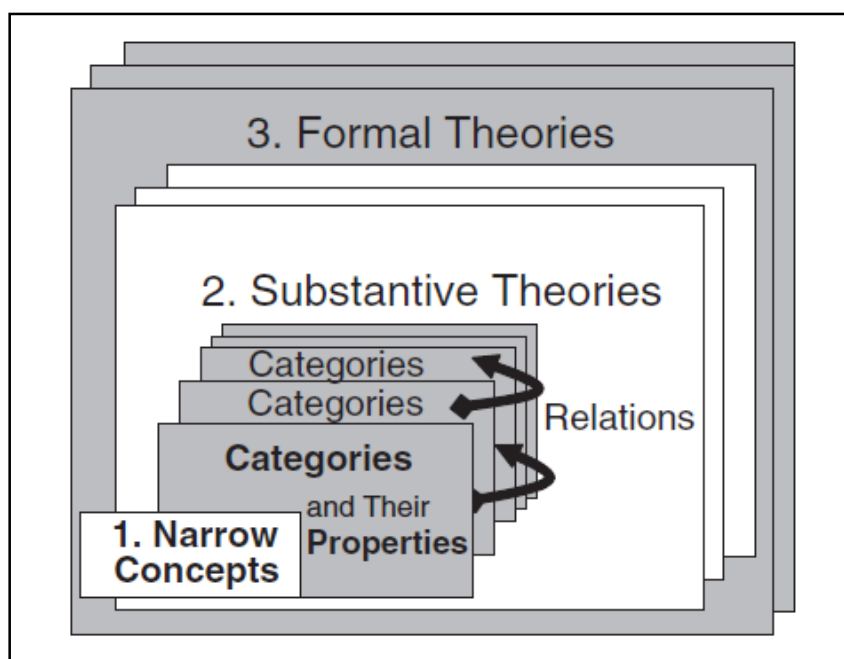
Figure 3.3: The progression of theory development in the Grounded Theory methodology (adapted from Lehmann, 2001)

Narrow concepts are initial concepts that begin with the theory building process and are constrained in use, range and scope. Substantive theories refer to theories that have been derived from the area of enquiry. They are independent and go beyond analysed data and all incidents examined (Glaser & Strauss 1967). Formal theories form part of the highest level of abstraction and are normally termed "formal theory". They concentrate on conceptual entities such as collaboration work or organisational knowledge (Strauss, 1987).

Figure 3.3 also shows the hierarchy of theories. The implication of this is that as the researcher goes up the levels of abstraction, the range and scope of theory also increases. Glaser and Strauss (1967) recommended deriving a formal theory by comparative analysis of dissimilar substantive theories within a specific substantive area and by comparing substantive theoretical ideas from several other different cases. In this research project the envisaged emerging framework will also be compared to at least one of the existing frameworks.

3.6.4 Theoretical sensitivity and use of Grounded Theory

The concept of theoretical sensitivity is critical for grounded theorist because it is directly related to theory generation. It claims that views and observations can be understood differently depending on the researchers interpersonal and reasoning during the process of data collection and interpretation. As Remenyi (2013) points out that, theoretical sensitivity requires intellectual maturity and some degree of self-judgement and detachment when making meaning

of data and observed phenomena. It is for this reason that when the researcher was interviewing participants, he was open minded and avoided preconceived views and judgements. Insights generated from literature review helped the researcher to achieve a good degree of open-mindedness and ask questions that elicited valuable information from all the participants. Therefore it is important to note that literature review served two purposes in this research project:

1. To generate preliminary insights (conceptual frameworks) on characteristics of the substantive area of agile development methodologies and cloud computing.

2. To explore and gain an understanding of trends and patterns and theories that is shaping the landscape of agile development methodologies and their deployment in migration to cloud computing. Such a deeper understanding was needed to help the researcher to come up with follow up questions when interviewing participants (Corbin and Strauss 1990).

This approach to working with literature is in resonance with the Grounded Theory principle of emergence that underpins this research.

3.7 The case study method

Case study approaches are usually employed in studies that evaluate a phenomenon within a real life context (Yin 2009; Creswell 2007; Yin 2003a). The aim is to understand some phenomenon unique to the case or they can then be applied to others cases or contexts. Cases are normally chosen based on their uniqueness. Case studies research focus on an in-depth examination of one or a few instances of some social phenomenal such as a community village, family etc. The "case" in itself is arguably of little consensus as pointed out by Ragin and Becker (1992) but can be used broadly. The main purpose of the case can be descriptive or can be used to explain some phenomenon. Researchers using a case study may only consider an idiographic understanding of a specific case under observation or may integrate Grounded Theory principles as a basis for development of more general, nomothetic theories (Babbie 2008).

Yin (2009) suggests that a case study may be used in addressing the "how" and the "why" research questions and where the focus is on contemporary issue with little control over events. The main question of this study requires the researcher to address the following: "How a

framework that explains the process of migration of agile software development methodologies to cloud computing approach can be designed for SMMEs software developers in South Africa". Therefore, in order to address this, the researcher employed the case study method.

Case studies can also be used in quantitative or qualitative research (Walsham 2006; Darke, Shanks & Broadbent 1998). In this study a qualitative approach was adopted as the primary strategy due to the nature of the problem. However, quantitative techniques were also used simultaneously during data collection and results were integrated during the analysis stage. This provided shorter data collection time and addressed weaknesses inherent in either approaches. The researcher was not an observer but shared concepts and interpretations with participants as recommended by Walsham (2006). The focus was to generate a framework, and hence Grounded Theory practices were integrated in the case study for the purpose of building the framework.

In a case study, a researcher has to carefully make decisions on the unit of analysis according to propositions and research questions (Yin 1994; Benbasat, Goldstein & Mead 1987). A case study normally has six sources of qualitative evidence namely; interview, physical artefacts, documents, direct observation, archival records and participant observation (Yin 2009). Yin also recommends the use of case study protocol in order to increase the research reliability. A case study protocol is basically a document giving guidelines on the essential procedures for conducting the case research, the instrument itself and the data analysis. TOE theoretical framework, for data analysis was used in this case study.

Yin (2009) suggests variations within case studies when used as a research method. For instance, Willig and Rogers (2008) identified four different types of case studies that can be outlined based on the researcher's decision on expected results. These are single versus multiple case studies; intrinsic versus instrumental case study; descriptive versus explanatory case study and the naturalist versus pragmatic case study.

Based on the problem area, the selected case study for this research is confined to SMMEs in the field of software development in South Africa and the boundary define the unit of analysis. The prescribed research questions directed an inquiry into addressing solutions to the research problem at the same time guided the researcher on parameters for relevant data collection method. Therefore, a descriptive-type of case study was adopted which allowed description of

processes, concepts and procedures in context. The articulation of propositions and questions at the beginning of the study helped in specifying the boundaries of the case and as facilitated interpretations of data and framework building (Mills, Durepos & Wiebe 2010). Further, Creswell (1994) indicates that a focussed and detailed description of a given phenomenon allows data coding when Grounded Theory analysis is used.

3.8 Scope of the case study

The scope of a case study can be widespread ranging from individuals, organizational groups or events. Yin (2009; 18) states that "the boundaries between phenomenon and context are not clearly evident" in case studies. As extensive as it may be, the investigator can set boundaries with respect to the type of information required from participants based on the research question. In determining case study boundary, factors such as time, location and events can be used (Remenyi and Williams 1998). The scope of this case study is set around events of software development with the view to understand agile development practice in SMMEs before and after migration to cloud technologies. The study is limited to software development companies based in South Africa only.

3.9 Sampling techniques

After the on-line survey data gathering and analysis, the researcher selected and worked with those participants who are associated with software development companies and have experience in software development. Special attention was given to those participants who were involved in the use of agile development methodologies at the level of directors, senior manager or developer in their respective companies. Some were managers while others were not. Thus the sampling technique used in this study was mainly purposive and strategic in orientation. The main objective of using such a technique was to ensure that data-rich participants are identified and selected (Yin 2004). Table 3.2 below gives details of the selected participants.

Participant	Company Name/Type of Business/Location	Brief Profile
Participant No. 1	• Unboxed Consulting • Software Development/Consulting • Cape Town	• Development Manager • More than five years' experience in Agile and Scrum in multitude of environments. • Works with teams ranging from 3 to 30.

		• He has worked in hardware development, high demand web properties, back end systems and desktop applications. • He has also served as a Scrum master, Product owner, team member and Project Manager in his portfolios.
Participant No. 2	• Visa • Information Technology and Services • Cape Town	• Software Architect • More than five years' experience as a development specialist. • Experience with using agile methodologies for application development.
Participant No. 3	• nReality Systems • Software Engineering consultancy • Johannesburg	• One of the companies' founding Director. • Has more than 10 years' experience in software engineering. • He deeply cares about delivering pragmatic software solutions. • He is currently involved in coaching teams in agile and implementing solutions using agile.
Participant No. 4	• ProjectCodex • Consulting/ Code Academy using Agile methodologies • Cape Town	• Co-Founder and CTO • Professor engineer and computer scientist. • He has expertise in telecommunication, digital processing and software development.
Participant No. 5	• Joxicraft (Pty) Ltd • IT services company with a clear focus on combining business and technology in key areas such as Cloud, data center infrastructure, user support and IT outsourcing. • Kimberley	• Founding member and CEO. • Experience with a variety of computer applications. • Worked formally as a Solution Architect and has experience in small medium enterprise in terms of general software development.

Participant No. 6	• <u>Indigo Cube</u>
	• Software improvement
	   o Skills development
	   o Training
	   o Coaching
	   o Learning programmes
	• Johannesburg
		• Managing Director.
		• Over 22 years working experience and has spent the last 14 years in the software industry.
		• He has been working closely with IBM and Rational Software developing high value-add software development solutions for large organisations mainly in the banking, telecommunications and public sector industries.

		• An objective-driven manager and informed strategist with a particular passion for achieving results.
Participant No. 7	• Imperial group • Logistics, Automotive Distribution and Retail, Car Rental, Financial Services • Johannesburg	• <u>Information Systems Developer</u>. • Maintain, audit and improve organisational support systems by working on the internal operations of computers, using existing systems or incorporating new technologies to meet Imperial Group Needs. • Works as a Systems analyst, Architect, SQL Developer and Web Developer. • Involved in requirements analysis and software development and testing.

Participants No. 8 and 9 *Interviewed together*	• Geekulcha
	• Tech Events and Software development.
	    o Research and development
	    o Hardware and skills development.
	• Pretoria
		• COO and CTO of Geekulcha.
		• Android Developers
		• Mentors on Dev Ecosystem and Maker Culture

Table 3.2: Profile of Participants

3.10 Data collection processes

Data used in this study was, in line with its qualitative research methodology, collected mainly through interviews, questionnaires and literature review. These data collection methods are elaborated on below.

As already pointed out in chapter one, these data collection protocols were done concurrently. The interview process was guided by a case study protocol (Yin 2009). It constituted a detailed plan of how the researcher had to achieve desired study objectives. In line with Grounded Theory methodology and the qualitative nature of this study unstructured interview schedules were used (Charmaz 2003). The order of questions making up the interview schedule was also not strictly adhered to, as the researcher wanted the process to be as open as possible allowing participants to think and talk freely.

The data collection process started in the last quarter of year 2014. A thorough Internet search was used from the directory listing of South African Software Engineering companies. After identifying them, the researcher developed an online survey and invited identified companies to participate. In an attempt to compensate any inconsistencies with respect to contact

information in the directory listing, a link to the survey was published through the Institute of Information Technology Professionals South Africa (IITPSA) (IITPSA 2014).

The results of the on-line survey helped in describing the characteristics of the population from which initial purposive sample was selected for interviews. A recommended sample size for Grounded Theory cited from Walden University (2013), range from 6 to 30. The initial sample size was three and as the research progressed eight interview cases were obtained. The on-going interviewing processes were based on and or shaped by insights generated previous research processes e.g. survey data analysis. Even within the same in-depth interview follow up questioning was determined by issues emerging from the discussion of the previous question (Strauss and Corbin 1990).

Maykut and Morehouse (1994: 80) describe in-depth interviewing as "a conversation with purpose and a form of discourse shaped and organised by asking and answering questions" In the case of this study the discourse being explored through the in-depth interviews were around the challenges associated with cloud computing, SMMEs experiences of working with the identified challenges, factors that affect successful use of agile development methodologies in cloud computing migration and as well as the kind and orientation of a framework that can be developed to help mediate the challenges associated with all the processes referred to above. In total eight interviews were planned for and successfully conducted. Data emerging from these interviews are presented and discussed in chapter five.

3.11 Research ethics

The study of "a contemporary phenomenon in real-life context" as in the case of this study obliged the researcher to take note of important ethical practices (Yin, 2009:73).

According to Welman and Kruger (2005), ethical considerations mainly exist at three phases of research project; firstly at the time participants are selected, secondly during measurement or intervention procedure and thirdly in the publication of the results. In conducting this study, the researcher was guided by the Association of Computer Machinery (ACM) code of ethics as outlined by Mason et al. (1995).

Before the data collection stage, the researcher sought ethical clearance from the university by outlining the objectives of the research and type of questions that will be asked to the

participants. It was only after ethical clearance (Appendix III) was given that the researcher started to interact and conduct interviews with the selected participants. Due to distances and the need to save on time informed consent were elicited from the target participants through emails. The researcher also made it clear to the participants that all data collected and analysed will be kept strictly confidential in order to protecting their privacy.

In addition the researcher also ensured that interviews were conducted within a safe space in order for participants to feel comfortable and be able to freely express themselves. At each interview, the researcher started by clearly explaining to the participant the purpose of the interview and also ensured that there was no absolute misrepresentation within the conversation and reporting of data collected (Sekaran 2003)

3.12 Trustworthiness

Academic debate on how trustworthy or credible research of a qualitative landscape is has been going on for some time now (Hamersley, 2008). Shenton (2004) argued that even though many critics are unwilling to accept the trustworthiness of qualitative research, frameworks for confirming rigour in this form of work exists. On the other hand Patton (2002: 14) argued that while the credibility in quantitative research depends on instrument construction, in qualitative research, "the researcher is the instrument". With this in mind, the researcher used the following strategies for enhancing trustworthiness:

Provision of sufficient information about the research context
Dilley (1999) and Shenton (2004) had drawn thoughtfulness to the significance of context, in improving the trustworthiness and credibility of social research. In addition, Shenton (ibid.) recommended that a comprehensive description of the area under study can significantly improve credibility, as it presents the actual situations that have been studied and the contexts that surround them. In this study, in addition to reading around the area of cloud computing and use of agile development methodologies the researcher spent close to year developing contextual profiles of SMMEs using ICT and cloud computing services.

Peer review and frequent debriefing
Other than prolonged engagement with participants, the researcher also presented and shared his research, in its proposal stage, and as it developed through to its conclusion, with a wide range of critical friends and fellow researchers. A paper was developed and

published in a peer reviewed conference called Cloud Computing (CLOUD), 2014 IEEE 7th International Conference and further an extended version was peer reviewed was published in the International *Journal of Cloud Computing* (ISSN 2326-7550). Vol. 2, No. 2, April-June 2014. Both papers are presented in Appendix IV. Presenting his ideas and emerging insights about ICT, cloud computing and use of agile development methodologies proved very useful to the researcher. The idea of sharing experiences of how the study is unfolding, is similar to what Shenton (2004: 67) referred to as "frequent debriefing sessions". It is from these sessions that provided a sounding atmosphere for testing, developing ideas and interpretations. It also provides opportunities for scrutiny of the study by fellow peers, academics and ICT researchers and users, and their feedback allows a researcher to rethink the way the study is developing.

Highest ethical standards and procedures

Golafshani (2003) pointed out that abiding to ethical matters increases the whole trustworthiness of a research project. Cautious thinking and practices in dealing with ethical as was previously discussed in Section 3.6.1 contributed to the overall trustworthiness and credibility of this research (Leedy & Ormrod, 2005).

3.13 Validity and reliability

Validity refers to "the extent to which a measurement instrument actually measures what it purports to measure" (Lusk & Shogren 2007: 247).Validity is further classified into two types; external validity and internal validity. The former refers to validity of the survey beyond the study such as generalisability to the population and context and the later refers to quality and completeness of the measurement (Bless, Higson-Smith & Kagee 2006; Bless & Achola 1999).

Saunders, Lewis & Thornhill (2009) associates internal validity and reliability of data collected and response rate to the way questions are designed and thoroughness of pilot testing implying that accurate data can only be collected using a valid questionnaire and in a consistent manner. According to Foddy (1994:17) the idea is to make sure that the questions on the questionnaire are making sense. He also recommends a four stage approach in dealing with validity and reliability as shown in Figure 3.4:
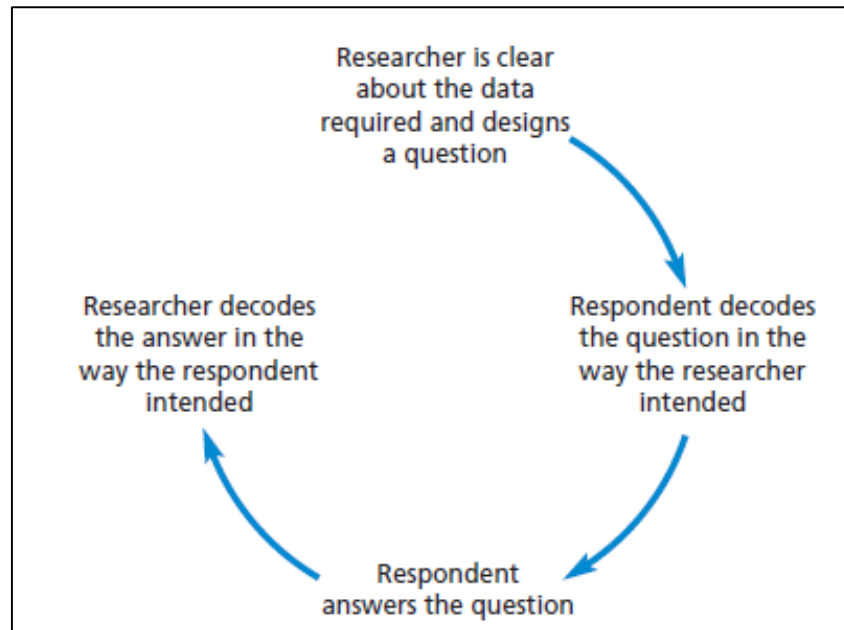
Figure 3.4: Stages that must occur if a question is to be valid and reliable (Foddy 1994)

For instance in this study, the researcher's main question at the survey stage was "What are the agile methodologies in use in South Africa?" Subsequently, four other sub questions were to be ascertained as follows:

1. What agile methodology are you using?
2. What cloud computing services are you using?
3. What type of applications, tools are used to develop software in cloud computing?
4. What are the perceptions held by agile software developers with respect to cloud computing?

Based on this it was easier to collect valid data upon which to move onto the next stage of data collection and analysis. The questionnaire use is annexed in this report as Appendix II. The questionnaire represented the reality of what was to be measured based on the intended research question provided and hence enforcing internal validity.

After the questionnaire was designed, it was further implemented by use of LimeService, a professional online survey tool (https://www.limeservice.com/en/). The tool provides an environment for the respondents to get access to the questionnaire online using an Internet link. After completing answering the questionnaire, the tool allows for storage of respondents data of which the researcher had access to. The researcher then decoded the data by downloading it

into a Microsoft Excel spreadsheet and SPSS, a statistical package from which further data analysis in terms of frequencies was employed.

Thus the researcher is very confident that issues to do with enhancing the validity, reliability and trustworthiness of this study were adequately dealt with.

3.14 Conclusion

In chapter three the researcher presented an overview of the philosophical framework that determined and shaped the design and conduction of this research project. The chapter provided adequate information on the actual research methodology, and methods used to carry out the study. Chapter three is therefore a chapter in which the researcher showed his efforts to master research methodologies. The chapter also provides a background against which the validity and credibility of the findings of this research can be judged. The critical thinking and rigour with which the researcher approached the study is clearly articulated.

As pointed out in chapter one the next two chapters (4 & 5) now present an analysis of data generated and associated emerging findings.

Chapter 4 : SURVEY DATA ANALYSIS AND FINDINGS

4.1 Introduction

Chapter four presents the data generated from the data collection instruments. This chapter begins the process of interpreting and unpacking the meaning of the data presented. It is important to highlight here that the approach to the survey was totally investigative and no generalisation was anticipated. This was because the researcher only needed to initiate research processes knowing that the rest of the research processes was qualitative in orientation and approach. The survey significantly helped the researcher in the identification and selection of participants earmarked to partake in the case studies. The main objective of the survey data analysis was therefore to evaluate the extent of use of agile development methodologies by SMMEs in South Africa and use this as the basis (preliminary insights) for exploring the need for a framework to support use of agile development methodologies in cloud computing migration.

Specifically chapter four covers the following aspects of the survey data presentation and analysis:

- Demographic information
- Experience in agile methodologies and cloud computing
- Experience in cloud computing for general purpose work
- Perceived usefulness and perceived ease of use towards cloud migration

It is equally important to also note that the survey data was analysed using a variety of techniques and these ranged from frequencies to percentages. These techniques were employed, as Sekran argues, to get the goodness of fit.

4.2 Demographic information

Tables 4.1 and 4.2 show the demographic statistics. The survey involved participants who coming from software development companies in South Africa. Thirty-six (36) participants representing different companies responded positively to the questionnaire. Seventy-five percent (75%) of the respondents represented private companies. The majority of the companies were situated in Gauteng (38.9%) and Western Cape 38.9%). Although they were situated in these regions, it was also noted that some of them had presence in form of branches

in other regional towns. The participants were either owners or senior members of staff who actively participated in software development processes. Their company profiles entailed provisioning of information technology and software development with the sixty-nine (69%) employing between one and ten employees.

Type of Company	Frequency	Valid Percent
Close Corporation	1	2.8
Private Company	27	75
Private Consultant	1	2.8
Public Company	4	11.1
State Owned Company	3	8.3
Total	**36**	**100**

Table 4.1: Company types

Region	Frequency	Valid Percent
Free State	6	16.7
Gauteng	14	38.9
Kwazulu-Natal	2	5.6
Western Cape	14	38.9
Total	**36**	**100**

Table 4.2: Regions Represented by companies

4.3 Experience in agile methodologies and cloud computing

Table 4.3 shows that fifty percent (50%) of the participants had more than ten years of experience in software development. It was also found out that eight-one percent (81%) were knowledgeable and practiced agile development methodologies of which scrum was the most popular methodology. Table 4.4 and 4.5 show the results. The trend however shows that most of them just acquired this experience with no more than five years.

Software Engineering Experience	Frequency	Valid Percent
1 - 5 Years	11	30.6
6 - 10 Years	4	11.1
Less than a year	2	5.6
More than 10 years	18	50
Prefer not to say	1	2.8
Total	**36**	**100**

Table 4.3: Software Engineering Experience

Agile Development Experience in Cloud Environment	Frequency	Valid Percent
Less than a year	7	19
1 - 5 Years	20	56
6 - 10 Years	2	6
Total Experience	**29**	**81**
No experience at all	5	14
No answer	2	6
Total	**36**	**100**

Table 4.4: Agile Development Experience with Cloud Environment

Methodology	Number of Responses	Percent	Percent of Cases
Scrum	23	40.40%	69.70%
Lean	6	10.50%	18.20%
Kanban	11	19.30%	33.30%
Extreme Programming	11	19.30%	33.30%
None	6	10.50%	18.20%
Total	**57**	**100.00%**	**172.70%**

Table 4.5: Methodology in use

In terms of usage of cloud computing, almost sixty-four percent (64%) were already using cloud technologies and twenty-two (22%) were still considering to move to the cloud (Table

4.6).The main reason to moving to the cloud was attributed to benefits such as agility, scalability, cost, improved IT control and IT visibility, centralised management and mobility; and mobile device management as indicated in Table 4.7.

Cloud or Not	Frequency	Valid Percent
Considering	8	22.2
No	3	8.3
No Answer	2	5.6
Yes	23	63.9
Total	**36**	**100**

Table 4.6: Migration Status

Business Case	Number of Responses	Percent	Percent of Cases
Agility	16	15.80%	45.70%
Scalability	14	13.90%	40.00%
Cost	17	16.80%	48.60%
Improved IT control and IT visibility	13	12.90%	37.10%
Centralized management	17	16.80%	48.60%
Mobility and mobile device management	13	12.90%	37.10%
Competitive advantage	9	8.90%	25.70%
Unsure	2	2.00%	5.70%
Total	**101**	**100.00%**	**288.60%**

Table 4.7: Business Case for Cloud Migration

The majority (61%) of respondents had up to ten years of experience using agile methodology with the cloud environment while thirty-three (33%) had less than one year or literally no experience at all (Table 4.8). Table 4.9 shows results of a self-assessment on using cloud computing with agile methodology by respondents that showed approximately seventeen percent (17%) had high experience, forty-two (42%) had moderate experience and thirty-one percent with low experience.

Cloud Experience	Frequency	Valid Percent
Less than a year	7	19.4
1 – 10 Years	22	61
No answer	2	5.6
No experience at all	5	13.9
Total	**36**	**100**

Table 4.8: Cloud Experience

Self-Assessment Experience: Cloud for Agile	Frequency	Valid Percent
High experience	6	17
Low experience	11	31
Moderate experience	15	42
Unsure	4	11
Total	**36**	**100**

Table 4.9: Self-Assessment Experience Cloud for Agile

Table 4.10 below shows twenty-seven percent (27%) respondents use public cloud and forty-four percent (44%) are using the private cloud option. A combinational use of the private and public clouds was also noted. However, about twelve percent of respondents were unsure what model they were using.

Cloud Model	Responses		Percent of Cases
	N	**Percent**	
Public	13	27.10%	36.10%
Private	21	43.80%	58.30%
Community	2	4.20%	5.60%
Hybrid	6	12.50%	16.70%
Unsure	6	12.50%	16.70%
Total	**48**	**100.00%**	**133.30%**

Table 4.10: Cloud Model

4.4 Experience in cloud computing for general purpose work

Regarding use of cloud computing for general purpose work, we found that fourteen percent (14%) respondents did not use cloud computing services at all for general work. However, eight-three percent indicated moderate to high usage. Refer to Table 4.11. Table 4.12 shows that the popular cloud service providers are Google and Microsoft with seventy percent dominance (70%) while a small section of eleven percent (11%) opting for open source solutions. As depicted in Table 4.13 it was observed that cloud services are mainly exploited from the Software as a Service (SaaS) environment with thirty-seven percent (37%) and other environments such as Platform as a Service (PaaS) (25%) and Infrastructure as a Service (IaaS) (24%).

General Cloud Experience	Frequency	Valid Percent
Do not use cloud services at all	5	13.9
High usage	16	44.4
Moderate usage	14	38.9
Unsure	1	2.8
Total	**36**	**100**

Table 4.11: General Cloud Usage

Service Provider	Responses		Percent of Cases
	N	**Percent**	
Google	20	37.00%	60.60%
Microsoft	18	33.30%	54.50%
Amazon	5	9.30%	15.20%
Salesforce	2	3.70%	6.10%
Open source solution	6	11.10%	18.20%
None/Unsure	3	5.60%	9.10%
Total	**54**	**100.00%**	**163.60%**

Table 4.12: Service Providers

Cloud Service Type	Responses		Percent of Cases
	N	Percent	
SaaS	20	37.00%	60.60%
PaaS	14	25.90%	42.40%
IaaS	13	24.10%	39.40%
Unsure	7	13.00%	21.20%
Total	**54**	**100.00%**	**163.60%**

Table 4.13: Cloud Service Type

Access to internet for these services was found to be at both office and home and the speeds vary (Table 4.14). It was also found that mostly internet speed of access was under 10Mbps. Other challenges relating to participants' experiences of internet and cloud computing were:

- Service providers are unreliable and offer low quality services,
- Limited use arising from single service provider,
- South Africa Internet infrastructure is slow, expensive and uncompetitive,
- Flexibility, disaster recovery and security are not guaranteed.

Location	Responses		Percent of Cases
	N	Percent	
Office	34	56.70%	94.40%
Home	26	43.30%	72.20%
Total	**60**	**100.00%**	**166.70%**

Table 4.14: Location of Internet Use

4.5 Perceived usefulness towards cloud migration

Although some of the respondents disagreed with the assumed positive aspects of integrating agile methodology with cloud computing, the majority (71%) fully agreed that integrating cloud computing services into agile would enable them to accomplish tasks more quickly. Sixty-one (61%) of the respondents also fully agreed that using cloud computing with agile enhances the quality of their work. Important to highlight is that the cloud environment was also found to be a critical factor in facilitating agile development. Sixty-eight percent (68%) confirmed this observation. Table 4.15 illustrates these findings.

Question	Total	Strongly Agree	Agree	Neither Disagree Nor Agree	Disagree	Strongly Agree	Total
Integrating cloud computing services into agile would enable me to accomplish tasks more quickly	31	23%	48%	19%	6%	3%	100%
Using cloud computing with agile enhances the quality of work	31	16%	45%	26%	10%	3%	100%
Using the cloud with agile would make it easier to do my work	31	16%	52%	26%	3%	3%	100%
I find cloud computing useful in my work on agile methodologies	31	19%	52%	16%	6%	6%	100%

Table 4.15: Perceived Usefulness towards cloud migration

4.6 Perceived ease of use towards cloud migration

The majority of respondents fully agreed that it would be easy for them to integrate agile methodologies with cloud computing and that it would be easy to use cloud computing services in order to accomplish their work. They also observed that it is easier to become more skilful in using cloud computing when agile methodologies are used. See Table 4.16 shows this emerging trend.

Question	Total	Strongly Agree	Agree	Neither Disagree Nor Agree	Disagree	Strongly Agree	Total
Integrating agile development with cloud computing would be easy for me	32	28%	41%	25%	3%	3%	100%
It is easy to use cloud computing services to accomplish work with agile methodologies	32	13%	47%	28%	9%	3%	100%
It is easy for me to become skilful in using cloud computing with agile methodologies	32	19%	41%	31%	6%	3%	100%

Table 4.16: Perceived ease of use towards cloud migration

4.7 Conclusion

As pointed out in the introduction chapter four presented the data that was generated through the survey phase of this study. The data was presented according to themes or categories that relates to the kind of information needed by the researcher in order for him to move onto the next phase of the research. The chapter also analysed the data and started to make the emerging

knowledge claims relating to the orientation and use of agile development methodologies in South Africa.

The next chapter (chapter 5) now moves on to present data emerging from the case study processes, and at the same time analyse it to obtain the trends and patterns that are beginning to emerge.

Chapter 5 : DATA ANALYSIS

5.1 Introduction

The chapter starts by presenting an overview of how the data generated in the case study processes was analysed. In this regard the chapter discusses the staged Grounded Theory process and how it was used. The definitions of open coding, axial coding and selective coding are also given and the way these data analysis techniques were used is fully described. The chapter also presents to the reader categories and or themes emerging as the data analysis progressed from open to selective coding.

Using selective coding and drawing on insights developed during literature review coupled with data presented chapter five goes on to outline and elaborate on the main themes (findings) emerging from this research. An effort is put to relate these emerging themes to focus and objective of the study. The chapter is therefore mainly aimed at giving the reader adequate information on the way the researcher worked with the data and the new knowledge that is emerging.

5.2 Data analysis frameworks and techniques

Data analysis enables the researcher to interpret and make meaning of data in order to explain the phenomenon being researched, which in the case of this study is around use of agile development methodologies in cloud computing migration and the need for a guiding framework to support SMMEs in South Africa. Data analysis can also be simply defined as a process whereby a researcher search for patterns in raw data with a view to ultimately explain what those patterns mean in relation to a particular research question or area.

Working within a Grounded Theory analytical framework as put forward by Strauss and Corbin (1990) the researcher subjected all the eight interview transcripts to open, axial and selective coding. In addition the researcher also applied the brackets technique where necessary to avoid and mediate challenges relating to allowing his preconceived ideas to influence the coding of data and establishment of categories (Chamaz 2006). Another tool called the "*Atlas.ti*" which is a qualitative analysis application tool was also used together and alongside the coding processes.

It is important to re-emphasize that the data analysis framework used in this study needed to be in sync with the qualitative nature of the research's methodological design. It is for this reason that data analysis techniques such as open coding, axial coding and selective coding were used. The data analysis framework used in this study is therefore that of Grounded Theory used within a qualitative research methodology orientation.

5.3 Data management

Data collection and keeping it in an easy retrievable manner is an important aspect of the whole process of data management (Huberman & Miles, 1994). To achieve this, the researcher was informed with O'Leary's (2004) ideas for data management and reflexive analysis. Reflexive analysis, according to O'Leary (ibid.) involves being as close as possible to data from the initial collection (which was the survey) and right through to the interviews of the eight research participants. Also of significance was the idea of "keeping a sense of the overall project", as the study progresses (O'Leary 2004: 185). In practice this entails that the researcher made sure that data generated from survey and interviews was systematically organised, indexed, and processed (if interviews, transcribed, if video clips, edited) and made readily available for referencing back to when trying to make meaning and draw conclusions. In addition, cautious indexing of data made it easy to reference back to sources of evidence. For instance in this study all the eight interviewees were indexed e.g. Participant 3 indexed as P3.

Data generated in this study was also stored in the form of an electronic research journal. Further to that, all interview transcripts and filled in questionnaires were printed and hard copies archived. Screening, which in this case implied initial coding of data, to see which ones are more usable or useful, was also done. Data considered less valuable was not discarded but archived separately as the researcher realised that during the course of this study he might need to go back to it. The entire process of data management and analysis was very demanding and again provided for an opportunity for a lot of learning. Having a comprehensive plan for managing data proved very useful, as it allowed the researcher to easily access and retrieve data as and when it was needed (Davies 2007).

5.4 Open coding

Open coding refers to the initial or earliest phase of the coding process in the Grounded Theory approach to qualitative research (Strauss & Corbin 1990). In this study constant comparison

using the Grounded Theory analysis technique of open coding was conducted by capturing categories of incidents and their properties as codes and quotations. The theoretical sensitivity of the researcher informed the choice of codes from incidents examined in the interview transcripts. The process used sentences or lines that made up an incidence in the interview. A researcher can perform an open coding exercise and come up with as many categories as possible. As new categories emerged the researcher compared these with existing ones. Through this processes existing categories are expanded or new ones formulated. In line with Grounded Theory it is important to mention that at this stage (open coding) themes and categories had to emerge from the data (phrases and words in the interview transcripts) and not from literature or preliminary conceptual frameworks. This allowed the researcher to enhance his theoretical sensitivity and the pitfalls of importing existing theories into this stage of analysis. According to Grounded Theory themes must emerge from data (Strauss & Corbin 1990; Remenyi 2013).

A total of 105 codes emerged at this stage of data analysis. These 105 codes represented discrete instances of phenomenon as identified in the interview transcripts and referring to a particular substantive are of study or research question. In other words, they are the low-level categories that emerged from data. Remenyi (2013) refers to these codes as open codes or frost cycle codes because they represent data patterns discovered from the substantive area.
A complete list of these codes and frequency of quotations are shown in Table 5.1.

No:	Codes from Initial Open Coding Process:	Frequency of incidents
1	Abstraction of Services Through the Use of a Tool	3
2	Access Speed	1
3	Access to Development Tools in The Cloud	4
4	Agile Development Business Performance	1
5	Agile Development Challenges	3
6	Agile Methodology In Use	13
7	Agile Project Management Skills	1
8	Agile Provides Better Environment for Development	2
9	Agile Provides Quick Feedback Process	1
10	Appreciation of Development and Operation Tools	1
11	Availability Issues	4

12	Back-Up and Recovery Strategies	2
13	Bandwidth Limitations	3
14	Benchmarking on Cloud Applications	1
15	Bigger companies have own Clouds	1
16	Buy-outs by Bigger Companies	2
17	Capabilities of Cloud Servers	1
18	Capability of local Cloud Providers	1
19	Capital Expenditure Shift	1
20	Capital Investment on Infrastructure	2
21	Choice of Methodology Issue	2
22	Cloud Computing Environment	8
23	Cloud Computing Environment facilitates different role players	2
24	Cloud Computing Environment Provides a Variety of Tools	1
25	Cloud Service Compatibility	1
26	Cloud Service Providers	3
27	Cloud Service type for Development	3
28	Cloud Services Demand and Supply Issues	1
29	Cloud Viability Considerations	1
30	Collaboration	8
31	Communication Strategies	8
32	Competitive Advantage of Cloud Tools	2
33	Conflicts with Stakeholder During Development	1
34	Connectivity Issues	2
35	Considerations for a cloud Service Provider	1
36	Continuous Integration and Delivery Issues	4
37	Control on Spending In case of traffic Surges	1
38	Control over Own Data	1
39	Cost Considerations	6
40	Cost Effectiveness	1
41	Customers use their own Private Clouds	1
42	Data Ownership Worries	3

43	Data Safety Concerns	1
44	Deployment Options	2
45	Deployment Time	4
46	Developer's Perspective of Cloud Technology	2
47	Developer Pairing Collaboration Tools	2
48	Development and Operations Tools	5
49	Development Experience	1
50	DevOps is becoming the Mainstream of Development	4
51	Distributed Data Centers	1
52	Dynamic Resource Provisioning	1
53	Expertise in use of General Technologies	6
54	Factors for Successful Migration	2
55	Feedback Processes	1
56	Hosting Considerations	5
57	Human Element	6
58	Independence of Technology Considerations	7
59	Industry Demand	1
60	Innovation and Product Demand	2
61	Institute Tracking Mechanisms	1
62	Integration Issue	1
63	Inter-Operability Issues	2
64	Issues with Cultural Differences	3
65	Latency Issues	3
66	Licensing Consideration	1
67	Load balancing by Providers	1
68	Local Server Limitations	1
69	Local Server Preference for Certain Data	2
70	Local Server Reliability	2
71	Market Analysis	1
72	Market Scope	1
73	Multi-Vendor Considerations	1
74	Need for Guidance to Support Business Expansion	1

75	Need for a Combination of Skills in Development and Operations	1
76	Need for Adaptation to Environment	1
77	Need for Expertise in Agile Project Management	3
78	Need for Expertise in Use of DevOps Tools	7
79	Need for Local Data Centers	3
80	Need for Project Management Skills	2
81	Need for Tools to Proportionately Allocate Resources According to Requirement	2
82	Need for Training in the Use of Cloud Tools	7
83	Need to Analysis Data Segment to put in the Cloud	1
84	Need to understand Cloud Limitations	1
85	Organization Size Perspective	2
86	Processing Speed	1
87	Project Time Overruns	1
88	Quality Assurance Issues	2
89	Reliability of the Cloud	4
90	Resource Constraint on Small Companies	2
91	Scaling	3
92	Security Considerations	7
93	Shorter Times Requirement For Daily meetings	1
94	Some Code Repositories Still on Local Servers	1
95	Staged Migration Process	5
96	Stakeholder Role	3
97	Storage Limitations	1
98	Third Party Role	2
99	Trust and Data Safety Issues	1
100	Uncertainty Leading to Unexpected Losses	1
101	Use of a Combination of Tools Developers and Customers	1
102	Use of Own Data Centers	1
103	User Requirement	3
104	Vendor Independence	1

| 105 | Work Experience | 1 |

Table 5.1: Initial Codes

Open coding as the first phase of identifying and labeling themes in raw data sets the stage for axial coding, where the dissected data is reassembled as the researcher develops and relates categories. Below is an outline of how axial coding was done in this research project.

5.5 Axial coding

According to Strauss and Corbin (1990) and Glaser (1978) axial coding involves identifying relationships among the open codes. In practice it entails that data is assembled in new ways after open coding, by making connections between categories. Analytically it involves a process of moving from inductive to deductive analysis (Urquhart, Lehmann & Myers 2009; Charmaz 2004; Crossan, Lane & White 1999; Sutton and Staw 1995; Whetten 1989;)

In this study axial coding meant that the researcher had to work on the 105 categories emerging from open coding and try to establish;

- The *conditions* that give rise to the code
- *Context* into which each code is embedded
- *Action/interaction strategies* in which the code is handled, managed, carried out and
- *Consequences* of those strategies

By engaging in axial data coding process the researcher was able to expand his knowledge and understanding of the categories or themes that are emerging in the study (Charmaz 2004; Whetten 1989).

Throughout axial coding, the categories and concepts that were developed through open coding were combined and empirically generalized by organizing them into a "coding paradigm" that linked phenomena to causal relationships and the context of the phenomenon being investigated (Glaser 1978). Strauss and Corbin (1990) recommended an application of a set of scientific terms that make categories at axial coding very visible. For example grouping categories in an organising scheme such as conditions, actions (interactions) and consequences. The researcher did not observe the formal prescription of axial coding as prescribed by Strauss and Corbin but identified sub-categories through links between and amongst them from the experiences learnt during the literature review study. Kathy Chamaz used a similar approach during one of her studies (Chamaz 2011).

Grounded Theory also prescribes further analysis of substantive codes to theoretical codes that has a conceptual meaning to the substantive incidents of data gathering. A process of discovering possible relationships and constant comparisons was undertaken. Codes that showed relationships were grouped together into families of codes. The family of codes represented codes that refer to similar occurrences such as market scope or resource availability. Accordingly the researcher had to draw on literature (as data) to explain the conditions giving rise to the emerging families of codes and what this may mean to the central research question being explored in this study (Strauss & Corbin 1990). Table 5.2 below shows the results of the axial coding process.

Categories from Open Coding Process	Frequency of Quotations
Compatibility	8
Geo-restriction	12
Industry	6
Innovativeness	7
Market Scope	8
Organisation Size	20
Prior technology experience	32
Relative Advantage	28
Supplier Efforts and external computing support	18
Top Management Support	5
Trialability	19
Uncertainty	31

Table 5.2: Categories and Quotations from axial and selective coding

In Grounded Theory data analysis framework axial coding is succeeded by selective coding. Hence the next section outlines the thinking that guided the researcher in conducting selective coding as a data analysis technique characteristic of studies that are underpinned by Grounded Theory such as this one.

5.6 Selective coding

Selective coding entails asking a question such as "is one category or theme appearing central in relation to the research's main objective or research question?"

The process of selective coding therefore involves selection of a central (core) category as a vehicle for the integration of the other major categories thereby developing and refining theoretical claims (Gasson 2003; Strauss and Corbin 1990). According to Strauss and Corbin (ibid) selective coding is a late phase of analysis in the Grounded Theory approach to qualitative research and it is the process that takes the researcher through to a point of developing and validating a knowledge claim (formulating a theory).

Selective coding also requires the researcher to actively be involved in analysing the categories based on the main phenomenon as required by the research objectives. This entailed revisiting the research questions and determining which data is necessary for analysing based on the intended theory (Gasson 2003; Glaser 1992). The focus is more to do with establishing and explaining relationships between categories and subcategories of the relevant phenomenon (Corbin & Strauss, 1990). The whole idea at this stage is to refine and integrate categories to a higher level of abstraction by clarifying logic, removal of irrelevant properties and integrating details of properties into those that are interrelated. Otherwise, the process is not that different from the axial coding apart from the level of analysis and conceptualization of categories to a model or framework that meets the research objectives.

It is at this stage of data analysis that the researcher needed to work closely with the main research question and objectives. This was important as it helped the researcher to start making plausible connections or causal relationships between the emerging codes and the aim of the study, which revolves around determining factors needed to inform the development of a framework to support deployment of agile development methodologies in cloud computing migration by SMMEs in South Africa.

Interesting to point out is that the families of categories identified during the axial coding were in concurrence with a framework proposed by Mwansa and Mkandla in 2014. The codes were also in resonance with the TOE framework (that of Environment issues, Technology issues and Organizational issues). Table 5.3 shows identified themes in detail with corresponding classification of categories identified earlier.

Code families from selective coding process	Codes
Environment	Industry, Market Scope, resource availability & Supplier Efforts and external computing support
Organisation	Innovativeness, Organisation Size, Prior technology experience, communication strategy &Top Management Support
Technology	Compatibility, Geo-restriction, Relative Advantage, Trialability & Uncertainty

Table 5.3: Detailed Themes and respective codes

In the following sections the researcher started to discuss the above themes in form of story lines. According to (Whetten 1989) at this phase of selective coding the researcher is expected to explicate the story line, describe the emerging core or central category and relate it to other categories. It also entails judging if that core category can explain the other categories and validating the storyline against data. In practice it is therefore important that the researcher bring in here data (evidence in form of excerpts from interview transcripts) and couple it with insights gained during the literature study to further develop and validate the emerging theories in relation to the research question.

5.7 Family code 1: Environment Context

In dealing with the environment context, we need to address two environmental aspects. One is the agile development environment that has requirements of practices that nurtures an agile culture based on agile principles (Marinescu 2012; CollabNet Inc. 2011; Keith 2002; Hu, Wong, Iszlai & Litoiu 2009; Salesforce 2008). The other environmental context is the cloud computing environment that also by its definition is supposed to provide computing utilities in a manner that is specified (NIST 2011; Mell *et al*. 2011; Salesforce 2008).

The following factors were observed; industry referring to software engineering industry specifically those that are involved in using agile development methodologies, market scope, resource availability and supplier efforts and external computing support. When probed further during the interviews none of the eight participants referred directly to regulatory aspects in

the country other than the one who made an opinion on government support to support implementation of the telecommunication policy. This response was categorised under the "supplier efforts and computing support category". Figure 5.1 summaries the interrelationships of categories or factors as drawn from the analysis, representing environment context as imagined by participants interviewed.
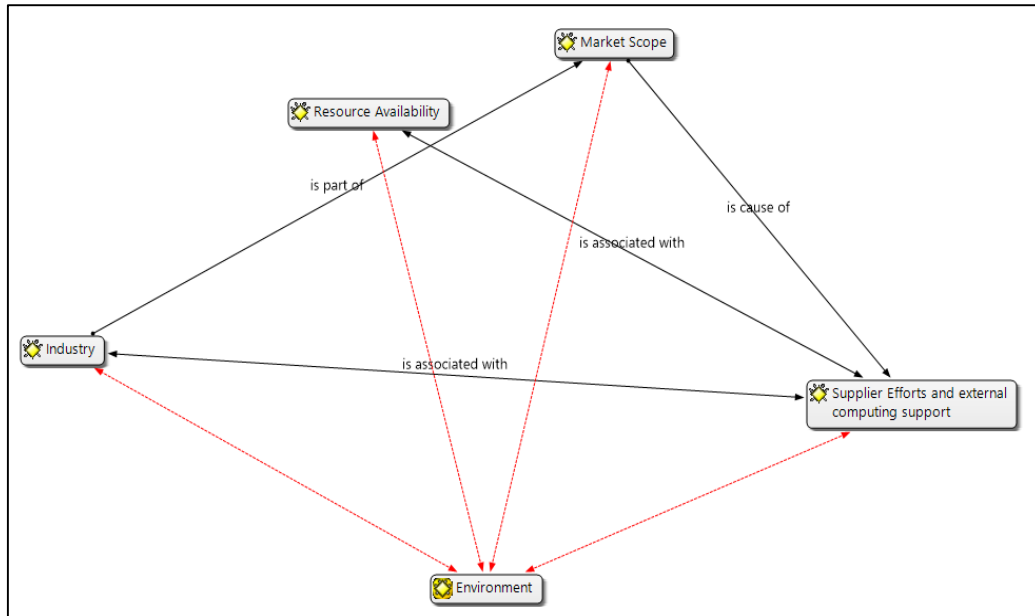
Figure 5.1: Relationship Diagram for Environment Context

It was also found that there is high demand for improved technology use in software development industry (see excerpt P2 below). Improved technology involves newer ways of provision of computing services that include that of cloud computing. This observation is consistent with the trend of cloud adoptions as observed by Alshamaila *et al* (2013), Low, Chen and Wu (2011) and already highlighted in chapter two. However, there seemed to be still a gap in terms of research on industry requirements. More research is needed in order to come up with support mechanisms to emerging ICT industries in South Africa. Such mechanisms include technology which ranges from open source to commercial tools such as provided by cloud computing environment. Commenting on industry characteristics one of the participants (P2) said;

> *"Nowadays if you look at technology industry it's demanding too much, there's a big gap on research to be able to focus on these guys. In terms of Cloud Computing, tools themselves, they range from open source to commercial. Depending with the size of the computer and their requirements you can be able to fit easily. Which is quite difficult, most developer houses are Agile, PhP, Java or python or confusion it's only where they can find integration that multi skilled people who are able to do that. So you can*

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imagine if you are in that environment where the DevOps is supposed to do all this"
(P2).

As illustrated in Figure 5.1, Industry was also found to have a direct relationship with supplier effort and external computing support as provided by the cloud service providers. It is argued that organisations do not need to invest in capital infrastructure such as network and servers when moving to the cloud (Arutyunov 2012; Hakan 2009). It is also claimed that cloud computing provides organisations an environment with improved manageability and less maintenance (ibid).

Another interesting observation is the relationship between industry and market scope. Most organisations involved in agile development are part of the software development market scope. Consequently, the major players within the software development market scope have influence on smaller organisations which in some cases lead to buy-outs. The study found out that smaller companies are being bought out by bigger companies. On the other hand, this entails that the efforts from external service providers to assist smaller companies are being frustrated or contradicted by the market scope involving large and international corporate organisations. An interview excerpt from Participant 2 below is illustrative of how this observation is unfolding in South Africa

> *"Usually, small companies are being bought off by big companies. We have a small organization called iKubu (Pty) Ltd it was bought by Garmin they sponsored and developed all the technology.*
>
> *Facebook just bought a company called Parse marking its entry into a new business of providing tools and services for developing mobile applications. And as a small guy they could not adapt to that. If the research is not done and these guys learn to adapt and cope when things get out of hand they will always be bought out by the bigger guys." (P2)*

Participants interviewed also indicated that agile methodology and cloud computing environments are currently becoming preferred ways to software development. Especially in current competitive business environments where as pointed out by Kareem *et al* (2013) you require rapid response to issues of development and access to tools. When asked to explain why cloud computing is now a preferred way Participant 3 said;

> *"Cloud computing is every Developers dream, it makes everything you did (sic) in any way easy. Its very Developer orientated the way things are documented." (P3)*

Making reference to the same observation and elaborating on budgetary allocations to enable adoption and use of cloud computing services Participant 7 also stated that;

> *"We are part of the Microsoft Bizbug so we have about R60 000 of access to the Cloud Services" (P7)*

In concurrence with Participant 7, Participant 8 pointed out that;

> *"They are very few organizations that are not already using Agile in some way, shape or form and most of them bad."*

The nature of market scope growth as depicted above has a direct impact on the overall provision of computing resources in South Africa and may also somehow results in improved support services. However, it should be noted that the observed trend of adoption of cloud computing in South Africa is still not comparable to that of USA and Europe. This is mostly due to the lack of resources such as private clouds to migrate services to that is typical of many African countries (See Chapter two; Schofield & Abrahams 2015).

Bemoaning the lack of services for cloud computing in South Africa Participant 1 was quoted saying;

> *"It's still kind of traditional and equally undistributed for example in USA and Europe it's perfectly acceptable to run very large cloud for example the UK has its own private cloud that it uses and its migrating all of its services, whereas in South Africa you still have large organizations that are theoretically into Agile but are still tied to the nature As an Agile Consultant I put an effort for people to have face to face communication. Now I belong to an organization that is quite distributed and it's been a core focus for us since last year to figure out how we collaborate without face to face communication"(P1)*

An impact association between resource availability and supplier efforts and external computing support was also found. Participant 1 highlighted issues that are linked to inter-operability within the cloud service providers by stating that;

> *"Some of the challenges we face are things like in multi nationals and large organizations where they have multiple companies in their portfolios and they want to centralize things. Basically it creates an issue such that you find yourself working for a company that is fast moving and happy with Cloud Technologies but they have to integrate with some 3rd party within the stable of companies, who isn't quite of there yet"* (P1).

It also became clear from the study that, at times integration of required tools from other service providers was a big challenge to smaller organisations that may not be having access to all the necessary tools. This, as already discussed in chapter two is one of the challenges affecting adoption and use cloud computing services in South Africa.

Participant 2 went on to suggests the need to check carefully the capacity of service providers in terms provision of services such as backups for disaster recovery. Participant 2 was quoted saying;

> *"Most organizations offering Cloud Computing Services, you have to look at how big the organization is what kind of mechanism they have in terms of backup, disaster recovery, in terms of load balancing and how many data centers do they have. Are they starting up people who are hunger resourced in terms of infrastructure?*
>
> *If you look at guys like Facebook, Google and Amazon these companies have data centers almost everywhere. They are able to fall back if you acquire data services from them; they are able to fall back on another data center if the main one experiences problems.*
> *We have got infrastructure issues and loomed issues, when you come to cases you always have to establish who is your provider and how much expertise, experience and what services do they have and what tools they provide that you are interested in"* (P2)

What seems to be coming out of the above observation and as supported by Schofield (2013) is the inherent lack of support infrastructure towards provision of cloud computing services in South Africa, making it more difficulty for SMMEs to access such important ICT services. In relation to the same observation Participant 4 also pointed out that the cost of connectivity has also been very expensive in the country. Participant 4 claimed that;

"Internet connectivity is expensive and slow compared to most industrial countries. Poland and Thailand leave us in the dust.

Government policy on telecommunications and an aging IT professional cohort that is resistant to change." (P4)

The observed lack of support infrastructure and the expensive connectivity bring about uncertainty and anxiety amongst "would be users" especially small companies usually falling within the SMMEs category. The same observation thus has a bearing on cloud computing adoptions patterns in South Africa. Would be users tend to panic to adopt new technologies if there is no assurance of quality of service.

Resource availability such as reliable cloud computing infrastructure and services is a critical factor in the adoption process (Sen 2013; Schofield 2013). According to NIST cloud computing services through the SaaS, PaaS and IaaS platforms are provided through the network infrastructure. Availability of resources and infrastructure needed for agile practices also came out as a major concern to "would be users" of cloud computing services in South Africa. During the interviews a number of participants expressed their concerns about the low availability of such resources. Trying to stress that sharing ideas on development projects, which is often unavoidable when resources are limited, can be problematic due to cultural differences Participant 1 said;

"My first taste of this was while I was living in the USA. What I realised is that Americans are generally effusive in their enthusiasm. For someone coming from a more austere culture, one influenced for example by an English culture, this can come across as insincere. Contrarily, our more austere reactions to an American can come off as cold and rude.

Software Development is a very English speaking culture, and it is usually the language used in off-shore development. To take this familiarity with a common language as also being a shared culture is where things can go badly wrong

When you move this interaction into economically sensitive activity, the potential for misunderstanding and misreading is significant. One important example is that when outsourcing to India which is a strongly paternalistic culture, it is very rude to disagree with someone in authority. As a result, the Indian team will never say "no" to a request from a customer (P1)

On the same observation Participant 4 raised concerns about reliability and bandwidth made available to small organisations such as SMMEs. The participant pointed out that

> *"Internet connectivity is expensive and slow compared to most industrial countries. Poland and Thailand leave us in the dust*
>
> *The reliability with SQLAzure is up to 95 % reliability Online, there are times when you cannot access it, and the speed of the connection is too slow to do actual live processing. How we use Cloud Technology is more on a reporting basis.*
>
> *The problem with South Africa in perspective is that the amount of bandwidth that we working with. With large corporates you can get pretty fast lines, you can about hundred megabytes and that enables you to run large processes on SQL Cloud. You can run large calculations on SQL Azure or SQL Cloud and you do not have to worry about your bandwidth.*
>
> *On small companies if you running you have to worry about bandwidth if you running Cloud Services"* (P4)

On the other hand and in line with what Participant 4 stated, Participant 5 argued that government's support to ICT is not adequate and has largely remained monopolised and expensive. Participant 5 went on to suggest that *"Government needs to open the telecommunications sector to greater competition"*

Commenting on the same issues Participant 7 casted doubts on resource availability due to distances in between places of development and where data resources are kept. In this regard the participant complained that;

> *"Already the issues of latency cause delay for us to converse. The reliability and availability do affect the Project at the end of the day. An experience we had with this is we had a case of where 2 members of a Team, one was based in Mozambique another in eNkangala close to Mpumalanga and another team member was based in Pretoria. It happened that 2 members that were based in another location were playing a major role in the project e.g. in Mozambique there was an Internet shutdown for the whole country so that became a problem cause we needed resources from him we needed him to take his Code to the Cloud and he couldn't do that for 2 days and it did delay us"* (P7)

It has thus emerged from this study that the environment context does affect the way individual and organisational ICT users perceive and adopt cloud computing services. Central amongst the users' concerns is the absence of adequate ICT infrastructure and limited resources to promote agile development practices and sustain good quality cloud computing services. This observation was also pointed out by chapter two section 2.6.

5.8 Family code 2: Organisation

According to Baker (2011) the organisation context applies to characteristics of organisations and resources that are available to support linkages within the organisation e.g. communication processes. From data analysis the following attributes namely "innovativeness", "organisation size", "prior technology experience", "top management support" and "cloud resource availability" came out as the key factors shaping organisational context. Figure 5.2 illustrates the interaction and interrelationships
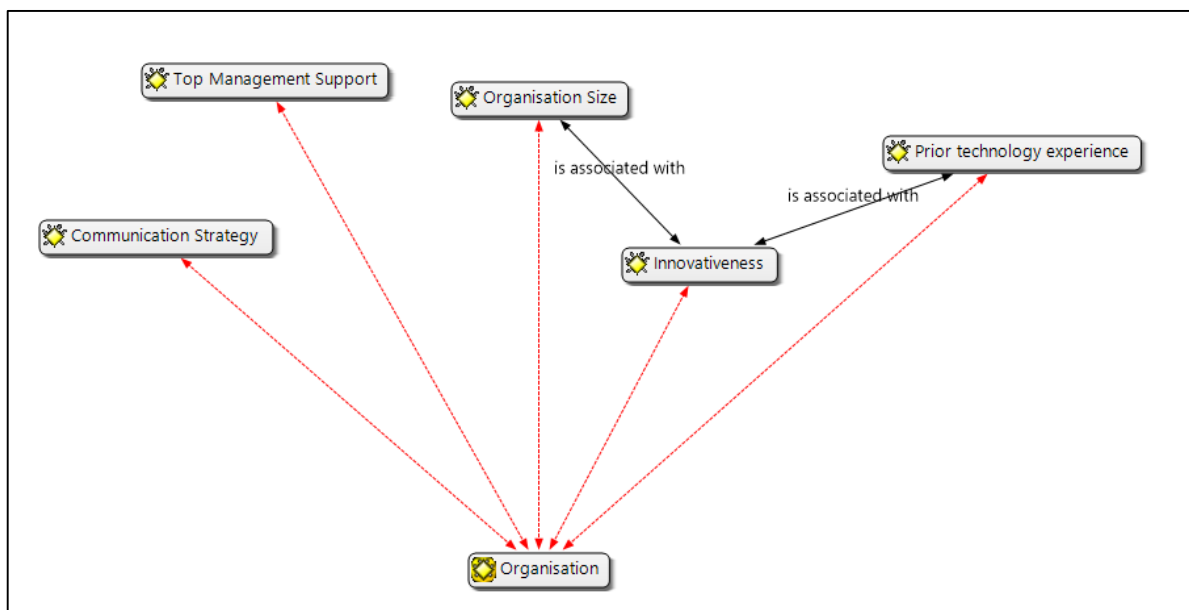
Figure 5.2: Relationship Diagram for Organisation Context

Agile development practices require that people work together closely both in terms of in terms of distances and interactive proximity (Fowler 2004). It is therefore necessary that an interactive and inclusive communication strategy is developed and properly articulated for implementation.

However, in cases where developers and clients are geographically apart, challenges in terms of reliable and efficient communication may, as pointed out by Participants 3 and 6 plays out as a major drawback.

Participant 3 highlighted the fact that;

> *"The data centers are based in Western Europe in Ireland both Amazon and Microsoft and am not sure of Google and there's latency. If you hosting a Website or Application or API over there, there is a slight bit of latency. This is the most important thing for me to know and for most applications it's not disruptive" (P3)*

Whilst Participant 6 elaborated on the same matter by saying that;

> *"To the enterprise it empowers Teams not to be geographically dependent. Agile due to the people element requires you to be together. Already the issues of latency cause delay for us to converse" (P6)*

Apart from communication problems, delays in the provision of cloud services are a major problem especially in an environment such as South Africa where, as emerging from this study, there are bandwidth and connectivity issues.

Top management support is of outmost important in managing migration as pointed out by Yigitbasioglu (2015) and Poon & Young (2013). During the interviews Participants 1 and 4 alluded to this observation. Both participants talked about the value that support from top management promoted and supported cloud computing migration processes within their respective organisations. The participants further claimed that top management is key in management of migration projects (Yigitbasioglu 2015). With regard to the importance of top management support Participant 1 said;

> *"Our CEO is very passionate about hardware and we had a bunch of servers lying around which hosted our Code Repositories and our mail.*
> *As an Agile Consultant I put an effort for people to have face to face communication. Now I belong to an organization that is quite distributed and it's been a core focus for us since last year to figure out how we collaborate without face to face communication" (P1)*

Similarly Participant 4 also stated that;

> *"The CEO needs to communicate a very clear strategy and back it all the way. The CTO needs to have a deep understanding of agile methodology and have the ability to architect and deliver a scalable product. The cloud is somewhat irrelevant from a technological point of view"* (P4)

On the aspect of innovation Participant 7 argued that adoption of cloud based tools such as Intel cloud tools can actually facilitate creativity. The participant was quoted saying that;

> *"In small companies, it is easy individually experiment with innovative tools such as Intel cloud development tools"* (P7).

Such tools like or IBM Bluemix are not extensively used in in South Africa. Participant 8 confirmed this dilemma as follows:

> *"IBM has a software called Bluemix.net where you can look at their site and see that you can actually provision a little development for yourself*
> *The only offering that I know that you can go in and get access to development tools is Bluemix form IBM and no one is using it in South Africa."* (P8).

Similarly Kop and Carroll (2011) also argued that creativity and innovation are intertwined. Currently IBM is offering some cloud based tools for free whilst tools such as DevOps that combines system development and administration tasks are being considered as innovative approaches (Humble & Molesky 2010; DeGrandis 2011). The interaction and relationship between creativity and innovativeness was also pointed out by Participant 1 by saying;

> *"Most organizations are starting to look for devOps to do sysadmin work rather than having separate development writing tools for the support organization and business interfaces, and sysadmins doing the more low-level and hardware work"* (P1).

Interesting and still related to organisation context it also emerged out that there is a close relationship between of innovation and size of the organisation. Participant 2 claimed that smaller organisations are closely attached to innovations whilst previous research shows that the relationship between organisation size and innovation varies considerably depending on patents (Teirlinck & Spithoven 2013; Kim, Lee, & Marschke 2004).

Commenting on this observation Participant 2 said that *"As a small organization people are attached to their innovations"* (P2)

From study observations, it can be argued that small firms or organisations involved in agile development are more likely to be innovative and it is innovation that big organisations tend to buy-out.

Also interesting some of the interviewed research participants made comments relating to small organisations such as SMMEs and connection between productivity and innovation. Participant 2, though not coming out quite clearly, said that

> *"Small scale companies in terms of productivity are quick to ship produce but undermine processes, security, quality and all those kind of things. If you a small guy you do not have resources. They do not follow normal corporate investments but innovate" (P2)*

This positive relationship between innovation and productivity in the context of smaller organisations has also been confirmed by researchers although the nature of this relationship can be explained based on strategies of technological competitiveness and cost competitiveness these small organisations are involved in (Bogliacino & Pianta 2009).

Related to agile development and the size of organisation Participant 5 noted that;

> *"Agile development in itself if you find it in small companies it might work but in terms of large corporates what ends up happening is that the Project ends up running longer than expected and the amount of changes that are required on a weekly basis by customers the customer does not usually know what they want from that Application" (P5)*

Commenting further on the same observation Participant 2 went on to claim that;

> *"In large corporates the requirements stay static; you can come back and review whether those requirements have been met. And then develop the new requirements; it's easier to handle the Application Development process rather than changing the Application during every week and then trying to get your end goal" (P2)*

Prior technology experience is another factor linked to organisation context that also came out as important in the way users adopts and work with cloud computing ICT services.
The association between prior technology experience and adoption of new ICT technologies like cloud computing is already acknowledged (lee 2007). Other scholars argue that prior technology is a facilitator to the intent to use. Further, it has also been argued that the level at

which prior technology experience is in an organisation determines how much experimentation is done in the cloud environments.

Participant 3, though in a long and winding way elaborated on this observation by saying that;

> *"If by the migration we also mean that the development team takes ownership of their own infrastructure (a company structure rather than technology change), then an important factor is that the team has to have the Ops skills. See the DevOps movement comes to mind.*
>
> *I have to say what has not changed, a lot of my career I worked on Microsoft Stack that needs visual studio and all that, if you move into the Cloud your underlying technology does not change, the same platforms we run on our servers are the ones we run in the Cloud. You do not need to learn new programming languages you do not need to know any other platforms. There's definitely new technology but whether it's in the Cloud or not that's beside the point."*
>
> *Depending on the time you need to experiment and that's if you already have basic knowledge. This is the key challenge of these Cloud environments and 2 clicks you have new PC up and running it does not cost much.*
>
> *Just understanding Agile is a challenge on it's on. Forget about how your services are hosted. It's important to find the overlap if we go into normal agile way it's a vas topic for our different cultures and getting different people to work together"* (P3)

Drawing from comments made by participants as articulated above it is coming out that prior technology experience constitute a relative advantage for organisation anticipating to migrate to cloud computing services. The more insight in to the technology which in this case is cloud computing the more likely that its usefulness would be appreciated and this often translate into quick adoptions (Low *et al.* 2011).

As already highlighted in chapter two (literature review) y lack of prior technology experience can also result in uncertainty. Participant 7 pointed out that uncertainty come as a result of not being knowledgeable about the new technologies.

When people don't understand the value of the new technologies then it becomes unlikely for them to adopt the same.

Commenting on the importance of prior technology experience Participant 1, 2, and 5 reportedly said;

"And the critical success factor for me is really an understanding and appreciation of the emergence of DevOps. DevOps offers middle ground where we start treating server infrastructure and configuration as code and as a result bring those things under management where they perhaps have not been in the past" (P1)

"First of all when you moving into agile and Cloud Computing there's a different Project Manager. With agile, you need additional roles for project management and therefore more skillsets required. For small businesses what they have to look at are these roles like Project Manager, Scrum Master, serious roles like Technical Lead and Development Team. They have to look at these roles and see if they are able to upskill. You also need to have tracking mechanism cause most of these tools especially those found in the Cloud.

DevOps is your traditional system administration that requires to also have let's say a major amount of knowledge of the products they support. Because he doesn't have the experience or know how once the packaging of the application and software is, he can't go further than that then you can pass over to the Developers.

Which will actually make a switch into more of your system administration. Coming from that space of building software you understand the programming language, you understand Release Management, Applications behaviour, change management, Continuous integration. It is a fairly new field that's coming up of the weaknesses that are there. You have guys you have been doing a great as System Administration. Besides the infrastructure they are supposed to know all this. There is a very big gap, it ups the standard of developers and the entire developer team plus the infrastructure team. Which is trained to bridge the gap.

The skill sets that are needed to actually deliver that particular feature and assign the appropriate people. Daily stand-ups means time should be considered and not be long, any issues that arise you need to resolve them within the small time frame. If they have an understanding, it's much easier cause you can have more roles fulfilled by less resources and just need the necessary skills (P2)

"Need to understand limitation of cloud technologies. As for now every company need to migrate to the cloud technologies as it is the next frontier and in addition they need to fully understand resources and constraints at play"(P5)

It is important that practitioners are well versed with agile methodology practices before even moving to the cloud (Gavri 2015; Mani, Jayakumar & Gopalakrishnan 2014). However, prior knowledge and experience of technology does not on its' own always translate into adoptions of all new technologies. At times, as observed during the survey process most ICT practitioners find it difficult to put agile methodologies in practice even when they are theoretically well versed with cloud computing. Making reference to the point raised here Participant 4 stated that;

> *"The hard part is agile, not cloud computing. So many companies claim to be agile but really don't understand the concept.*
>
> *You need good testing methodologies, performance monitoring tools, strategies to grow, market analysis, customer understanding and more.*
>
> *Agile is quite a holistic approach that is probably the biggest key to any successful migration, regardless of the technology (cloud or not). Many employees will fight agile methodologies as much as cloud technologies so a migration may fail because a migration to agile failed*
>
> *Testing, performance monitoring, scalability, client analysis and understanding. This is all about understanding your market and delivering a product in a timely fashion"* (P4).

In concurrence with Participant 4's observation Participant 5 also declared that;

> *"We are using Agile Methodology and to be honest we are having huge problems with agile methodology.*
>
> *We have Moon Desktop on SQL Azure, you can have the Cloud Infrastructure or your Windows Platform in the Cloud. My main base is Microsoft, so you can use SQL Azure. How we develop is that we have centralized large data Centre, we will then develop, compress data because our bandwidth in terms of office cannot handle large amounts of the data being transferred from Texas or London wherever. And then be calling back for the Application*
>
> *Need to understand limitation of cloud technologies. As for now every company need to migrate to the cloud technologies as it is the next frontier and in addition they need to fully understand resources and constraints at play (P5).*

Similarly Participant 6 pointed out that;

> *"Another thing I can point out is when you move up your Cloud Technology Stack more experience is required. Because if you simply using services online you only need to know essentially your own tools.*
>
> *Now if you go into your platform, you need to know OS and there is some skill level that is required. But these 2 platforms are not requirements for developers because platforms are essentially a backbone operating system, you are responsible for software's development environments and data frameworks"* (P6)

And finally Participant 7 suggested that;

> *"I think we need to invest more on human skills, build capacity on human skills on people who can work on security. I see an inclusive investment on all this"* (P7)

5.9 Family code 3: Technology

The technology context entails establishing and exploring causal relationships between and amongst technological compatibility, geo-restriction, relative advantage, and trialability and uncertainty factors. Figure 5.3 illustrates the established interrelationships.
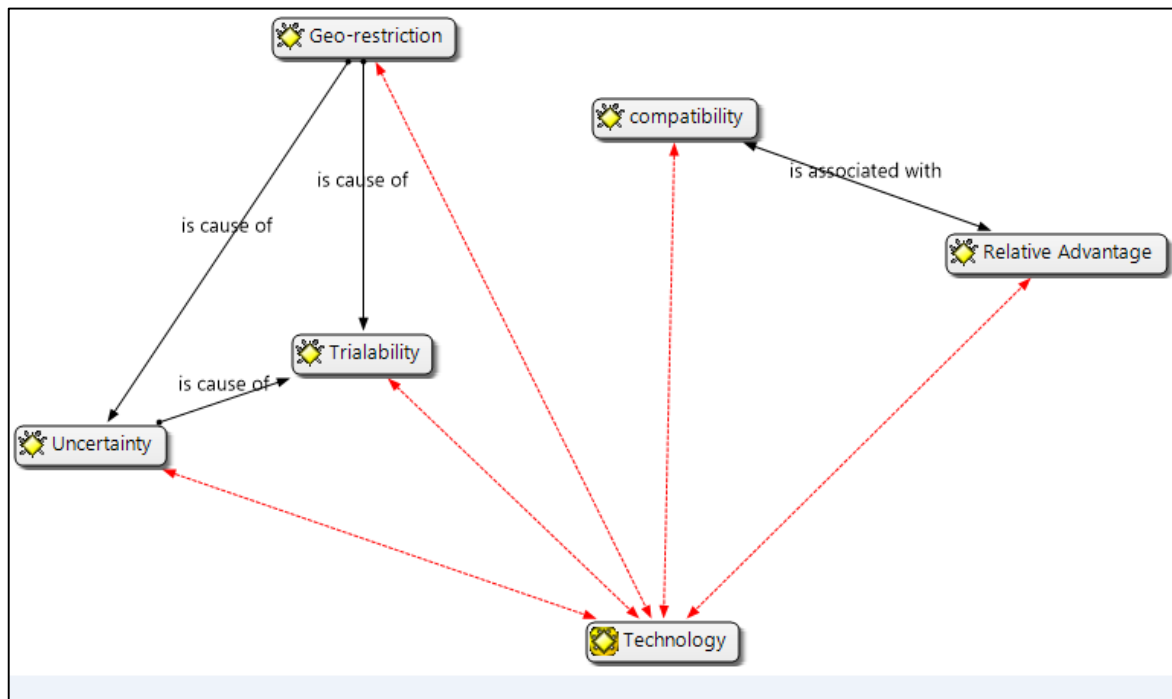
Figure 5.3: Relationship Diagram for Technology Context

First to emerge is that geo-restriction can bring about uncertainty. Participant 1 pointed out to this by saying;

> *"As a result we got this kind of impendence mismatch between stockholders that still very tied to physical infrastructure basically treating the cloud as second classes something not to be trusted or something less secure than physical systems.*
>
> *One of the things of vital importance is decent code of afterwards ...so being able to up the level of communication from email, instant messaging, to voice call and video conference. It is vital in terms of navigating those challenges and communication and challenges to collaboration when working in an agile way" (P1)*

As discussed in chapter two section 2.6, physical infrastructure mismatches may drive clients to uncertainty. Participant 4 asserts that some developers feel that data is safer within their building than stored in data centres away from the premises. Emphasising this participant said;

> *"Existing developers don't want to learn how to use the cloud and there is this weird idea that data in your building is safer than data on a cloud server.*
>
> *The important point is that the only thing that "cloud" means is that you don't really know where your physical server is located. Using the cloud is an economical decision, not a technical one" (P4)*

In support of Participant 4's observation above, Participant 3 also argued that data centres located in distant locations may bring about uncertainties in the provision of services such as hosting as a result of latency. Participant 3 argued that;

> *"The data centers are based in Western Europe in Ireland both Amazon and Microsoft and am not sure of Google and there's latency. If you hosting a Website or Application or API over there, there is a slight bit of latency. This is the most important thing for me to know and for most applications it's not disruptive.*
>
> *As People Orientated, communication is key to making it work. First the problem for me is not where the infrastructure is hosted, it is not related to where your infrastructure is hosted" (P3)*

The challenges associated with location of data centres and how that results in uncertainty on the way organisations perceive and work with cloud computing services were further elaborated on by Participants 2 and 5.

Emphasising the importance of having local data centres or centres that are within reach geographically Participant 2 said that;

> *"It's quite a challenge I have been basically depending on infrastructure and resources provided by somebody else and that is always a challenge.*
> *If you look at guys like Facebook, Google and Amazon these companies have data centers almost everywhere. They are able to fall back if you acquire data services from them they are able to fall back on another data center if the main one experiences problems" (P2)*

In re-highlighting the same observation Participant 5 went on to claim that;

> *"It's better to have a localized server plant process the data and once the data is been processed then push it up to the Cloud then access it from the Cloud" (P5)*

The interrelationship between geo restriction and uncertainty came out strongly in this study, and will be discussed further in chapter six.

Another interesting link established during data analysis (axial and selective coding) is that between trialability and uncertainty. As pointed out by Participants 1 and 3 trialability can be caused by uncertainty. This interrelationship has also been confirmed by Pennings (2015). Commenting on the relationship between trialability and uncertainty participants 1 said;

> *"At the moment what they are doing is somebody has to buy these things and try to compare offerings across of Cloud Providers. Trial ability straight!!!*
> *There's still aspects of that I think we still kind of negotiating. We could turn the corner in a perspective that we could demonstrate that the Cloud is viable, that is financially of interest to the organization because it would end up investing large amounts of Capex into servers" (P1)*

Still elaborating on the interrelationship between uncertainty and trialability the same participant (P1) went on to point out that;

> *"When we start talking the impact of Lean Software Development and if you wanted to build a Minimum Viable Product (MVP), you were not sure of what impact it would have in the market place and what potential it would attract.....so you just have to try it" (P1)*

Also important to note is uncertainty was observed to have a relationship with other factors besides trialability. These factors include, as already illustrated in figure 5.6, geo-restriction, compatibility, and relative advantage. Confirming the interrelationships around compatibility Participant 3 mentioned that;

> *"Am glad you said that everyone uses it to their purpose and the extreme case e.g. Western Digital have their personal cloud that's basically a portable hard drive that does not make a definition there" (P3).*

Referring to issues of compatibility Participant 5 argued that;
> *"We treat Cloud technology as localized technology, the only difference is that we can access them either in the office on the customer side, we do not really treat them as different technology to our development tech" (P5).*

Whilst on the other hand Participant 6 also commented on the issues of compatibility by saying;
> *"That inter-operability does not exist. It reminds me of when networking was starting. Apple had its own network, Microsoft and Novell. Those proprietor sort of systems and you were forced to use their Vendor Specific Applications, Hardware etc. It reminds of the same type of thinking that has been implemented. We could call it Cloud Technology just another form of Private network. We are back at that day again.*
>
> *My questions would be how you planning to implement this cause they are a lot of considerations such as provision of tools. Practicality of small business may not work very well" (P6)*

In sync with Participant 1 and 6 above and making a point on the importance of compatibility in the technology context, Participant 7 highlighted that;
> *"It's mostly a question of adaptability, adapting to the current standards of design and development…and this affect how we choose to adopt new technologies" (P7)*

On the relative advantage factor of technology relating to cloud computing Participant 1 had this to say;
> *"One of the biggest problems you face in trying to deliver software in short increments is that you typically run into environments where you have to collaborate with 3rd parties to deploy software. E.g. back in early 2000 my wife was working with Mosque Ceiling. They had a 3rd party responsible for their hosting and as a result they had to*

submit a change request like a month in advance in order to get a code deployed. The
time period has shrunk dramatically because of the Cloud technology

Being able to spin up an instance with your latest future branch and being able to test
it and then tearing the server down is all made possible through the Cloud Technology,
as before it would be sharing resources and have to schedule and inform colleagues
am going to put my branch this afternoon no one touch the server. "

Your ability to scale the application in cloud technology means you do not have to
invest in over architecting systems to make sure you have enough physical servers
hooked up" (P1)

What this implies is that by using agile development methodologies in adoption and use of
cloud computing environments organisations will save on investment as they do not need the
additional overheads associated with heavy solution of design tasking.

Elaborating on how the above observation helps to reduce investment costs Participant 1 went
on to state that;

"And increasingly we paying a lot of attention to DevOps areas where we are starting
to make use of tool chains like Ansible for configuration management that are able to
set up development environments quicker and be able to run in the Virtual machines
within Developers laptops.

What used to happen in the past was systems administrators working on hardware
boxes and really keeps the lights on, manage hardware/networks, rack and stack,
install/manage software on servers and/or clients, etc." (P1).

DevOps offers a philosophy that a tool chain enables dealing with large scale Cloud based
infrastructure in a very cost effective and very risk-averse approach.

With direct reference to the relative advantage of development operations such as agile
development Participant 5 stated that;

"I think on Agile Development in terms of Management point of view it has added more
benefits, it's easier for Management to access their reports from their Tablets and
Mobile phones cause they do not have to be at a specific location" (P5)

And what the observations and views of the eight interviewed participants does bring out is the
different causal interrelationships between and amongst the context of environment,
organisation and technology and how these interrelationships influence the manner in which

organisations perceive, decide to adopt and use new technologies e.g. in the case of this study agile development methodologies and cloud computing.

It was based on this deeper understanding that the researcher was able to move a step towards the development of propositions whose objective, as outlined in chapter one, is to support SMMEs using agile development methodologies to adopt cloud computing services.

5.10 Conclusion

As overviewed in its introduction chapter five presented the data that was generated through the case study and interviewing processes. The chapter started by orienting the reader to the data analysis framework that was used. The chapter then outlined the data management process, detailing what it is and how it was done. In line with its objective, as overviewed in the introduction chapter five then provided a thick description of the data analysis, starting with open coding up until the last stage of selective coding. Each coding stage was defined and explained. From selective coding the chapter presented and discussed in brief the three emerging family categories (codes) around which the development of the anticipated theoretical framework and associated propositions are going to be oriented.

Chapter 6 : DISCUSSION OF FINDINGS

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6.1 Introduction

Against the insights gained from the data analysis processes as articulated in chapter five, in chapter six the researcher intends to present a detailed discussion of what is being considered as the main findings or substantive theoretical propositions emerging from this research project. Structured around the three main thematic factors (herein referred to as family codes) namely the environment, organisation and technology contexts chapter six refines and presents the emerging frame work to guide the use of and working with agile development methodologies in cloud computing migration. In structure the chapter starts by presenting five propositions before presenting the framework.

Chapter six is therefore the chapter in which the final results and output of this study are articulated. This makes the chapter a relatively shorter but exciting and important. An attempt to compare the emerging propositions and framework with previous research, although not very critical for this study, given its objective, is done in the chapter by making reference to previous studies and frameworks. From chapter six the researcher move onto chapter seven in which he reflected on the overall research process and made recommendations for future ICT studies.

6.2 Emerging theoretical propositions

Since the objective of this study was in some way to also ultimately develop theoretical propositions to support SMMEs in South Africa to work better with agile development methodologies in cloud computing adoption, it was critical that the researcher first expand his knowledge of both the current information system context and the challenges that information system practitioners are grappling with. Through literature review analysis the researcher gained substantial insights into the software development context in South Africa. Through the survey and later interviews the researcher gained even more insights and appreciation of some of the inherent and at times subtle challenges that makes it difficult for SMMEs or small organisations to adopt and migrate to cloud computing. The process of data analysis from the open coding up to the selective coding provided a lot of learning and generation of new knowledge (formulation of theoretical propositions). It is against this in-depth understanding, and expanded knowledge that the researcher developed the propositions outlined below. Each

of the propositions constitutes new thinking and insight, making these propositions one of the two main contributions that this research has made to the field of information systems and ICT in general.

6.2.1 Supportive environment

Based on the understanding that the environment context, as outlined in chapter five Section 5.3 as shaped by relational interactions between and amongst factors such as resources availability, market scope, industry and supplier effort and external computing support, plays a key role in hindering or promoting adoption and use growth. It is therefore important that all players double their efforts to create an enabling environment for SMMEs to adopt and utilise new ICT technologies. The observation that SMMEs in South Africa have taken a leading role in adoption of cloud computing services and technologies even make it more critical that some of the challenges that are inherent in the environment within which they work be given attention. For instance SMMEs who are using agile development methodologies require full support from external entities.

Creating a supportive environment in the context of ICT technologies and their adoption entails that;

- affordable and reliable communication network infrastructure is put in place,
- Resources availability and access is improved
- Policy frameworks and strategies are put in place to regulate and enhance security and reliability aspects of ICT services and operations
- Localisation of data centers is done to increase availability and reliability of cloud services.

An environment that is stimulative and enabling of ICT is therefore unarguably imperative if the current growth in adoption and use of cloud computing services by SMMEs in South Africa is to be sustained and even increased.

6.2.2 Development Practices

Agile development practitioners at SMME level should translate theoretical claims into practice especially the need for cultural harmonisation. This came out strongly during in this study. This study observed that many ICT practitioners even though theoretically well versed with agile development practices often struggle to put their knowledge into practice. Very few implements agile development practices according to the required principles. This observation explains the reason why it is extremely difficult to find good agile development practices in South Africa, more so at SMME level.

It is therefore important that both the private sector and government invest more in capacity building and professional development first and foremost targeting SMMEs. The kind of training envisaged must be able to transcend theory and practice making sure that users knowledge of agile development translate into good practices. Much of the benefits and relative advantage of using agile and cloud computing services can only be realised through good practices. The uncertainty and scepticism that currently prevail amongst SMMEs on the use of agile and cloud computing services can also be understood as linked to their limited abilities to use the technologies in ways that provide direct benefits.

6.2.3 Creativity, innovation and size of organisation

It was also observed that smaller organisations tend to be more creative and innovative especially when they adopt cloud tools and frameworks such as DevOps that support agile development practices. This observation is very important and has diverse implications for promoting on-going growth in adoption and use of agile development methodologies and cloud computing services by SMMEs in South Africa. However the problem that seemed to be coming out in this study, regarding the creativity and innovativeness of smaller organisations is that often they get bought off by bigger companies. This observation can be understood as a direct outcome of the interrelationship between industry and market scope where, as already discussed in chapter five Section 5.3, most organisations involved in agile development are part of the software development market scope resulting in the major players having influence on smaller organisations.

The sad thing about this scenario is that at times efforts from external service providers to assist smaller companies are frustrated or contradicted by the market scope involving large and international corporate organisations. Software development industry market scope should not contradict efforts from service providers who are in support of smaller organisations.

Hence it is important, as also already stipulated in section 6.2.1, that regulatory frameworks must be put in place to control and minimise the possible buy-outs by bigger or multinational corporations. The framework to be presented later in this chapter needs to also speak to such contextual ICT challenges that are inherent in South Africa if it is going to have any impact. And that may entail carefully interrogating the interrelationships between market scope, size

of organisation and industry and model the relational interactions in ways that are supportive to SMMEs using agile development in South Africa.

6.2.4 Resource availability and support infrastructure

Resource availability such as reliable cloud computing infrastructure and services is a critical factor in the adoption process. Therefore the observed lack of support infrastructure and reliable services provision within the ICT sector in South Africa is having a negative effect on SMMEs' perceptions and adoption of cloud computing services. Given that successful use of agile development methodologies and cloud computing services requires infrastructure such as data centres, and services like internet means that if not addressed the current lack of support infrastructure, limited bandwidth and the expensive connectivity will continue to bring about uncertainty and anxiety amongst "would be users" especially SMMEs in South Africa.

Current internet service provision in South Africa tends to arguably disadvantage small organisations in the use of cloud environment. This is because of the unreliability of the services, high costs involved, the limited bandwidth and their failure to guarantee security and disaster recovery.

Also linked to the problems of limited resources is that in spite of increased research in addressing cloud services lock-in concerns, an open and compatible development environment has not been provided especially to SMMEs who have limited capacities in resources.

Important to note here is that government must invest more in ICT support infrastructure and service providers should increase their capacity to provide reliable and accessible ICT services. Attention must also be given to improving compatibility and inter-operability through open development architectures, within the ICT infrastructure and service industry. Compatibility and inter-operability has the potential to stimulate growth in agile and cloud computing adoptions and use

Further to that communication strategies aimed at facilitating reliable resource availability and accelerated geo-restriction technologies that can also improve resource availability must be put in place.

6.2.5 Prior knowledge and experience

It is important that ICT practitioners are well versed with agile methodology practices before even moving to the cloud. Prior knowledge is essential in adapting to the innovative cloud environment. It also arguably enhances user's ability to appreciate and manage issues around

compatibility. It also came out strongly that SMMEs who had prior knowledge were less uncertain about the adoption of new technologies such as agile methodologies and migrating to cloud computing environments.

Prior knowledge also increases relative advantage since no additional overheads are needed. However it is important to, as already pointed out in chapter five, note that prior knowledge and experience of technology does not on its' own always translate into adoptions of all new technologies. Thus the interrelationship between prior knowledge and experience and the many other factors influencing the adoption processes must be viewed and worked with cautiously. For instance prior knowledge on its own, without top management support and adequate resources availability may not produce any meaningful impact on the growth of agile and cloud computing adoptions amongst SMMEs in South Africa. An integrated and holistic approach is therefore needed across the entire ICT spectrum of players and users.

6.3 Emerging theoretical framework

Based on the propositions overviewed in section 6.2 and recent work done by Mwansa and Mnkandla in 2014 the researcher went on to develop a theoretical framework, which in line with the main objective of this research project can guide SMMEs in their adoptions and use of agile development methodologies and migration to cloud computing environments. Such a theoretical framework presents an overall picture of the possible courses of action for achieving a particular objective, which in this case is improved adoptions and use by SMMEs of new ICT technologies e.g. cloud computing. The theoretical framework present in this chapter is therefore a tool for setting up of ideas and objectives that can lead to creation of a consistent set of rules and standards around which ICT users can work with agile development and migration to cloud computing.

Theoretical frameworks can be viewed as organised structures of ideas, and concepts with coherence to make them communicable to different people (Gelso 2006). Thus a theoretical framework provides a general illustration of relationships between the different dimensions of a given phenomenon whilst it, on the other hand, specifies direction for action or practice.

Developing a theoretical framework is not an easy task and many researchers tended to focus more on improving or building new frameworks from existing ones. In this study, the idea was

to generate knowledge and to improve on the existing theoretical framework namely TOE. Figure 6.1 below illustrates the developed theoretical framework.
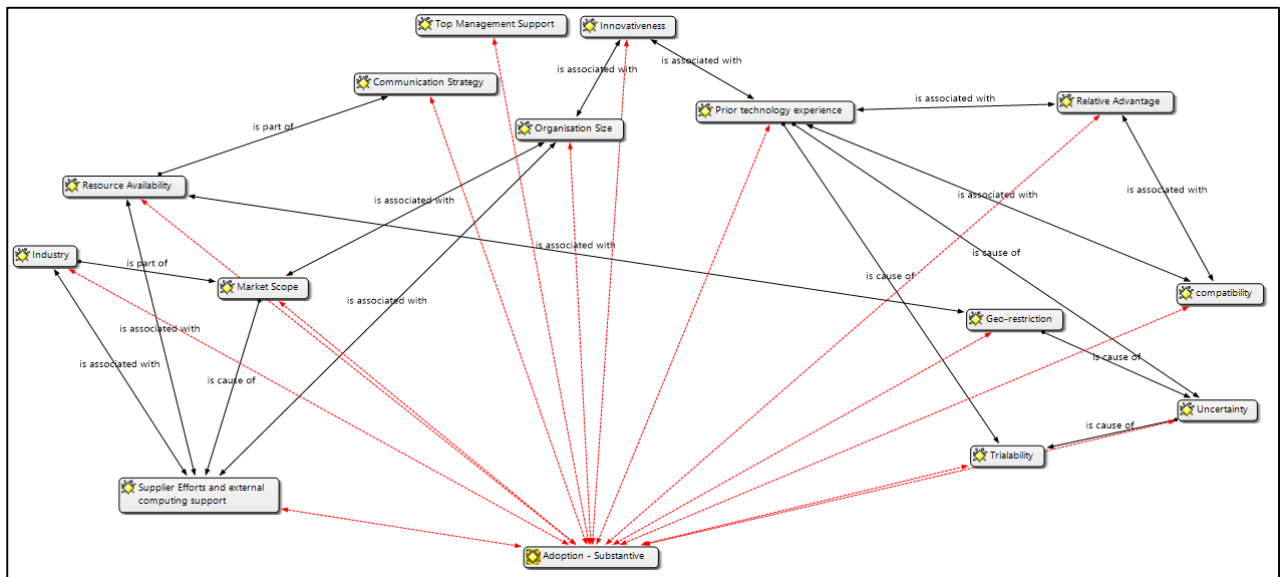
Figure 6.1 Relational Interactions Diagram

In essence figure 6.1 shows the interrelationships between and amongst the different factors and how those interrelationships can support adoption and use of agile development methodologies and migration to cloud computing by SMMEs in South Africa. Based on these interactions figure 6.2 below represents the emerging framework as envisaged in the ultimate objective of this study.
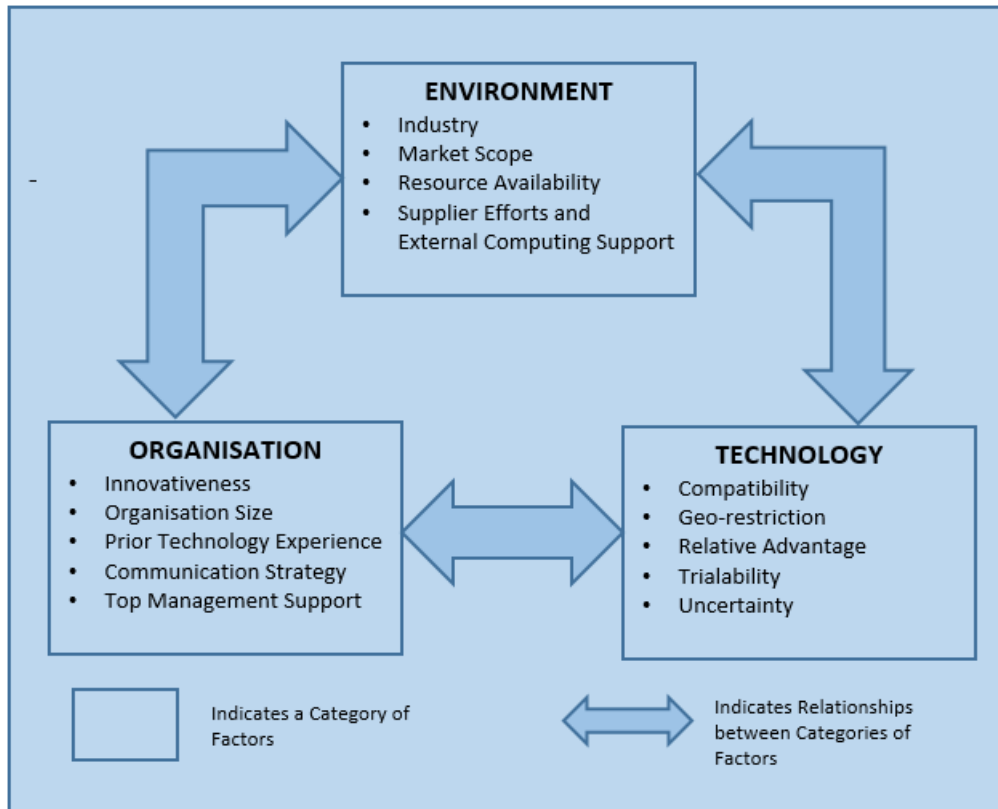
Figure 6.2: Emerging Theoretical Framework

Important to emphasise is that the framework shows how the factors interact in the current situation (South African ICT sector/context) as discussed and explored in chapter five. Also important, to note is that whilst the concepts and interactions constituting the above framework are neither exhaustive nor linear the framework remains an important contribution to ICT in that it explores the causal relationships (describes the *"why")* between the different contextual factors in detail. And that the expanded knowledge of how *("how")* factors influence each other has potential to help formulate actions needed to be taken to promote adoptions and use of agile methodologies in cloud computing migration. This is, besides the propositions presented in Section 6.2 another contribution that this research project has made to the field of ICT in South Africa.

6.4 Application of theoretical framework

And because cloud computing is relatively a new phenomenon decisions about moving to the cloud can be overwhelming to organizations. This observation makes the development of frameworks such as the one coming out of this study necessary.

Just as the many other frameworks and taxonomies that have been developed, this framework has potential to assist SMMEs in South Africa as they consider the use of the cloud. The framework provides a systematic way of evaluating and understanding factors that help would-be cloud computing users to make an informed decision. In essence the emerging framework provides mechanisms to aid decision making.

Although the target user group for the frame emerging from this study are SMMEs any IT and non-IT individual may find the framework an important tool for evaluating potential cloud-based IT capabilities and limitations. Thus the framework does have potential to enhance adoption and use processes across the entire ICT spectrum.

6.5 Evaluation of theoretical propositions and emerging framework

It is imperative to highlight that the findings of this study as discussed in the emerging framework above that they are consistent with previous studies done within the ICT field. For instance the factors and relational interactions reported in this study resonated very well with the findings of the study done by Hong and Zhu (2006). In their study focusing on exploring technology-related factors and obstacles associated with adoption of new ICT technologies they also found out that there were three drivers for ecommerce adoption namely technology integration, web functionalities, and web spending. Just as in the case of the proposition coming from this study technology integration spoke to issues of compatibility, whilst web functionalities related to level of capability and knowledge within an organisation. Web spending talked to costs tied to the decision of adopting the new technologies and this also came out strongly in this study. The same study also found out that firm size, which also came out in this study is another factor shaping adoption and use of new technologies by organisations.

The findings of this study also relate very closely with those of Ghobakhloo, Arias-Aranda and Benitez-Amado (2011) who examined the factors within the TOE framework that affect the decision to adopt electronic commerce (EC) amongst small to medium enterprises. As is the case of this study, they also found out that adoption is affected by perceived relative advantage, perceived compatibility, CEO's innovativeness, information intensity, buyer/supplier pressure, support from technology vendors, and competition (Ghobakhloo, et al. 2011). On the other hand studies done by Woodside and Quaddus (2015) also found out that the adoption and use

of ICT by SMEs were largely influenced by cognitive evaluation, facilitating condition, environmental pressure, and country readiness. Such findings also gives credibility to the findings and theoretical propositions emerging from this study.

6.6 Conclusion

Chapter six started by presenting the five propositions that have emerged in this study. Moving on the chapter then presented the theoretical framework that was developed on the basis of the propositions and the researcher's understanding of the issues affecting agile development methodologies and migration to cloud computing environment in South Africa. The chapter also oriented the reader to the ways in which both the propositions and developed framework can be used to promote and support adoptions and use of agile methodologies and cloud computing migration by SMMEs in the country. As already spelt out in its introduction chapter six is relatively shorter but important. In chapter seven the researcher moves on to close the study.

Chapter 7 : REFLECTIONS AND RECOMMENDATIONS

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7.1 Introduction

Chapter seven concludes this research study. The chapter provides a critical reflection of study. It starts by highlighting some of the limitations associated with the conceptualisation, design and methodological framework used in this study. Techniques for mediating some of the limitations are discussed. Chapter seven moves on to present and discuss the modest contribution that this study has made to the field of ICT in southern Africa, particularly South Africa. The chapter closes by pointing out and elaborating on what could be areas of interest and or opportunities for future ICT research in the region. Chapter seven is therefore a synthesis of how this research project was conceptualised and done and what it contributed to the field of ICT.

7.2 Reflections on the study

Conducting this study was a very inspiring experience. Therefore, it is imperative that a reflection on the whole study is conducted. To start with, it enabled the researcher to point out and discuss what came out as some of the limitations of the study. Then later it enabled the researcher to appreciate and present the main contributions of this study to the field of information systems and ICT in South Africa. The process of reflection itself also provided for a lot of learning and professional growth of the researcher. It was certainly the last but not least important part of the entire research project.

7.3 Challenges faced during the Study

The researcher realised two important issues that emerged as challenges faced during the conduction of this study. The first one was the lack of previous research to draw on considering that the research area is still new and the second one was limited resources, given the scope and geographical location of the targeted interviewees. Below is a discussion of the two limitations and how the researcher worked around them.

7.3.1 Lack of previous research

Cloud computing is a new phenomenon and not many studies have been conducted in the field of cloud computing adopting agile development methodologies. In fact it is only recently that most researchers are exploring this area. During the conceptualisation stage of this study, the researcher struggled a lot to find good quality and comprehensive previous research reports. This led to use of technical reports as literature in some cases where academic material was absent. Previous research reports are imperative in that other than providing the appropriate literature they can help a researcher to develop a more solid line of argument relating to the justification and importance of the proposed research study. Previous research reports also gives more information on what areas in information systems still needed to be further explored.

As also anticipated the lack of previous research focusing on agile methodologies and migration to cloud computing in the context of South Africa, presented its own challenges during literature review. Most of the literature available and upon which the researcher based some of his conceptual framing were not of South African context or orientation. To go round this the researcher relied on his own experience of working within the ICT sector and the comments made by targeted research participants when they were interviewed.

7.3.2 Time and limited resources

The challenge of time and limited resources given that the researcher was doing this study part time and that most of the interviewees were spread across the breadth and length of South Africa needed no emphasis.

First conducting this study whilst working at same time had the potentials to compromise the amount of time and attention that the researcher dedicated to the study processes. A lot of effort and careful time management was therefore needed and that ability to manage time and be able to carry on the research whilst working full time did not come easily. At times it meant short changing family times and borrowing from the night

On the other hand it proved a challenge for the researcher to engage with research participants face to face as resources to cover travel and other costs were not available. The problem was made worse by the fact that the data-rich participants were not found in one area of South Africa. Use of skype over and above the numerous emails communications helped the researcher out.

7.4 Contribution of study

As the researcher reflect on this research project and what it played out to be, he begins to appreciate the modest contribution that the study has made to the field of information systems research, knowledge and practice.

And besides being one of the few studies with a direct focus on SMMEs and how they can work better with agile development methodologies in cloud computing migration this study has also provided a basis upon which future ICT research can be conceptualised and conducted

Some of the contributions that can be ascribed to this study include:

7.4.1 Provision of a body of literature

As already pointed out earlier in this chapter there is a general lack of literature relevant to this area of study research in the context of South Africa. Looking back the researcher is convinced that this study represents a new and or additional body of literature upon which future researchers can develop their own studies be it conceptually or methodologically.

Methodologically, this study though not the first one to do so, has contributed knowledge and experience on how to work with Grounded Theory for data analysis within qualitative research in information systems field. This is an arguably valuable contribution as it will advance more engaged use of Grounded Theory. Future researchers can actually draw lessons on how to better work with Grounded Theory, including how to select coherent methods, techniques for data collection and frameworks for data analysis.

7.4.2 Identification of areas for future research

As already argued in Chapter one there is need for more research into ICT in South Africa. Whilst conducting this study it emerged that there are a number of areas, factors and issues that remained unexplored. These areas thus constitute opportunities for future ICT research.

The following three areas emerged as possible streams for future ICT research;

- o *Problematizing* and exploring of the different interrelationships between the different factors influencing ICT use in South Africa. What this study did is to establish the interactive relationships and not explore in-depth each of the identified linkages. There is a lot still to be learnt by digging deeper and unpacking the nature and orientation of the interrelationship beyond the cause and effect level of analysis'

- *Investigating existing ICT policy frameworks in South Africa in order to understand their limitations and strengths for advancing use of agile development practices and cloud computing services.*

- *Conducting follow up studies* to monitor and evaluate the application of new and existing theoretical frameworks with regard to supporting adoption and use of new ICT technologies and services. The framework developed through this study need to be appraised alongside its usage so as to gain more insights into how the framework can be improved. It is also necessary to explore a quantitative approach on data generated from the coding process such as frequencies of code in relation to their relationships.

7.5 Conclusion

Chapter seven has provided a synthesis of the whole study. The chapter also opened by discussing the limitations associated with the conceptualisation, design and implementation of this study. The chapter moved on to highlight the contribution that this study has made to the field of heritage education. A number of recommendations are made and a discussion of possible research agendas has been included.

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APPENDIX I

Case Study Interview Questions

Section A: Existing Environment

A1: What are the agile methodologies in use in South Africa?

    A.1.1: Are you using agile methodology in your software development?

    A.1.2: What cloud computing services are you using?

    A.1.3: What type of applications, tools are used to develop software in cloud computing?

    A.1.4: What impact has cloud computing have on agile development?

    A.1.5: What are your expectations when using agile software development in a cloud environment?

Section B: Conditions for Successful Migration

 B.1: What factors are necessary in ensuring that organizations using agile development methodologies in South Africa succeed in migration to cloud computing?

[You may be guided by factors that play some role in migrations such as relative advantage, uncertainty, geo-restriction, compatibility, trialability, size, top management support, prior experience, innovativeness, industry, market scope, supplier efforts and external computing support]

    B.1.1: What factors are responsible for your success in migrating your organisation's agile development to cloud computing?

    B.1.2: What difficulties or weaknesses are you encountering during the process of migrating to cloud computing?

    B.1.3: What factors are responsible for the difficulties you are experiencing with migrating to cloud computing?

    B.1.4: What factors are responsible for the weaknesses you are experiencing with migration to cloud computing?

Section C: Action/Interaction between Migration Success Factors

C.1: How do the factors that are necessary in ensuring that organizations using agile development methodologies in South Africa succeed in migration to cloud computing interact with each other?

C.1.1: How do the factors that are responsible for your success in migrating to cloud computing influence one another?

C.1.2: How do the factors that are responsible for the difficulties you are experiencing influence one another?

C.1.3: How do the factors that are responsible for the weaknesses you are experiencing influence one another?

C.1.4: What is the relationship between factors that account for your success and those that account for your difficulties and weaknesses?

Section D: Action/Interaction between Migration Success Factors and Successful Migration

D.1: How do the factors necessary in ensuring successful migration of organizations using agile development methodologies in South Africa contribute to such success?

D.1.1: How do the factors that account for successful migration to cloud computing contribute to such success?

D.1.2: How do the factors that account for difficulties in migrating to cloud computing contribute to such difficulties?

D.1.3: How do the factors that account for difficulties in migrating to cloud computing contribute to such difficulties?

Section E: The Framework Building

E.1: How will the framework be compiled to ensure that the migration can be successful?

E.1.1: What is important to consider in migrating agile development methodologies to cloud computing?

E.1.2: How should the process of migrating agile development methodologies to cloud computing be managed?

E.1.3: What should be the roles of different stakeholders within the organisation in ensuring successful migration?

E.1.4: What should be the roles of different stakeholders outside the organisation in ensuring successful migration?

APPENDIX II

Survey Questionnaire

The extent of use of Agile Development Methodologies by SMMEs
Section A: Background of the company

Please [√] or fill-in the space provided and provide only one answer for the following questions.

A1. Indicate the type of company

a	Private Companies	b	Public Companies	c	Personal Liability companies	d	State Owned Companies

A2. In which region(s) or town(s) do you operate from?

a	Gauteng (please specify town(s))
b	Western Cape (please specify town(s))
c	Free State (please specify town(s))
d	Eastern Cape (please specify town(s))
e	Mpumalanga (please specify town(s))
f	Northern Cape (please specify town(s))
g	Kwazulu-Natal (please specify town(s))
h	Limpopo (please specify town(s))
i	North-West (please specify town(s))

A3. Indicate the telephone number for the main company's contact personnel.

A4. What is your position in your company?

a	Executive Director/COO	B	Software Developer	c	Software Support Specialist	d	Other (Specify)

A5. How many people does your company employ?

a	1-5	B	6-10	c	11-20	d	21-50	e	Over 51

Section B: Experience in Agile Methodologies and Cloud Environments

B1. How long have you been in software Development?

a	Less than a year	B	1– 5 years	c	6-10 yrar	d	More than 10 years

B2. What Agile methodology do you use?

a	Scrum	B	Lean	c	Kanban	d	Other(Specify)	e	None

B3. Is your company already operating in the cloud or considering moving parts of your business into the cloud?

a	Yes	B	No	c	Considering

B4. What would you consider the primary business case for your organisation to move into the cloud?

a	Agility
b	Scalability
c	Cost
d	Improved IT control and IT visibility
e	Centralised management
f	Mobility and Mobile Device Management
g	Competitive advantage
h	Easy access to developer tools
i	Unsure

B5. How long have you been using agile development using cloud platform?

a	Less than a year	B	1-5 years	c	6-10 years	d	More than 11 years	e	Not Applicable

B6. Please specify what is the most appropriate cloud model you are using or considering:

a	Public	B	Private	c	Hybrid	d	All	e	Not Applicable

B7. What is your self-assessment of using cloud platform for agile development?

a	Low experience	B	Moderate experience	c	High Experience

Section C: Experience in Cloud Environments for General Purpose Work

C1. At present, how often do you use cloud platform for other general purpose work

a	Low experience	B	Moderate experience	c	High Experience

C2. At present, which cloud service provider do you use for other general purpose work?

a	Amazon	B	Google	c	Salesforce	d	Open Source	e	Other(Specify)

C3. What cloud computing services are you using for other general purpose work?

a	SaaS	B	PaaS	c	IaaS	d	Other(Specify)

C4. Mostly, where do you access the Internet in doing your work? (Please check √ only one answer)

a	At my office	B	At my home	c	Both at office and at home	d	Not sure	e	Hardly used both

C5. What Internet access method do you use at your office for your work? (Please check √ only one option)

a	Business Network	B	Wireless	c	Other (please specify)

C6. What internet access method do you use in doing your work?

a	Broadband	B	Dial-up	c	Wireless	d	Other(Specify)

If you have any additional comments you wish to make about Internet and cloud usage, please add them here.

Section D: Perceived Usefulness and Preserved Ease of use towards Cloud Migration.

D1. Perceived usefulness and perceived ease of use toward usage of cloud services for agile development

1 = Strongly Disagree; 2 = Quite Disagree; 3 = Slightly Disagree; 4 = Neutral; 5 = Slightly Agree; 6 = Quite Agree; 7 = Strongly Agree							
PERCEIVED USEFULNESS about the cloud usage.	1	2	3	4	5	6	7
Using cloud enables me to accomplish tasks more quickly							
Using the cloud enhances the quality of my work							
Using the cloud makes it easier to do my work							
I find the Internet useful in my work							
PERCEIVED EASES OF USE about the cloud usage.							
Learning to use the Internet is easy for me							
I find it easy to use the Internet to do what I want to do							
I find it easy for me to become skilful in using the Internet							

APPENDIX III

Ethical Clearance

UNISA
college of
science, engineering
and technology

Mr Gardner Mwansa (34208704)   2014-09-17
College of Science, Engineering and Technology
UNISA
Johannesburg

Ref: 163/GM/2014

The request for ethical approval for your PhD (Information Systems) research project entitled "Development of a Framework for Agile Development Methodologies Migration to Cloud Computing with Specific Reference to Small, Medium and Micro Enterprises in the South African Environment" refers.

The College of Science, Engineering and Technology's (CSET) Research and Ethics Committee (CREC) has considered the relevant parts of the studies relating to the abovementioned research project and research methodology and is pleased to inform you that ethical clearance is granted for your study as set out in your proposal and application for ethical clearance.

Therefore, involved parties may also consider ethics approval as granted. However, the permission granted must not be misconstrued as constituting an instruction from the CSET Executive or the CSET CREC that sampled interviewees (if applicable) are compelled to take part in the research project. All interviewees retain their individual right to decide whether to participate or not.

We trust that the research will be undertaken in a manner that is respectful of the rights and integrity of those who volunteer to participate, as stipulated in the UNISA Research Ethics policy. The policy can be found at the following URL:

http://cm.unisa.ac.za/contents/departments/res_policies/docs/ResearchEthicsPolicy_apprvCounc_21Sept07.pdf

Please note that if you subsequently do a follow-up study that requires the use of a different research instrument, you will have to submit an addendum to this application, explaining the purpose of the follow-up study and attach the new instrument along with a comprehensive information document and consent form.

Yours sincerely

Prof Christopher Enweremadu
Deputy Chair: College of Science, Engineering and Technology Ethics Sub-Committee

University of South Africa
College of Science, Engineering and Technology
The Science Campus
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APPENDIX IV

Peer reviewed papers

To insert peer reviewed papers (attached)

Axial codes and Quotations

Codes-quotations list
Code-Filter: All

_____

_____

Code: Communication Strategy {12-1}

PARTICIPANT 1 PODCASTS.rtf - 1:36 [As an Agile Consultant I put a..] (29:29) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation] [Top Management Support - Families (2): Adoption - Substantive, Organisation]
No memos

As an Agile Consultant I put an effort for people to have face to face communication. Now I belong to an organization that is quite distributed and it's been a core focus for us since last year to figure out how we collaborate without face to face communication.

PARTICIPANT 1 PODCASTS.rtf - 1:42 [My first taste of this was whi..] (36:36) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation] [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

My first taste of this was while I was living in the USA. What I realised is that Americans are generally effusive in their enthusiasm. For someone coming from a more austere culture, one influenced for example by an English culture, this can come across as insincere. Contrarily, our more austere reactions to an American can come off as cold and rude.

PARTICIPANT 1 PODCASTS.rtf - 1:44 [Software Development is a very..] (35:35) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation] [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

Software Development is a very English speaking culture, and it is usually the language used in off-shore development. To take this familiarity with a common language as also being a shared culture is where things can go badly wrong.

PARTICIPANT 1 PODCASTS.rtf - 1:45 [What we do at organization lev..] (9:9) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

What we do at organization level is we have an organization review week. The Captain gets us together and we take a look at all our projects as an organization. We have an opportunity to show what we have done and every 2 weeks we have a Kaizen meeting.

PARTICIPANT 1 PODCASTS.rtf - 1:46 [so being able to up the level ..] (30:30) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

so being able to up the level of communication from email, instant messaging, to voice call and video conference. It is vital in terms of navigating those challenges and communication and challenges to collaboration when working in an agile way.

PARTICIPANT 1 PODCASTS.rtf - 1:47 [The opportunity is to create d..] (32:32) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

The opportunity is to create deep connections with other people but need traditional things like face to face communication. The big one for me is sharing meals, it hacks our monkey brain we evolved to eat together as groups and it helps us to feel like family. It creates work connections people particularly making celebrations and it's also good to connect with our customers as well.

PARTICIPANT 1 PODCASTS.rtf - 1:48 [When you move this interaction..] (37:37) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

When you move this interaction into economically sensitive activity, the potential for misunderstanding and misreading is significant. One important example is that when outsourcing to India which is a strongly paternalistic culture, it is very rude to disagree with someone in authority.

PARTICIPANT 3 PODCASTS.rtf - 5:25 [We have a Scrum Meeting every ..] (8:8) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

We have a Scrum Meeting every Monday and the customer changes a certain functionality, we have to go back and change certain processes that require or interact with that functionality.

PARTICIPANT 3 PODCASTS.rtf - 5:26 [How we normally use it is that..] (11:11) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

How we normally use it is that the client will then request reports from his Mobile phone, so like Android. We develop our reporting platform on Android Tools, that reporting platform will then connect to SQL Azure. You do not have to connect to a specific SQL database, your Android Application can connect to SQL and you can access that data from any point.

PARTICIPANT 3 PODCASTS.rtf - 5:27 [In terms of human interactions..] (28:28) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

In terms of human interactions we have day to day meetings. We have an 8 o'clock meeting in terms of what part of the Application needs to be done for that day. We then go through the issue log with customers or the Managers of the Application.

PARTICIPANT 7 PODCASTS.rtf - 7:15 [communication is one of the bi..] (24:24) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

 communication is one of the biggest problems as far as Agile is concerned cause when you are moving into Cloud Computing or enablement you need to address that effectively.

PARTICIPANT 7 PODCASTS.rtf - 7:16 [We have a Team that works here..] (7:7) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

We have a Team that works here in Pretoria and a Team that works in Mozambique. They will be working together on a Project, communication was much better and everyone was quoting efficiently and resources were accessed much better.

_____

Code: compatibility {8-2}

PARTICIPANT 2 PODCAST.rtf - 2:2 [So which means you can adapt p..] (4:4) (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology] [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

So which means you can adapt plans while you busy building

PARTICIPANT 4 PODCASTS.rtf - 3:4 [Am glad you said that everyone..] (17:17) (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology]
Memos: [compactibility issues]

Am glad you said that everyone uses it to their purpose and the extreme case e.g. Western Digital have their personal cloud that's basically a portable hard drive that does not make a definition there.

PARTICIPANT 3 PODCASTS.rtf - 5:21 [We treat Cloud technology as l..] (28:28) (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology]
Memos: [Compactibility]

We treat Cloud technology as localized technology, the only difference is that we can access them either in the office on the customer side, we do not really treat them as different technology to our development tech.

PARTICIPANT 6 PODCASTS.rtf - 6:1 [What technology will be used a..] (6:6) (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology]
No memos

What technology will be used at this stage its irrelevant, this has a direct link back to your Project Manager Principle .It speaks of people first, data then technology.

PARTICIPANT 6 PODCASTS.rtf - 6:8 [The resource you require doubl..] (16:16) (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology]
No memos

 The resource you require double if you are going to be developing Online, let's say you are developing locally and in deploying and building in the Cloud. Doing all your testing in the Cloud. That is almost like a once off it is not regular and it does not require a Continuous connectivity to the internet.

PARTICIPANT 6 PODCASTS.rtf - 6:14 [That inter-operability does no..] (24:24) (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology]
No memos

That inter-operability does not exist. It reminds me of when networking was starting. Apple had its own network, Microsoft and Novell. Those proprietor sort of systems and you were forced to use their Vendor Specific Applications, Hardware etc. It reminds of the same type of thinking that has been implemented. We could call it Cloud Technology just another form of Private network. We are back at that day again.

PARTICIPANT 6 PODCASTS.rtf - 6:15 [My questions would be how you ..] (26:26) (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology]
No memos

My questions would be how you planning to implement this cause they are a lot of considerations such as provision of tools. Practicality of small business may not work very well.

PARTICIPANT 7PODCASTS.rtf - 7:7 [It's mostly a question of adap..] (16:16) (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology] [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

It's mostly a question of adaptability, adapting to the current standards of design and development.

_____

Code: Geo-restriction {12-2}

PARTICIPANT 1 PODCASTS.rtf - 1:22 [As a result we got this kind o..] (25:25) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

As a result we got this kind of impendence mismatch between stockholders that still very tied to physical infrastructure basically treating the cloud as second classes something not to be trusted or something less secure than physical systems.

PARTICIPANT 1 PODCASTS.rtf - 1:25 [One of the things of vital imp..] (30:30) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]
No memos

One of the things of vital importance is decent code of afterwards ...so being able to up the level of communication from email, instant messaging, to voice call and video conference. It is vital in terms of navigating those challenges and communication and challenges to collaboration when working in an agile way.

PARTICIPANT 2 PODCAST.rtf - 2:7 [It's quite a challenge I have ..] (11:11) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]
No memos

It's quite a challenge I have been basically depending on infrastructure and resources provided by somebody else and that is always a challenge.

PARTICIPANT 2 PODCAST.rtf - 2:9 [If you look at guys like Faceb..] (12:12) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

If you look at guys like Facebook, Google and Amazon these companies have data centers almost everywhere. They are able to fall back if you acquire data services from them, they are able to fall back on another data center if the main one experiences problems

PARTICIPANT 4 PODCASTS.rtf - 3:10 [The data centers are based in ..] (23:23) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Resource Availability - Families (2): Adoption - Substantive, Environment] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

The data centers are based in Western Europe in Ireland both Amazon and Microsoft and am not sure of Google and there's latency. If you hosting a Website or Application or API over there, there is a slight bit of latency. This is the most important thing for me to know and for most applications it's not disruptive.

PARTICIPANT 4 PODCASTS.rtf - 3:15 [As People Orientated, communic..] (30:30) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]
No memos

As People Orientated, communication is key to making it work. First the problem for me is not where the infrastructure is hosted, it is not related to where your infrastructure is hosted.

PARTICIPANT 5 PODCAST .rtf - 4:5 [Existing developers don't want..] (19:19) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Existing developers don't want to learn how to use the cloud and there is this weird idea that data in your building is safer than data on a cloud server.

PARTICIPANT 5 PODCAST .rtf - 4:12 [The important point is that th..] (39:39) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]

No memos

The important point is that the only thing that "cloud" means is that you don't really know where your physical server is located. Using the cloud is an economical decision, not a technical one.

PARTICIPANT 3 PODCASTS.rtf - 5:2 [It's better to have a localize..] (3:3) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]
No memos

It's better to have a localized server plant process the data and once the data is been processed then push it up to the Cloud then access it from the Cloud.

PARTICIPANT 6 PODCASTS.rtf - 6:4 [To the enterprise it empowers ..] (14:14) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

To the enterprise it empowers Teams not to be geographically dependent. Agile due to the people element requires you to be together.

PARTICIPANT 6 PODCASTS.rtf - 6:5 [So the system driven process o..] (14:14) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]
No memos

So the system driven process on a Cloud platform is more lenient and forgiving as far as the people element is concerned. There is not that heavy reliance that the entire team should be here. You can have your team spread out geographically across the world even.

PARTICIPANT 6 PODCASTS.rtf - 6:16 [Because the question would com..] (30:30) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]
No memos

 Because the question would come one of the benefits would be your geographic independence.

_____

Code: Industry {6-2}

PARTICIPANT 2 PODCAST.rtf - 2:19 [Which is quite difficult, most..] (31:31) (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment]
No memos

Which is quite difficult, most developer houses are Agile, PHP, Java or python or confusion it's only where they can find integration that multi skilled people who are able to do that. So you can imagine if you are in that environment where the DevOps is supposed to do all this

PARTICIPANT 2 PODCAST.rtf - 2:22 [Nowadays if you look at techno..] (34:34) (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 Nowadays if you look at technology industry it's demanding too much, there's a big gap on research to be able to focus on these guys.

PARTICIPANT 2 PODCAST.rtf - 2:28 [In terms of Cloud Computing, t..] (9:9) (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment]
No memos

In terms of Cloud Computing, tools themselves, they range from open source to commercial. Depending with the size of the computer and their requirements you can be able to fit easily.

PARTICIPANT 4 PODCASTS.rtf - 3:23 [Cloud is every Developers drea..] (20:20) (Super)

Cloud is every Developers dream, it makes everything you did in any way easy. Its very Developer orientated the way things are documented.

PARTICIPANT 7PODCASTS.rtf - 7:2 [We are part of the Microsoft B..] (5:5)   (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

We are part of the Microsoft Bizbug so we have about R60 000 of access to the Cloud Services. In small companies, it is easy individually experiment with innovative tools such as Intel cloud development tools

PARTICIPANT 8PODCASTS.rtf - 8:7 [They are very few organization..] (10:10)   (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

They are very few organizations that are not already using Agile in some way, shape or form and most of them bad.

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Code: Innovativeness {7-2}

PARTICIPANT 1 PODCASTS.rtf - 1:32 [We also started investigating ..] (30:30)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

We also started investigating on tools that would allow Developers to pair remotely, to be looking at the same piece of code and be able to manipulate it in less times so others can be able to get feedback.

PARTICIPANT 1 PODCASTS.rtf - 1:38 [Most organizations are startin..] (16:16)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation]
No memos

Most organizations are starting to look for devOps to do sysadmin work rather than having separate development writing tools for the support organization and business interfaces, and sysadmins doing the more low-level and hardware work.

PARTICIPANT 2 PODCAST.rtf - 2:23 [As a small organization people..] (35:35)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation] [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

As a small organization people are attached to their innovations.

PARTICIPANT 4 PODCASTS.rtf - 3:8 [Cloud is every Developers drea..] (20:20)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation]
No memos

Cloud is every Developers dream, it makes everything you did in any way easy. Its very Developer orientated the way things are documented. For instance am talking about Zero, Amazon Web services, it's not a disruptive thing.

PARTICIPANT 4 PODCASTS.rtf - 3:16 [I can tell you one big move th..] (30:30)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation]
No memos

I can tell you one big move that happened in the more Agile focused companies they introduced DevOps concept. It's a developer in operations and in an Agile sense that person becomes the part of the feature development team.

PARTICIPANT 3 PODCASTS.rtf - 5:22 [need to understand limitation ..] (34:34) (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation] [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

need to understand limitation of cloud technologies. As for now every company need to migrate to the cloud technologies as it is the next frontier and in addition they need to fully understand resources and constraints at play.

PARTICIPANT 8PODCASTS.rtf - 8:4 [IBM has a software called Blue..] (4:4) (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation]
No memos

IBM has a software called Bluemix.net where you can look at their site and see that you can actually provision a little development for yourself. At this stage IBM development tools are for free but maybe at a later stage they will start charging for it.

The only offering that I know that you can go in and get access to development tools is Bluemix from IBM and no one is using it in South Africa.

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Code: Market Scope {8-3}

PARTICIPANT 1 PODCASTS.rtf - 1:40 [It's still kind of traditional..] (27:27) (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment]
Memos: [Market]

It's still kind of traditional and equally undistributed for example in USA and Europe it's perfectly acceptable to run very large cloud for example the UK has its own private cloud that it uses and its migrating all of its services, whereas in South Africa you still have large organizations that are theoretically into Agile but are still tied to the nature.

PARTICIPANT 1 PODCASTS.rtf - 1:41 [As an Agile Consultant I put a..] (29:29) (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

As an Agile Consultant I put an effort for people to have face to face communication. Now I belong to an organization that is quite distributed and it's been a core focus for us since last year to figure out how we collaborate without face to face communication

PARTICIPANT 2 PODCAST.rtf - 2:25 [Usually, small companies are b..] (36:36) (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment] [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

Usually, small companies are being bought off by big companies. We have a small organization called iKubu (Pty) Ltd it was bought by Garmin they sponsored and developed all the technology.

PARTICIPANT 4 PODCASTS.rtf - 3:18 [I would rather ask a more cruc..] (34:34) (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

I would rather ask a more crucial question based on how you can use the Cloud and the opportunities the Cloud gives as a competitive advantage.

PARTICIPANT 4 PODCASTS.rtf - 3:23 [Cloud is every Developers drea..] (20:20) (Super)

Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

Cloud is every Developers dream, it makes everything you did in any way easy. Its very Developer orientated the way things are documented.

PARTICIPANT 7PODCASTS.rtf - 7:2 [We are part of the Microsoft B..] (5:5) (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

We are part of the Microsoft Bizbug so we have about R60 000 of access to the Cloud Services

PARTICIPANT 8PODCASTS.rtf - 8:6 [Most of the companies we consu..] (8:8) (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

Most of the companies we consult with have very big development infrastructure and own machines.

PARTICIPANT 8PODCASTS.rtf - 8:7 [They are very few organization..] (10:10) (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

They are very few organizations that are not already using Agile in some way, shape or form and most of them bad.

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Code: Organisation Size {20-3}

PARTICIPANT 1 PODCASTS.rtf - 1:34 [I think it always easier for s..] (19:19) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

I think it always easier for smaller firms to do so, when you contemplating a large infrastructure like a Bank wanting to move into the Cloud. The need for Security and so on are quite greater than the small firms, there's a distinct challenge in the sheer scale of things.

PARTICIPANT 1 PODCASTS.rtf - 1:39 [Some of the challenges we face..] (24:24) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
Memos: [Stakeholder support]

Some of the challenges we face are things like in multi nationals and large organizations where they have multiple companies in their portfolios and they want to centralize things. Basically it creates an issue such that you find yourself working for a company that is fast moving and happy with Cloud Technologies but they have to integrate with some 3rd party within the stable of companies, who isn't quite of there yet.

PARTICIPANT 2 PODCAST.rtf - 2:5 [If the company is small these ..] (7:7) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

If the company is small these roles do not necessarily have to be independent, one person can fulfill these roles.

PARTICIPANT 2 PODCAST.rtf - 2:8 [most organizations offering Cl..] (11:11) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

most organizations offering Cloud Computing Services, you have to look at how big the organization is, what kind of mechanism do they have in terms of backup, disaster recovery, in terms of load balancing and how many data centers do they have. Are they start up people who are hunger resourced in terms of infrastructure?

PARTICIPANT 2 PODCAST.rtf - 2:9 [If you look at guys like Faceb..] (12:12) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

If you look at guys like Facebook, Google and Amazon these companies have data centers almost everywhere. They are able to fall back if you acquire data services from them, they are able to fall back on another data center if the main one experiences problems

PARTICIPANT 2 PODCAST.rtf - 2:13 [Small scale companies in terms..] (23:23) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

Small scale companies in terms of productivity they are quick to ship, produce but undermine processes, security, quality and all those kind of things. If you a small guy you do not have resources. They do not follow normal corporate investments.

PARTICIPANT 2 PODCAST.rtf - 2:21 [Much research has to be concen..] (34:34) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

Much research has to be concentrated on the small firms, do things right. How to incorporate all these demanding things within their small resources

PARTICIPANT 2 PODCAST.rtf - 2:23 [As a small organization people..] (35:35) (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation] [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

As a small organization people are attached to their innovations.

PARTICIPANT 2 PODCAST.rtf - 2:24 [When you need to expand and th..] (35:35) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

When you need to expand and the little tools you were using, you also need to expand need to increase massively. You are still a small organization that was operating from home but now need to expand to meet the demand.

PARTICIPANT 2 PODCAST.rtf - 2:25 [Usually, small companies are b..] (36:36) (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment] [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

Usually, small companies are being bought off by big companies. We have a small organization called iKubu (Pty) Ltd it was bought by Garmin they sponsored and developed all the technology.

PARTICIPANT 2 PODCAST.rtf - 2:26 [Facebook just bought a company..] (36:36) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

 Facebook just bought a company called Parse marking its entry into a new business of providing tools and services for developing mobile applications. And as a small guy they could not adapt to that. If the research is not done and these guys learn to adapt and cope when things get out of hand they will always be bought out by the bigger guys.

PARTICIPANT 2 PODCAST.rtf - 2:29 [We have small licenses per use..] (9:9) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

We have small licenses per user and corporate licenses. Once you do that gap analysis in terms of the tools and skill sets and tools, you can be able to fit within those options.

PARTICIPANT 4 PODCASTS.rtf - 3:5 [The first Agile Project I did ..] (18:18) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
Memos: [Data Centres]

The first Agile Project I did was for Branch Banking Software for Standard Bank which is based on applications and it's quite faraway from software as a service. I have done a lot for bigger financial companies and for various reasons they all had their own data centers. Most of the work I have done was for our own company data Centre. The software products we build ourselves are all in the Cloud so its Cloud based.

PARTICIPANT 4 PODCASTS.rtf - 3:9 [For a simple setup not really ..] (22:22) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

For a simple setup not really and I had a lot less issues than I had in physical location, it has few clicks and lots of tutorials. It has a lot less red tape and a few things you have to be aware of as a South African Company specifically

PARTICIPANT 4 PODCASTS.rtf - 3:17 [Maybe DevOps as a Developer te..] (32:32) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Maybe DevOps as a Developer team becomes easier when you host infrastructure service as opposed to having in house infrastructure. You tend to have big teams and there's big processes between the teams.

PARTICIPANT 4 PODCASTS.rtf - 3:19 [As a smaller company how can t..] (34:34) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

As a smaller company how can they use the practices like continuous delivery with the cloud to outsmart the bigger players? Small companies have access to infrastructure that Standard Bank does not have.

PARTICIPANT 3 PODCASTS.rtf - 5:7 [Agile development in itself if..] (15:15) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

Agile development in itself if you find it in small companies it might work but in terms of large corporates what ends up happening is that the Project ends up running longer than expected and the amount of changes that are required on a weekly basis by customers the customer does not usually know what they want from that Application.

PARTICIPANT 3 PODCASTS.rtf - 5:9 [In large corporates the requir..] (15:15) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

In large corporates the requirements stay static, you can come back and review whether those requirements have been met. And then develop the new requirements, it's easier to handle the Application Development process rather than changing the Application during every week and then trying to get your end goal

PARTICIPANT 3 PODCASTS.rtf - 5:14 [On small companies if you runn..] (18:18) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 On small companies if you running you have to worry about bandwidth if you running Cloud Services.

PARTICIPANT 8PODCASTS.rtf - 8:9 [It's easy to organize people i..] (13:13) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

It's easy to organize people into teams but it's not easy to organize infrastructure for them to fall in line with those teams.

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Code: Prior technology experience {32-5}

PARTICIPANT 1 PODCASTS.rtf - 1:5 [You do not need the additional..] (8:8) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

 You do not need the additional overheads associated with heavy solution of design tasking.

PARTICIPANT 1 PODCASTS.rtf - 1:21 [Basically it creates an issue ..] (24:24) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Stakeholders]

Basically it creates an issue such that you find yourself working for a company that is fast moving and happy with Cloud Technologies but they have to integrate with some 3rd party within the stable of companies, who isn't quite of there yet.

PARTICIPANT 1 PODCASTS.rtf - 1:37 [And the critical success facto..] (14:14) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
Memos: [DevOps]

And the critical success factor for me is really an understanding and appreciation of the emergence of DevOps. DevOps offers middle ground where we start treating server infrastructure and configuration as code and as a result bring those things under management where they perhaps have not be in the past.

PARTICIPANT 2 PODCAST.rtf - 2:3 [First of all when you moving i..] (7:7) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

First of all when you moving into agile and Cloud Computing there's a different Project Manager.

PARTICIPANT 2 PODCAST.rtf - 2:4 [With agile, you need additiona..] (7:7) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

With agile, you need additional roles for project management and therefore more skillsets required. For small businesses what they have to look at are these roles like Project Manager, Scrum Master, serious roles like Technical Lead and Development Team. They have to look at these roles and see if they are able to upskill

PARTICIPANT 2 PODCAST.rtf - 2:6 [You also need to have tracking..] (7:7) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

You also need to have tracking mechanism cause most of these tools especially those found in the Cloud.

PARTICIPANT 2 PODCAST.rtf - 2:14 [DevOps is your traditional sys..] (25:25) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

DevOps is your traditional system administration that requires to also have let's say a major amount of knowledge of the products they support.

PARTICIPANT 2 PODCAST.rtf - 2:16 [Because he doesn't have the ex..] (25:25) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

 Because he doesn't have the experience or know how once the packaging of the application and software is, he can't go further than that then you can pass over to the Developers.

PARTICIPANT 2 PODCAST.rtf - 2:17 [Which will actually make a swi..] (26:26) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Which will actually make a switch into more of your system administration. Coming from that space of building software you understand the programming language, you understand Release Management, Applications behavior, change management, Continuous integration. It is a fairly new field that's coming up of the weaknesses that are there. You have guys you have been doing a great as System Administration

PARTICIPANT 2 PODCAST.rtf - 2:20 [Besides the infrastructure the..] (31:31) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Besides the infrastructure they are supposed to know all this. There is a very big gap, it ups the standard of developers and the entire developer team plus the infrastructure team. Which is trained to bridge the gap.

PARTICIPANT 2 PODCAST.rtf - 2:27 [The skill sets that are needed..] (8:8) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

The skill sets that are needed to actually deliver that particular feature and assign the appropriate people. Daily standups means time should be considered and not be long, any issues that arise you need to resolve them within the small time frame. If they have an understanding, it's much easier cause you can have more roles fulfilled by less resources and just need the necessary skills.

PARTICIPANT 4 PODCASTS.rtf - 3:2 [Continuous Delivery, described..] (12:12) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
Memos: [Expertise]

Continuous Delivery, described in the book by Jezz Humble can be simplified with an elastic computing environment. Not all agile teams focus on these practices, but for me a better question would be: How does PaaS and IaaS enable Continuous Delivery of value?

PARTICIPANT 4 PODCASTS.rtf - 3:3 [f by the migration we also mea..] (14:14) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

f by the migration we also mean that the development team takes ownership of their own infrastructure (a company structure rather than technology change), then an important factor is that the team has the Ops skills. See the DevOps movement comes to mind.

PARTICIPANT 4 PODCASTS.rtf - 3:7 [I have to say what has not cha..] (19:19) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

I have to say what has not changed, a lot of my career I worked on Microsoft Stack that needs visual studio and all that, if you move into the Cloud your underlying technology does not change, the same platforms we run on our servers are the ones we run in the Cloud. You do not need to learn new programming languages you do not need to know any other platforms. There's definitely new technology but whether it's in the Cloud or not that's beside the point

PARTICIPANT 4 PODCASTS.rtf - 3:14 [Depending on the time you need..] (28:28) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

 Depending on the time you need to experiment and that's if you already have basic knowledge. This is the key challenge of these Cloud environments and 2 clicks you have new PC up and running it does not cost much.

PARTICIPANT 4 PODCASTS.rtf - 3:17 [Maybe DevOps as a Developer te..] (32:32) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Maybe DevOps as a Developer team becomes easier when you host infrastructure service as opposed to having in house infrastructure. You tend to have big teams and there's big processes between the teams.

PARTICIPANT 4 PODCASTS.rtf - 3:22 [Just understanding Agile is a ..] (38:38) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Just understanding Agile is a challenge on it's on. Forget about how your services are hosted. It's important to find the overlap if we go into normal agile way it's a vas topic for our different cultures and getting different people to work together.

PARTICIPANT 5 PODCAST .rtf - 4:2 [The hard part is agile, not cl..] (13:13) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

The hard part is agile, not cloud computing. So many companies claim to be agile but really don't understand the concept.

PARTICIPANT 5 PODCAST .rtf - 4:3 [You need good testing methodol..] (14:14) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

You need good testing methodologies, performance monitoring tools, strategies to grow, market analysis, customer understanding and more.

PARTICIPANT 5 PODCAST .rtf - 4:8 [Agile is quite a holistic appr..] (23:23) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
Memos: [Expertise]

Agile is quite a holistic approach that is probably the biggest key to any successful migration, regardless of the technology (cloud or not). Many employees will fight agile methodologies as much as cloud technologies so a migration may fail because a migration to agile failed

PARTICIPANT 5 PODCAST .rtf - 4:9 [Testing, performance monitorin..] (29:29) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Testing, performance monitoring, scalability, client analysis and understanding. This is all about understanding your market and delivering a product in a timely fashion.

PARTICIPANT 3 PODCASTS.rtf - 5:3 [We are using Agile Methodology..] (6:6) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
Memos: [Expertise]

We are using Agile Methodology and to be honest we are having huge problems with agile methodology.

PARTICIPANT 3 PODCASTS.rtf - 5:5 [We have Moon Desktop on SQL Az..] (10:10) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

We have Moon Desktop on SQL Azure, you can have the Cloud Infrastructure or your Windows Platform in the Cloud. My main base is Microsoft, so you can use SQL Azure. How we develop is that we have centralized large data Centre, we will then develop, compress data because our bandwidth in terms of office cannot handle large amounts of the data being transferred from Texas or London wherever. And then be calling back for the Application

PARTICIPANT 3 PODCASTS.rtf - 5:10 [knowledge base, how familiar a..] (18:18) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

 knowledge base, how familiar are you with the technology you are using. Before we used SQL Azure we did a test bench on how much data we can store on SQL Azure. How much data we can access untimely basis. We went through the whole bench mark process on how much we can run our full Application on SQL Azure.

PARTICIPANT 3 PODCASTS.rtf - 5:22 [need to understand limitation ..] (34:34) (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation] [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

need to understand limitation of cloud technologies. As for now every company need to migrate to the cloud technologies as it is the next frontier and in addition they need to fully understand resources and constraints at play.

PARTICIPANT 6 PODCASTS.rtf - 6:11 [Another thing I can point out ..] (21:21) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Another thing I can point out is when you move up your Cloud Technology Stack more experience is required. Because if you simply using services online you only need to know essentially your own tools.

PARTICIPANT 6 PODCASTS.rtf - 6:12 [Now if you go into your platfo..] (21:21) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Now if you go into your platform, you need to know OS and there is some skill level that is required. But these 2 platforms are not requirements for developers because platforms are essentially a backbone operating system, you are responsible for software's development environments and data frameworks.

PARTICIPANT 7PODCASTS.rtf - 7:1 [In terms of Cloud Computing, y..] (3:3) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

In terms of Cloud Computing, you need Tools like Gigs and all those. We also use Microsoft Azure for development and storage

PARTICIPANT 7PODCASTS.rtf - 7:5 [Security would be the first th..] (12:12) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Security would be the first thing, am looking for efficiency then speed, am looking for continuous allocation of resources. Am looking for an easier way of the platform maintainability and also looking for something that would allow me to work with a Team that works in USA.

PARTICIPANT 7PODCASTS.rtf - 7:6 [I think we need to invest more..] (14:14) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

I think we need to invest more on human skills, build capacity on human skills on people who can work on security. I see an inclusive investment on all this.

PARTICIPANT 7PODCASTS.rtf - 7:7 [It's mostly a question of adap..] (16:16) (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology] [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

It's mostly a question of adaptability, adapting to the current standards of design and development.

PARTICIPANT 7PODCASTS.rtf - 7:11 [I communication is one of the ..] (24:24) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
Memos: [Communication needs]

I communication is one of the biggest problems as far as Agile is concerned cause when you are moving into Cloud Computing or enablement you need to address that effectively

_____

Code: Relative Advantage {28-2}

PARTICIPANT 1 PODCASTS.rtf - 1:1 [One of the biggest problems yo..] (3:3) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [Developers now have direct a faster collaborative with third parties]

One of the biggest problems you face in trying to deliver software in short increments is that you typically run into environments where you have to collaborate with 3rd parties to deploy software. E.g. back in early 2000 my wife was working with Mosque Ceiling. They had a 3rd party responsible for their hosting and as a result they had to submit a change request like a month in advance in order to get a code deployed.

PARTICIPANT 1 PODCASTS.rtf - 1:2 [The time period has shrunk dra..] (4:4) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

The time period has shrunk dramatically because of the Cloud technology

PARTICIPANT 1 PODCASTS.rtf - 1:3 [Being able to spin up an insta..] (4:4) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

 Being able to spin up an instance with your latest future branch and being able to test it and then tearing the server down is all made possible through the Cloud Technology, as before it would be sharing resources and have to schedule and inform colleagues am going to put my branch this afternoon no one touch the server.

PARTICIPANT 1 PODCASTS.rtf - 1:4 [Your ability to scale the appl..] (5:5) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]

Memos: [Cloud environmnet]

Your ability to scale the application in cloud technology means you do not have to invest in over architecting systems to make sure you have enough physical servers hooked up.

PARTICIPANT 1 PODCASTS.rtf - 1:5 [You do not need the additional..] (8:8)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

 You do not need the additional overheads associated with heavy solution of design tasking.

PARTICIPANT 1 PODCASTS.rtf - 1:6 [And increasingly we paying a l..] (12:12)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [Cloud Tool]

And increasingly we paying a lot of attention to DevOps areas where we are starting to make use of tool chains like Ansible for configuration management that are able to set up development environments quicker and be able to run in the Virtual machines within Developers laptops.

PARTICIPANT 1 PODCASTS.rtf - 1:7 [What used to happen in the pas..] (15:15)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

What used to happen in the past was systems administrators working on hardware boxes and really keep the lights on, manage hardware/networks, rack and stack, install/manage software on servers and/or clients, etc.

PARTICIPANT 1 PODCASTS.rtf - 1:8 [DevOps offers a philosophy tha..] (17:17)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [DevOps]

DevOps offers a philosophy that a tool chain enables you to deal with large scale Cloud based infrastructure in a very cost effective and very risk averse approach.

PARTICIPANT 1 PODCASTS.rtf - 1:9 [The biggest thing small firm h..] (20:20)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [Expenditure]

 The biggest thing small firm have to take into consideration is that you move from a capital expenditure to a monthly expenditure for services.

PARTICIPANT 1 PODCASTS.rtf - 1:10 [Once you get your head around ..] (20:20)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [Cost of ownership]

Once you get your head around the total cost of ownership and the amount of business risks associated with email going down, it's actually a no brainer. It's more a question of understanding what the impact is on your capex and how that changes

PARTICIPANT 1 PODCASTS.rtf - 1:11 [Increasingly technology like D..] (22:22)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

Increasingly technology like Docker and Ansible basically make you Vendor Independent.

PARTICIPANT 1 PODCASTS.rtf - 1:12 [There's more technology emergi..] (22:22)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

There's more technology emerging in that space that basically reduces Cloud Computing into a commodity service. Which is not great for providers. At the moment what they doing is somebody has to buy these things and try to compare offerings across of Cloud Providers.

PARTICIPANT 1 PODCASTS.rtf - 1:13 [It's incredibly hard. The pric..] (22:22) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [Pricing]

 It's incredibly hard. The pricing strategies are a pain and hard to compare.

PARTICIPANT 1 PODCASTS.rtf - 1:14 [The tooling that's coming out ..] (22:22) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

The tooling that's coming out will allow you to turn a knob to scale up and turn a knob to scale down. Being able to dynamically cope with the traffic surges and really minute control over spending that you have in a Cloud.

PARTICIPANT 1 PODCASTS.rtf - 1:15 [We could turn the corner in a ..] (26:26) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

 We could turn the corner in a perspective that we could demonstrate that the Cloud is viable, that is financially of interest to the organization because it would end up investing large amounts of Capex into servers.

PARTICIPANT 1 PODCASTS.rtf - 1:16 [Now I belong to an organizatio..] (29:29) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [Face2face comm]

 Now I belong to an organization that is quite distributed and it's been a core focus for us since last year to figure out how we collaborate without face to face communication

PARTICIPANT 2 PODCAST.rtf - 2:1 [You can ship that out into pro..] (3:3) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

You can ship that out into production very fast. You will also allow the business to change functionality, as you are busy doing those, when you release a few subsets of functions you are able to see if this is what they really meant.

PARTICIPANT 2 PODCAST.rtf - 2:2 [So which means you can adapt p..] (4:4) (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology] [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

So which means you can adapt plans while you busy building

PARTICIPANT 2 PODCAST.rtf - 2:15 [A DevOps when he reports a pro..] (25:25) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

A DevOps when he reports a problem he does not just tell you that the application is not working. He has to give you information because he has looked into the laws and he has identified exactly where the problems is.

PARTICIPANT 2 PODCAST.rtf - 2:32 [Companies like IBU have their ..] (19:19) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

Companies like IBU have their own data centers for some of their cloud tools. Availability is always a challenge, availability means the infrastructure has to be redundant. Redundancy is expensive because

you have to duplicate and it's only the larger companies that can afford that. They are not perfect as well because they also get outages now and then.

PARTICIPANT 4 PODCASTS.rtf - 3:1 [My expectations are the same a..] (11:11) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

My expectations are the same as without a cloud environment. One thing I would expect is no dependency on another team for infrastructure provisioning – the development team should take ownership of their infrastructure.

PARTICIPANT 4 PODCASTS.rtf - 3:21 [In my mind that was my point o..] (37:37) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

In my mind that was my point of continuous delivery using the tools given by the Cloud. Hats a space where real opportunities are and it's not a different process in terms of company structure the openings still apply

PARTICIPANT 5 PODCAST .rtf - 4:1 [However, various software as a..] (9:9) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

However, various software as a service offerings (Github, Slack and Travis in our case) which are cloud services assist considerably with the agile methodologies. Another factor is deployment speed. On the cloud, I can scale our service by a factor of 100 in an hour. You cannot do that on your own server farm.

PARTICIPANT 3 PODCASTS.rtf - 5:6 [I think on Agile Development i..] (13:13) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

I think on Agile Development in terms of Management point of view it has added more benefits, it's easier for Management to access their reports from their Tablets and Mobile phones cause they do not have to be at a specific location.

PARTICIPANT 6 PODCASTS.rtf - 6:6 [So the system driven process o..] (14:14) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

So the system driven process on a Cloud platform is more lenient and forgiving as far as the people element is concerned. There is not that heavy reliance that the entire team should be here. You can have your team spread out geographically across the world even. The focus is no longer on the individual but on the output.

PARTICIPANT 6 PODCASTS.rtf - 6:7 [The most basic one would be ac..] (16:16) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

The most basic one would be access and primary need, reliable access is very important and Cloud Computing in its nature is very resource intensive, not only resource on your computing but also connectivity wise.

PARTICIPANT 8PODCASTS.rtf - 8:1 [Cloud Computing technology is ..] (3:3) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

Cloud Computing technology is becoming more in the field of provision infrastructure for the development effort.

PARTICIPANT 8PODCASTS.rtf - 8:2 [The machines you going to be d..] (4:4) (Super)

Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

The machines you going to be developing on and the environment you going to be testing on that's where Cloud Computing becomes very valuable.

_____

Code: Resource Availability {14-2}

PARTICIPANT 1 PODCASTS.rtf - 1:42 [My first taste of this was whi..] (36:36) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation] [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

My first taste of this was while I was living in the USA. What I realised is that Americans are generally effusive in their enthusiasm. For someone coming from a more austere culture, one influenced for example by an English culture, this can come across as insincere. Contrarily, our more austere reactions to an American can come off as cold and rude.

PARTICIPANT 1 PODCASTS.rtf - 1:43 [When you move this interaction..] (37:37) (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

When you move this interaction into economically sensitive activity, the potential for misunderstanding and misreading is significant. One important example is that when outsourcing to India which is a strongly paternalistic culture, it is very rude to disagree with someone in authority. As a result, the Indian team will never say "no" to a request from a customer.

PARTICIPANT 1 PODCASTS.rtf - 1:44 [Software Development is a very..] (35:35) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation] [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

Software Development is a very English speaking culture, and it is usually the language used in off-shore development. To take this familiarity with a common language as also being a shared culture is where things can go badly wrong.

PARTICIPANT 2 PODCAST.rtf - 2:30 [if you look at most organizati..] (11:11) (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

if you look at most organizations offering Cloud Computing Services, you have to look at how big the organization is, what kind of mechanism do they have in terms of backup, disaster recovery, in terms of load balancing and how many data centers do they have. Are they start up people who are hunger resourced in terms of infrastructure?

PARTICIPANT 2 PODCAST.rtf - 2:33 [We have got infrastructure iss..] (20:20) (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

We have got infrastructure issues and loomed issues, when you come to cases you always have to establish who is your provider and how much expertise, experience and what services do they have and what tools they provide that you are interested in.

PARTICIPANT 4 PODCASTS.rtf - 3:10 [The data centers are based in ..] (23:23) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Resource Availability - Families (2): Adoption - Substantive, Environment] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

The data centers are based in Western Europe in Ireland both Amazon and Microsoft and am not sure of Google and there's latency. If you hosting a Website or Application or API over there, there is a slight bit of latency. This is the most important thing for me to know and for most applications it's not disruptive.

PARTICIPANT 5 PODCAST .rtf - 4:6 [Finally, Internet connectivity..] (19:19)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

Finally, Internet connectivity is expensive and slow compared to most industrial countries. Poland and Thailand leave us in the dust.

PARTICIPANT 5 PODCAST .rtf - 4:14 [Government needs to open the t..] (36:36)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

Government needs to open the telecommunications sector to greater competition.

PARTICIPANT 3 PODCASTS.rtf - 5:13 [The problem with South Africa ..] (18:18)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 The problem with South Africa in perspective is that the amount of bandwidth that we working with. With large corporates you can get pretty fast lines, you can about hundred megabytes and that enables you to run large processes on SQL Cloud. You can run large calculations on SQL Azure or SQL Cloud and you do not have to worry about your bandwidth.

PARTICIPANT 3 PODCASTS.rtf - 5:14 [On small companies if you runn..] (18:18)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 On small companies if you running you have to worry about bandwidth if you running Cloud Services.

PARTICIPANT 3 PODCASTS.rtf - 5:24 [The reliability with SQLAzure ..] (4:4)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

The reliability with SQLAzure is up to 95 % reliability Online, there are times when you cannot access it ,the speed of the connection is too slow to do actual live processing. How we use Cloud Technology is more on a reporting basis.

PARTICIPANT 6 PODCASTS.rtf - 6:4 [To the enterprise it empowers ..] (14:14)   (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

To the enterprise it empowers Teams not to be geographically dependent. Agile due to the people element requires you to be together.

PARTICIPANT 7PODCASTS.rtf - 7:12 [The reliability and availabili..] (25:25)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

The reliability and availability do affect the Project at the end of the day. An experience we had with this is we had a case of where 2 members of a Team, one was based in Mozambique another in eNkangala close to Mpumalanga and another team member was based in Pretoria. It happened that 2

members that were based in another location were playing a major role in the project e.g. in Mozambique there was an Internet shutdown for the whole country so that became a problem cause we needed resources from him we needed him to take his Code to the Cloud and he couldn't do that for 2 days and it did delay us

PARTICIPANT 7PODCASTS.rtf - 7:14 [Already the issues of latency ..] (27:27)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

Already the issues of latency cause delay for us to converse.

_____

Code: Supplier Efforts and external computing support {17-3}

PARTICIPANT 1 PODCASTS.rtf - 1:39 [Some of the challenges we face..] (24:24)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
Memos: [Stakeholder support]

Some of the challenges we face are things like in multi nationals and large organizations where they have multiple companies in their portfolios and they want to centralize things. Basically it creates an issue such that you find yourself working for a company that is fast moving and happy with Cloud Technologies but they have to integrate with some 3rd party within the stable of companies, who isn't quite of there yet.

PARTICIPANT 2 PODCAST.rtf - 2:22 [Nowadays if you look at techno..] (34:34)   (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 Nowadays if you look at technology industry it's demanding too much, there's a big gap on research to be able to focus on these guys.

PARTICIPANT 2 PODCAST.rtf - 2:25 [Usually, small companies are b..] (36:36)   (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment] [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

Usually, small companies are being bought off by big companies. We have a small organization called iKubu (Pty) Ltd it was bought by Garmin they sponsored and developed all the technology.

PARTICIPANT 2 PODCAST.rtf - 2:30 [if you look at most organizati..] (11:11)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 if you look at most organizations offering Cloud Computing Services, you have to look at how big the organization is, what kind of mechanism do they have in terms of backup, disaster recovery, in terms of load balancing and how many data centers do they have. Are they start up people who are hunger resourced in terms of infrastructure?

PARTICIPANT 2 PODCAST.rtf - 2:33 [We have got infrastructure iss..] (20:20)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

We have got infrastructure issues and loomed issues, when you come to cases you always have to establish who is your provider and how much expertise, experience and what services do they have and what tools they provide that you are interested in.

PARTICIPANT 5 PODCAST .rtf - 4:6 [Finally, Internet connectivity..] (19:19)   (Super)

Finally, Internet connectivity is expensive and slow compared to most industrial countries. Poland and Thailand leave us in the dust.

PARTICIPANT 5 PODCAST .rtf - 4:7 [Government policy on telecommu..] (21:21) (Super)

Government policy on telecommunications and an aging IT professional cohort that is resistant to change

PARTICIPANT 5 PODCAST .rtf - 4:11 [Mostly, they should focus on t..] (36:36) (Super)

Mostly, they should focus on the product and not on the technology. Government needs to open the telecommunications sector to greater competition. Change resistent personnel need to wake up to the fact that change is the only constant in this business.

PARTICIPANT 3 PODCASTS.rtf - 5:13 [The problem with South Africa ..] (18:18) (Super)

The problem with South Africa in perspective is that the amount of bandwidth that we working with. With large corporates you can get pretty fast lines, you can about hundred megabytes and that enables you to run large processes on SQL Cloud. You can run large calculations on SQL Azure or SQL Cloud and you do not have to worry about your bandwidth.

PARTICIPANT 3 PODCASTS.rtf - 5:14 [On small companies if you runn..] (18:18) (Super)

On small companies if you running you have to worry about bandwidth if you running Cloud Services.

PARTICIPANT 3 PODCASTS.rtf - 5:20 [If you encrypting data you put..] (24:24) (Super)

If you encrypting data you putting more processes that make the Application slower than it should be. The minute your data is on the Internet you have no control of the data. You should acknowledge that you have no control over it, yes you do have certain control in terms of user account. The Company can do as they please, if the USA government tells Microsoft that they want to excess what's on your server. Microsoft has the obligation to give the USA government and whoever asks for it.

PARTICIPANT 6 PODCASTS.rtf - 6:9 [You need to consider the type ..] (17:17) (Super)

You need to consider the type of computing power you have got on your backend. The cost is connected directly in relation to that. Your connectivity comes into question I also recommend 10 megabits for such a business Online.

PARTICIPANT 6 PODCASTS.rtf - 6:13 [There are various user License..] (22:22) (Super)

There are various user License Agreements that do get signed. The commitment is that the data belongs to you and you can at any time opt out of the service. I do not think data ownership should be a worry.

PARTICIPANT 7PODCASTS.rtf - 7:4 [Maybe the Service Providers th..] (10:10)   (Super)

Maybe the Service Providers themselves must bring credibility to their systems by showing people they can be secure. I think we need more hackers who could test their systems.

PARTICIPANT 7PODCASTS.rtf - 7:10 [Let's face it we are in Africa..] (22:22)   (Super)

Let's face it we are in Africa so there's been a problem most of the times, there's a member who's working somewhere and u need to work together on a project and they complain about network or they complain about their machines so the only thing about Cloud now is a matter of infrastructure resources.

PARTICIPANT 7PODCASTS.rtf - 7:12 [The reliability and availabili..] (25:25)   (Super)

The reliability and availability do affect the Project at the end of the day. An experience we had with this is we had a case of where 2 members of a Team, one was based in Mozambique another in eNkangala close to Mpumalanga and another team member was based in Pretoria. It happened that 2 members that were based in another location were playing a major role in the project e.g. in Mozambique there was an Internet shutdown for the whole country so that became a problem cause we needed resources from him we needed him to take his Code to the Cloud and he couldn't do that for 2 days and it did delay us

PARTICIPANT 8 PODCASTS.rtf - 8:5 [IBM has a software called Blue..] (4:4)   (Super)

 IBM has a software called Bluemix.net where you can look at their site and see that you can actually provision a little development for yourself. At this stage IBM development tools are for free but maybe at a later stage they will start charging for it.

_____

Code: Top Management Support {5-0}

PARTICIPANT 1 PODCASTS.rtf - 1:35 [Our CEO is very passionate abo..] (14:14)   (Super)

Our CEO is very passionate about hardware and we had a bunch of servers laying around which hosted our Code Repositories and our mail.

PARTICIPANT 1 PODCASTS.rtf - 1:36 [As an Agile Consultant I put a..] (29:29)   (Super)

As an Agile Consultant I put an effort for people to have face to face communication. Now I belong to an organization that is quite distributed and it's been a core focus for us since last year to figure out how we collaborate without face to face communication.

PARTICIPANT 2 PODCAST.rtf - 2:18 [What you find is that most org..] (31:31) (Super)
Codes: [Top Management Support - Families (2): Adoption - Substantive, Organisation]
No memos

What you find is that most organization support multiple vendor and multiple technologies what you are asking from a Dev ops is to understand all that

PARTICIPANT 5 PODCAST .rtf - 4:10 [The CEO needs to communicate a..] (33:33) (Super)
Codes: [Top Management Support - Families (2): Adoption - Substantive, Organisation]
No memos

The CEO needs to communicate a very clear strategy and back it all the way. The CTO needs to have a deep understanding of agile methodology and have the ability to architect and deliver a scalable product. The cloud is somewhat irrelevant from a technological point of view

PARTICIPANT 3 PODCASTS.rtf - 5:4 [There's a conflict between you..] (6:6) (Super)
Codes: [Top Management Support - Families (2): Adoption - Substantive, Organisation]
No memos

There's a conflict between you the Developer, the customer and Management. What the Management thinks they want I would then go about Developing. They will come back and say I see what you have done, can you please change it, add this or takeaway this.

_____

Code: Trialability {19-2}

PARTICIPANT 1 PODCASTS.rtf - 1:21 [Basically it creates an issue ..] (24:24) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Stakeholders]

Basically it creates an issue such that you find yourself working for a company that is fast moving and happy with Cloud Technologies but they have to integrate with some 3rd party within the stable of companies, who isn't quite of there yet.

PARTICIPANT 1 PODCASTS.rtf - 1:26 [We work extensively with Digit..] (12:12) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

We work extensively with Digital Ocean which has proven to be a very competitive product in terms of getting things up and running quickly.

PARTICIPANT 1 PODCASTS.rtf - 1:27 [We also looking at technologie..] (12:12) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

 We also looking at technologies such as Docker in combination with Ansible, that's the stack that we think we going to need both for our own products and services we use plus application that we build for our customers.

PARTICIPANT 1 PODCASTS.rtf - 1:28 [When we were running on open s..] (20:20) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

When we were running on open source system for our calendar migrating that to Google, it took a really long time for us to get that because it involved suddenly from having zero costs to paying $5 per month.

PARTICIPANT 1 PODCASTS.rtf - 1:29 [At the moment what they doing ..] (22:22) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

At the moment what they doing is somebody has to buy these things and try to compare offerings across of Cloud Providers.

PARTICIPANT 1 PODCASTS.rtf - 1:30 [There's still aspects of that ..] (26:26) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

There's still aspects of that I think we still kind of negotiating. We could turn the corner in a perspective that we could demonstrate that the Cloud is viable, that is financially of interest to the organization because it would end up investing large amounts of Capex into servers.

PARTICIPANT 1 PODCASTS.rtf - 1:31 [in USA and Europe it's perfect..] (27:27) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

in USA and Europe it's perfectly acceptable to run very large cloud for example the UK has its own private cloud that it uses and its migrating all of its services, whereas in South Africa you still have large organizations that are theoretically into Agile but are still tied to the nature.

PARTICIPANT 1 PODCASTS.rtf - 1:32 [We also started investigating ..] (30:30) (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

We also started investigating on tools that would allow Developers to pair remotely, to be looking at the same piece of code and be able to manipulate it in less times so others can be able to get feedback.

PARTICIPANT 1 PODCASTS.rtf - 1:33 [what parts of your non-essenti..] (39:39) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
Memos: [Phasesd migration]

what parts of your non-essential, non-IP producing aspects of your business can be moved to SaaS firstly (e.g. email, CRM, accounting etc.). Increasingly this allows businesses to leverage inter-operability within these applications as more and more open API's are out there allowing devs to hook these things up. Add to that services like Zapier allow even more integration between these applications

PARTICIPANT 4 PODCASTS.rtf - 3:10 [The data centers are based in ..] (23:23) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Resource Availability - Families (2): Adoption - Substantive, Environment] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

The data centers are based in Western Europe in Ireland both Amazon and Microsoft and am not sure of Google and there's latency. If you hosting a Website or Application or API over there, there is a slight bit of latency. This is the most important thing for me to know and for most applications it's not disruptive.

PARTICIPANT 4 PODCASTS.rtf - 3:13 [It becomes tricky if you movin..] (26:26) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

It becomes tricky if you moving partially , also a complex environment with 30 servers doing different things, hats going to be a complex move, complex to move it to a different data center but to move it to the cloud it's so level even more complex. People in phases just build a new system to the cloud it's easy

PARTICIPANT 4 PODCASTS.rtf - 3:14 [Depending on the time you need..] (28:28) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

 Depending on the time you need to experiment and that's if you already have basic knowledge. This is the key challenge of these Cloud environments and 2 clicks you have new PC up and running it does not cost much.

PARTICIPANT 3 PODCASTS.rtf - 5:7 [Agile development in itself if..] (15:15) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

Agile development in itself if you find it in small companies it might work but in terms of large corporates what ends up happening is that the Project ends up running longer than expected and the amount of changes that are required on a weekly basis by customers the customer does not usually know what they want from that Application.

PARTICIPANT 3 PODCASTS.rtf - 5:9 [In large corporates the requir..] (15:15) (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

In large corporates the requirements stay static, you can come back and review whether those requirements have been met. And then develop the new requirements, it's easier to handle the Application Development process rather than changing the Application during every week and then trying to get your end goal

PARTICIPANT 3 PODCASTS.rtf - 5:11 [We found out that we could not..] (18:18) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

We found out that we could not and we had to scale our benchmarks down to a point where we could run our Application without any glitches to minimum glitches.

PARTICIPANT 3 PODCASTS.rtf - 5:19 [If you encrypting your data, y..] (23:23) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

If you encrypting your data, you are adding another process or functionality on top of a layer that makes it more difficult to excess your data. I would not advise encrypting unless the servers that you are running on a very top notch and paying for a higher level account that you no longer have power over that data cause it's on someone else's server

PARTICIPANT 3 PODCASTS.rtf - 5:23 [Full migration can be in part ..] (34:34) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

Full migration can be in part basis where they some resources or tools on their localized server whilst others can be in the cloud. This allows a balance in migration into two different infrastructural environments.

PARTICIPANT 6 PODCASTS.rtf - 6:9 [You need to consider the type ..] (17:17) (Super)

Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

You need to consider the type of computing power you have got on your backend. The cost is connected directly in relation to that. Your connectivity comes into question I also recommend 10 megabits for such a business Online.

PARTICIPANT 7PODCASTS.rtf - 7:8 [I think maybe we need to show ..] (18:18) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

I think maybe we need to show them more real Applications of Cloud enablement, we need to show them what works. We need to get practical with things and we need to show them it works. Obviously the transition would not be easy and I think with enough education it can work.

_____

Code: Uncertainty {31-3}

PARTICIPANT 1 PODCASTS.rtf - 1:17 [When we start talking the impa..] (5:5) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

When we start talking the impact of Lean Software Development and if you wanted to build a Minimum Viable Product (MVP), you were not sure of what impact it would have in the market place and what potential it would attract

PARTICIPANT 1 PODCASTS.rtf - 1:18 [The need for Security and so o..] (19:19) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Security]

 The need for Security and so on are quite greater than the small firms, there's a distinct challenge in the sheer scale of things

PARTICIPANT 1 PODCASTS.rtf - 1:19 [It's more a question of unders..] (20:20) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

It's more a question of understanding what the impact is on your capex and how that changes. That is really a big challenge for us.

PARTICIPANT 1 PODCASTS.rtf - 1:20 [At the moment what they doing ..] (22:22) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

At the moment what they doing is somebody has to buy these things and try to compare offerings across of Cloud Providers. It's incredibly hard. The pricing strategies are a pain and hard to compare

PARTICIPANT 1 PODCASTS.rtf - 1:21 [Basically it creates an issue ..] (24:24) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Stakeholders]

Basically it creates an issue such that you find yourself working for a company that is fast moving and happy with Cloud Technologies but they have to integrate with some 3rd party within the stable of companies, who isn't quite of there yet.

PARTICIPANT 1 PODCASTS.rtf - 1:22 [As a result we got this kind o..] (25:25) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

As a result we got this kind of impendence mismatch between stockholders that still very tied to physical infrastructure basically treating the cloud as second classes something not to be trusted or something less secure than physical systems.

PARTICIPANT 1 PODCASTS.rtf - 1:23 [We have asked to see a lot of ..] (26:26) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [un reliabity]

We have asked to see a lot of unreliability of the Cloud for example Facebook went down which took out Facebook authentication, which meant that they were a lot of services that relied on Facebook authentication that were effectively locked out a lot of their customers.

PARTICIPANT 1 PODCASTS.rtf - 1:24 [Building relations for me is a..] (32:32) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Building relations for me is about trust, it's incredibly hard but if you in an office with a person you can small talk with, have lunch together and you can see when they are upset. All those things disappear when you doing business communication remotely

PARTICIPANT 2 PODCAST.rtf - 2:10 [It is always good for the busi..] (12:12) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

It is always good for the business itself to have its own policy in terms of backup or disaster recovery.

PARTICIPANT 2 PODCAST.rtf - 2:11 [In terms of security nowadays ..] (14:14) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

In terms of security nowadays it's a big challenge, the most critical component of security is actually your own people. The infrastructure can be secured but remember all infrastructure and software is used by people.

PARTICIPANT 2 PODCAST.rtf - 2:12 [That is a difficult question, ..] (17:17) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

That is a difficult question, you know Amazon had outage last year and we were not able to access their Cloud Services for a day. So we do have several data centers, Facebook, Google and Amazon also have Data Centers.

PARTICIPANT 2 PODCAST.rtf - 2:31 [You need availability for all ..] (13:13) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

You need availability for all times, if you're Cloud Computing Services are not available that day, what do you do? If you look at these services themselves they provide a mechanism you can actually save so on a daily basis. It allows you to operate offline until they are back online. Once you adopt a service you need a mechanism to protect yourself that way you can function even if they are not available.

PARTICIPANT 4 PODCASTS.rtf - 3:10 [The data centers are based in ..] (23:23) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Resource Availability - Families (2): Adoption - Substantive, Environment] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

The data centers are based in Western Europe in Ireland both Amazon and Microsoft and am not sure of Google and there's latency. If you hosting a Website or Application or API over there, there is a

slight bit of latency. This is the most important thing for me to know and for most applications it's not disruptive.

PARTICIPANT 5 PODCAST .rtf - 4:4 [Key is good internet connectiv..] (16:16) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Key is good internet connectivity, something South Africa is way behind on.

PARTICIPANT 5 PODCAST .rtf - 4:5 [Existing developers don't want..] (19:19) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Existing developers don't want to learn how to use the cloud and there is this weird idea that data in your building is safer than data on a cloud server.

PARTICIPANT 3 PODCASTS.rtf - 5:1 [What I have noticed with local..] (3:3) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

 What I have noticed with localized infrastructure the reliability in terms of excessing the services.

PARTICIPANT 3 PODCASTS.rtf - 5:8 [It has been made much longer b..] (15:15) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

It has been made much longer by the client and am not really a fan of Agile Development space but in terms of quickness in getting Projects out there, for larger companies I would not advise it yet for small companies it can work

PARTICIPANT 3 PODCASTS.rtf - 5:15 [Last week you heard that the l..] (20:20) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Connectivity]

Last week you heard that the line that ran from Morocco to USA was cutoff and we were getting slow internet connection time. If that happens to a large corporate the ability to excess your data is limited, that has impact on your business in terms of the amount processes you can run.

PARTICIPANT 3 PODCASTS.rtf - 5:16 [Storing your data is then limi..] (20:20) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Storing your data is then limited and then the amount of productivity that you have in your company is then limited. Whereas running a local server the only thing between you and that server is a switch and then you can get access and process your data however you want.

PARTICIPANT 3 PODCASTS.rtf - 5:17 [I think for me, currently it's..] (21:21) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Important comment on uncertainty]

I think for me, currently it's still limited to the fact that it's not a platform where I can fully develop my whole Application and run it from a Cloud. It is only for allowing me to access my data from wherever I want, yes I can use Cloud Services for that.

PARTICIPANT 3 PODCASTS.rtf - 5:18 [I think there's a policy in th..] (23:23) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

I think there's a policy in the USA that if your data goes through the States the Government has the right to read or access the data. If you look at SQL Azure, most of the servers are in the USA, the

other half of the servers are in Europe. Yes you do own a certain part of your data cause you have the security in terms of account that you use for your data.

PARTICIPANT 3 PODCASTS.rtf - 5:19 [If you encrypting your data, y..] (23:23)   (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

If you encrypting your data, you are adding another process or functionality on top of a layer that makes it more difficult to excess your data. I would not advise encrypting unless the servers that you are running on a very top notch and paying for a higher level account that you no longer have power over that data cause it's on someone else's server

PARTICIPANT 3 PODCASTS.rtf - 5:20 [If you encrypting data you put..] (24:24)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

If you encrypting data you putting more processes that make the Application slower than it should be. The minute your data is on the Internet you have no control of the data. You should acknowledge that you have no control over it, yes you do have certain control in terms of user account. The Company can do as they please, if the USA government tells Microsoft that they want to excess what's on your server. Microsoft has the obligation to give the USA government and whoever asks for it.

PARTICIPANT 6 PODCASTS.rtf - 6:9 [You need to consider the type ..] (17:17)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

You need to consider the type of computing power you have got on your backend. The cost is connected directly in relation to that. Your connectivity comes into question I also recommend 10 megabits for such a business Online.

PARTICIPANT 6 PODCASTS.rtf - 6:10 [Security is also an aspect tha..] (19:19)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Security is also an aspect that the cloud provider worries about because they are responsible for the Security, essentially it's a black box there's no access in here only through this VPN that you created yourself.

PARTICIPANT 6 PODCASTS.rtf - 6:13 [There are various user License..] (22:22)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Uncertainity about service providers]

There are various user License Agreements that do get signed. The commitment is that the data belongs to you and you can at any time opt out of the service. I do not think data ownership should be a worry.

PARTICIPANT 7PODCASTS.rtf - 7:3 [One thing I can tell you about..] (10:10)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

One thing I can tell you about African Developers is that they do not have much trust into the Cloud

PARTICIPANT 7PODCASTS.rtf - 7:4 [Maybe the Service Providers th..] (10:10)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Maybe the Service Providers themselves must bring credibility to their systems by showing people they can be secure. I think we need more hackers who could test their systems.

PARTICIPANT 7PODCASTS.rtf - 7:5 [Security would be the first th..] (12:12) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Security would be the first thing, am looking for efficiency then speed, am looking for continuous allocation of resources. Am looking for an easier way of the platform maintainability and also looking for something that would allow me to work with a Team that works in USA.

PARTICIPANT 7PODCASTS.rtf - 7:9 [When you are now with Cloud Co..] (22:22) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

 When you are now with Cloud Computing not everybody wants to associate themselves with the Cloud they have that fear.

PARTICIPANT 8PODCASTS.rtf - 8:8 [We currently helping some cust..] (13:13) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

We currently helping some customers to go DevOps and its one of our biggest challenges. One of our biggest challenges is culture and organizational restructure.

_____

APPENDIX I

Themes of Case Study Interview Questions

Section A: Existing Environment

A1: What are the agile methodologies in use in South Africa?

    A.1.1: Are you using agile methodology in your software development?

    A.1.2: What cloud computing services are you using?

    A.1.3: What type of applications, tools are used to develop software in cloud computing?

    A.1.4: What impact has cloud computing have on agile development?

    A.1.5: What are your expectations when using agile software development in a cloud environment?

Section B: Conditions for Successful Migration

 B.1: What factors are necessary in ensuring that organizations using agile development methodologies in South Africa succeed in migration to cloud computing?

[You may be guided by factors that play some role in migrations such as relative advantage, uncertainty, geo-restriction, compatibility, trialability, size, top management support, prior experience, innovativeness, industry, market scope, supplier efforts and external computing support]

    B.1.1: What factors are responsible for your success in migrating your organisation's agile development to cloud computing?

    B.1.2: What difficulties or weaknesses are you encountering during the process of migrating to cloud computing?

    B.1.3: What factors are responsible for the difficulties you are experiencing with migrating to cloud computing?

    B.1.4: What factors are responsible for the weaknesses you are experiencing with migration to cloud computing?

Section C: Action/Interaction between Migration Success Factors

C.1: How do the factors that are necessary in ensuring that organizations using agile development methodologies in South Africa succeed in migration to cloud computing interact with each other?

C.1.1: How do the factors that are responsible for your success in migrating to cloud computing influence one another?

C.1.2: How do the factors that are responsible for the difficulties you are experiencing influence one another?

C.1.3: How do the factors that are responsible for the weaknesses you are experiencing influence one another?

C.1.4: What is the relationship between factors that account for your success and those that account for your difficulties and weaknesses?

Section D: Action/Interaction between Migration Success Factors and Successful Migration

D.1: How do the factors necessary in ensuring successful migration of organizations using agile development methodologies in South Africa contribute to such success?

D.1.1: How do the factors that account for successful migration to cloud computing contribute to such success?

D.1.2: How do the factors that account for difficulties in migrating to cloud computing contribute to such difficulties?

D.1.3: How do the factors that account for difficulties in migrating to cloud computing contribute to such difficulties?

Section E: The Framework Building

E.1: How will the framework be compiled to ensure that the migration can be successful?

E.1.1: What is important to consider in migrating agile development methodologies to cloud computing?

E.1.2: How should the process of migrating agile development methodologies to cloud computing be managed?

E.1.3: What should be the roles of different stakeholders within the organisation in ensuring successful migration?

E.1.4: What should be the roles of different stakeholders outside the organisation in ensuring successful migration?

APPENDIX II

Survey Questionnaire

The extent of use of Agile Development Methodologies by SMMEs
Section A: Background of the company

Please [√] or fill-in the space provided and provide only one answer for the following questions.

A1. Indicate the type of company

a	Private Companies	b	Public Companies	c	Personal Liability companies	d	State Owned Companies

A2. In which region(s) or town(s) do you operate from?

a	Gauteng (please specify town(s))
b	Western Cape (please specify town(s))
c	Free State (please specify town(s))
d	Eastern Cape (please specify town(s))
e	Mpumalanga (please specify town(s))
f	Northern Cape (please specify town(s))
g	Kwazulu-Natal (please specify town(s))
h	Limpopo (please specify town(s))
i	North-West (please specify town(s))

A3. Indicate the telephone number for the main company's contact personnel.

A4. What is your position in your company?

a	Executive Director/COO	B	Software Developer	c	Software Support Specialist	d	Other (Specify)

A5. How many people does your company employ?

147

a	1-5	B	6-10	c	11-20	d	21-50	e	Over 51

Section B: Experience in Agile Methodologies and Cloud Environments

B1. How long have you been in software Development?

a	Less than a year	B	1– 5 years	c	6-10 yrar	d	More than 10 years

B2. What Agile methodology do you use?

a	Scrum	B	Lean	c	Kanban	d	Other(Specify)	e	None

B3. Is your company already operating in the cloud or considering moving parts of your business into the cloud?

a	Yes	B	No	c	Considering

B4. What would you consider the primary business case for your organisation to move into the cloud?

a	Agility
b	Scalability
c	Cost
d	Improved IT control and IT visibility
e	Centralised management
f	Mobility and Mobile Device Management
g	Competitive advantage
h	Easy access to developer tools
i	Unsure

B5. How long have you been using agile development using cloud platform?

a	Less than a year	B	1-5 years	c	6-10 years	d	More than 11 years	e	Not Applicable

B6. Please specify what is the most appropriate cloud model you are using or considering:

a	Public	B	Private	c	Hybrid	d	All	e	Not Applicable

B7. What is your self-assessment of using cloud platform for agile development?

a	Low experience	B	Moderate experience	c	High Experience

Section C: Experience in Cloud Environments for General Purpose Work

C1. At present, how often do you use cloud platform for other general purpose work

a	Low experience	B	Moderate experience	c	High Experience

C2. At present, which cloud service provider do you use for other general purpose work?

a	Amazon	B	Google	c	Salesforce	d	Open Source	e	Other(Specify)

C3. What cloud computing services are you using for other general purpose work?

a	SaaS	B	PaaS	c	IaaS	d	Other(Specify)

C4. Mostly, where do you access the Internet in doing your work? (Please check √ only one answer)

a	At my office	B	At my home	c	Both at office and at home	d	Not sure	e	Hardly used both

C5. What Internet access method do you use at your office for your work? (Please check √ only one option)

a	Business Network	B	Wireless	c	Other (please specify)

C6. What internet access method do you use in doing your work?

a	Broadband	B	Dial-up	c	Wireless	d	Other(Specify)

If you have any additional comments you wish to make about Internet and cloud usage, please add them here.

Section D: Perceived Usefulness and Preserved Ease of use towards Cloud Migration.

D1. Perceived usefulness and perceived ease of use toward usage of cloud services for agile development

1 = Strongly Disagree; 2 = Quite Disagree; 3 = Slightly Disagree; 4 = Neutral; 5 = Slightly Agree; 6 = Quite Agree; 7 = Strongly Agree							
PERCEIVED USEFULNESS about the cloud usage.	1	2	3	4	5	6	7
Using cloud enables me to accomplish tasks more quickly							
Using the cloud enhances the quality of my work							
Using the cloud makes it easier to do my work							
I find the Internet useful in my work							
PERCEIVED EASES OF USE about the cloud usage.							
Learning to use the Internet is easy for me							
I find it easy to use the Internet to do what I want to do							
I find it easy for me to become skilful in using the Internet							

APPENDIX III

Ethical Clearance

UNISA | college of science, engineering and technology

Mr Gardner Mwansa (34208704)   2014-09-17
College of Science, Engineering and Technology
UNISA
Johannesburg

Ref: 163/GM/2014

The request for ethical approval for your PhD (Information Systems) research project entitled "Development of a Framework for Agile Development Methodologies Migration to Cloud Computing with Specific Reference to Small, Medium and Micro Enterprises in the South African Environment" refers.

The College of Science, Engineering and Technology's (CSET) Research and Ethics Committee (CREC) has considered the relevant parts of the studies relating to the abovementioned research project and research methodology and is pleased to inform you that ethical clearance is granted for your study as set out in your proposal and application for ethical clearance.

Therefore, involved parties may also consider ethics approval as granted. However, the permission granted must not be misconstrued as constituting an instruction from the CSET Executive or the CSET CREC that sampled interviewees (if applicable) are compelled to take part in the research project. All interviewees retain their individual right to decide whether to participate or not.

We trust that the research will be undertaken in a manner that is respectful of the rights and integrity of those who volunteer to participate, as stipulated in the UNISA Research Ethics policy. The policy can be found at the following URL:
http://cm.unisa.ac.za/contents/departments/res_policies/docs/ResearchEthicsPolicy_apprvCounc_21Sept07.pdf

Please note that if you subsequently do a follow-up study that requires the use of a different research instrument, you will have to submit an addendum to this application, explaining the purpose of the follow-up study and attach the new instrument along with a comprehensive information document and consent form.

Yours sincerely

Prof Christopher Enweremadu
Deputy Chair: College of Science, Engineering and Technology Ethics Sub-Committee

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Migrating Agile Development into the Cloud Computing Environment

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Abstract - The emergence of cloud computing is influencing how businesses develop, re-engineer, and implement critical software applications. The cloud requires developers to elevate the importance of compliance with security policies, regulations and internal engineering standards in their software development life cycles. Cloud computing and agile development methodologies are new technologies that have come with new approaches in the way computing services are provisioned and development of quality software respectively. However, the synergy between the two is bonded with technical and non-technical challenges. In this paper, a conceptual framework is proposed to support the process of migration of South African small, medium and micro enterprises (SMMEs) who are using agile software development methodologies to cloud computing environment.

Keywords-Cloud Computing, Agile Development Methodologies, SMMEs

I. INTRODUCTION

Cloud computing is trending within social and corporate realms and experts believe that it will reshape information technology processes in the next few years [1]. Cloud computing affords traditional and ubiquitous smart end user devices such as PCs, tablets and mobile smart phones to access computing services that include software applications, storage facilities, processing and application development by connecting to the Internet through Web 2.0 [2]. These resources are provided and kept by providers who are remotely situated. There are generally three cloud deployment models: *private cloud* - the company owns and controls its infrastructure and applications running behind a firewall with virtualization, tools and policies including deployments: *public cloud* - resources and applications are offered as services on a subscription basis by providers; and *hybrid cloud* - a mix of public and private clouds. Each of these deployments have advantages and disadvantages associated with them [3].

The whole cloud computing model is attractive to users of different needs as it provides the following benefits: cost saving in operation, development and fast deliveries; resources such as data, applications and tools can be accessed anywhere and by any Internet ready device with Web 2.0; offer customized computing infrastructure with convenient task-centric, on-demand way of sharing configurable shared pool of resources; facilitates

collaboration and provides good conditions for green computing [2]-[3].

Despite being endowed with benefits, cloud computing has challenges such as security concerns; data ownership concerns; lock-in and interoperability concerns; enterprise Support and Service Maturity; requirement for online connectivity and; anxiety among developers about a new cloud computing platform without appropriate guidance and understanding of how to effectively utilize cloud computing standard architecture [4]-[5].

In spite of significant challenges that the technology platform faces, many users, vendors and industry observers predict an optimistic future for cloud computing [2]. Worldwide, some agile developers have migrated to cloud computing environment. For instance, the R&D of Salesforce motivated migration of all software development to the cloud environment [6]. However, it is evident that this migration to private cloud has mainly involved large scale companies that have the capability to create private cloud infrastructures of their own with easy access to resources and tools. Small, medium and micro enterprises (SMMEs) on the other hand have challenges in adopting private cloud computing for reasons such as lack of capital base for investing in cloud infrastructure that will accommodate all resources needed for their development activities. This leaves them with the option of subscribing to public clouds only. This puts them at a disadvantage and subjected to the challenges of cloud computing associated with public clouds.

The South African Government currently considers SMMEs as vital enterprises for the economy [7]. They contribute 56% of private sector employment and 36% of gross domestic product [8]. According to the National Small Business Act (1996), an SMME in South Africa's finance and business services sector is an organization of micro-business which employs up to 5 employees, or a very small business employing of up to 10 employees, or a small business employing up to 50 employees, or a medium sized business employing up to 100 employees.

A significant adoption of cloud computing solutions in South Africa especially for business owners who are technologically proficient has been observed. These

adoptions have mainly been in web hosting and ecommerce (94%), email hosting/archiving (75%), customer Relationship Systems (58%), configuration and data backup (58%) and application development with 40% [9]. It will be interesting to investigate application methodologies, programming environments and tools used by these organizations who have adopted cloud computing as it was not part of [18]'s study. Reason being that, certain development methodologies such as agile emphasize specific practices that may bring about issues in the form of non-technical and technical problems associated to cloud computing environment. User/developer communication limitations and programming environment lock-in are examples of non-technical and technical problems respectively [10]-[11].

It is against this background that this research paper aims at proposing a framework based on apparent characteristics, practices and contexts that are critical in agile development processes in order to determine successful migration to cloud computing specifically for SMMEs in the South African context. A global phenomenon of cloud computing adoption in the SMMEs sector is evident [12]; however, this research is specific to the South African context due to unique standards and regulatory frameworks that guide Internet use.

It is envisaged that the framework will contribute to; 1. Theoretical knowledge and perceptions of technological innovation adoption frameworks as applied to agile development methodologies and cloud computing environment; 2. Determine effective interactions among the factors that contribute to successful migration; 3. Will provide guidelines to SMMEs in South Africa who are using agile development methodologies in effective transition into use of cloud computing without compromise on software quality.

The rest of this paper is organized as follows: Section 2 reveals the available literature on cloud computing environments and software engineering with a focus on agile development methodologies. In Section 3, an analysis of problems arising from developing on the cloud environment are discussed. Section 4 proposes a framework. Finally, the paper ends with a conclusion and recommendation for future work.

II. BACKGROUND

Cloud computing has over the last decade been a *catchword* in the computing circles and has escalated promises of a new paradigm shift in the manner in which computing services are provisioned to users individually as well as an organization [2] & [13]. Its use currently involves users using services on different levels of its architecture [2] - [3] & [14]. Users get access to services that include storage, access to application software, processing and application

development by using various devices such as smart phones, laptops, personal computers etc. [2]. In addition to this, there are other benefits such as cost savings, increased capacity and capabilities to Information Technology departments.

While there has been apparent significant benefits in the use of cloud computing, adoption of cloud technologies is still faced with doubts by many would-be users due to some challenges such as those of security, privacy, lock-ins and uncertainties in the regulatory frameworks [4]-[5]. However, there has also been substantial research in this area especially addressing challenges of the technology offerings as it will be discussed in this literature review.

A. Historical perspective and definition of cloud computing

The dawning age of cloud computing spans long before the advent of the Internet where researchers had a vision of what was termed as computer utility. For instance, in 1961, Professor John McCarthy predicted that computing would in future be structured like any other public utility such as telephone or electricity [15]. The cloud computing ideology can also be traced back to Advanced Research Projects Agency Network (ARPANET) in 1969 when Joseph Carl Robnett Licklider visualized a network of data and programs interconnected for everyone to use globally [16]. All these ideas had a theoretical concept of commoditizing computing services by providers who would make available services according to user requirements.

The philosophical ideas of the 1960s were introduced in the mainframes or datacentres managed by computer companies such as IBM from single installations. These were characterized by "dumb terminals" that never had any processing capacity but totally dependent on connectivity with the mainframe or minicomputer [17]. The target users were mainly corporate or Government institutions who also actually set them up internally due to the complexity and huge cost of maintaining them.

However, during the early 1980s, most organizations started acquiring personal computers and workstations which emerged within affordable levels. This technological landscape was perceived as bringing to an end the original utility computing philosophy. The personal computers brought about the second wave of computer revolution that focussed on digitalization where users were increasingly using computers for documents, spreadsheet and databases [18]. By the 1990s, as digitalization extended to storage of pictures, company documentation, music, video etc., it started to become almost impossible to store these forms of digitized information on stand-alone computers. This led to traditional systems of client-server architectures that accommodated a dedicated storage or application server of

which individual PCs would connect to and access required information [19].

Since the beginning of the new millennium, a new wave of computer revolution started to emerge. This new revolution calls for "atomization" and "ubiquitous computing". Atomization is the opposite of digitization that entails digital content to be turned back into atoms that can be realised by vision, touching and hearing. Ubiquitous computing involves development of non-traditional computing devices that promote atomization [18]. For instance, smart phones and iPods are ubiquitous computing devices.

This type of requirements has led to the rise of cloud computing which in a way also has evolved through a number of stages that includes grid and utility computing, application service provision (ASP) and Software as a Service (SaaS) [3] & [20].

Cloud computing creates a situation where a user application accesses computing resources through a type of service and not necessarily directly by talking to the specific CPU for processing or hard drive for storage. A precise definition of cloud computing can be difficult to define due to the fact that different technology specialists would go for different emphasis in their definition rather than most end-users. Gartner defines cloud computing as a style of computing where massively scalable IT related capabilities are provided "as a service" across the Internet to multiple external customers while Forrester defines it as a pool of abstracted, highly scalable, and managed infrastructure capable of hosting end-customer applications and billed by consumption [21].

The National Institute of Standards and Technology (NIST) offers a succinct definition which describes cloud computing as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [14]. Building on this, the user's perspective can in this manner mean cloud computing being dynamically scalable, device-independent and provides task-centric resources that are accessed from the Internet at a charge as per use basis from service provider's infrastructure (e.g., Google Apps, Amazon EC2, or Salesforce.com. With the evolution of the web to 2.0, it is prudent to speculate that cloud computing technology is geared to achieve the philosophical objective of making computing services as the 5th utility after water, electricity, gas and telephony [2]. It entails a radical move from the traditional client-server architecture into web service.

Cloud computing has essentially five characteristics that are supposed to be available in its infrastructure, namely; on-demand self-service, broad network access, resource pooling, rapid elasticity and; measured service [22]

On-demand self-service aims to reduce the configuration tasks from the user's point of view where resources such as the compute, storage or platform are self-provisioned or automatically configured. Other than creating accounts on a service provider, a user may not interact physically with the service provider's staff to have access to resources. Broad network access is a ubiquitous characteristic that allows access to resources using any device such as phones, PCs etc. as long as it is connected to the Internet and running a web browser. Resource pooling implements virtualization and multi-tenancy by supporting many concurrent users. Rapid elasticity creates a service platform or resource that increases or decreases according to user requirements. It is possible to declare the number of servers that one needs. This significantly aids cost saving in capital investments where organizations would not invest in computing resources that are often idle. Measured service is a "pay as you go" facility that literally removes the element of computing equipment being a fixed cost [18] & [22].

B. Cloud Deployment Models

[14] also defined cloud computing deployment models as follows: Private cloud —This is the most secure and risk-averse cloud that has the whole cloud infrastructure belonging only to a single organization; Community cloud is a cloud infrastructure shared by more than one organizations that have similar interests for serving a particular community; Public cloud is a cloud infrastructure owned by a service provider that offers cloud services to the public on commercial basis and the Hybrid clouds which are a combination of different [3]. For example, a company may decide to run its software applications on a public cloud but make storage on its private cloud. This research however, focuses on public clouds as SMMEs do not have capacity to invest in private clouds

C. Cloud Technologies

In order to replace the traditional client-server approach with cloud computing, there are basically three options or service types in which services can be provisioned. These are: 1. Software as a Service (SaaS); 2. Platform as a Service (PaaS) and; 3. Infrastructure as a Service (IaaS) [3].

Figure 1 shows the services types and their relationships. SaaS is designed to provide applications as a service to end users. The approach is to provide off-the-shelf and existing web applications. Users can access the applications and still be able to customise it to their conditions and requirements. In case of off-the-shelf application not being present in the

cloud infrastructure, then the SaaS becomes unsuitable. Then the user may have to use other service types that allow application development. SaaS is currently the most noticeable and used in the cloud as it mostly deals with end user software packages such as word-processing and spreadsheets. Example SaaS services are those from Google Docs and email services such as Gmail, Hotmail and Yahoo mail [18] & [22].

PaaS is designed to provide a platform service mainly for online application deployment for developers. The platform entails the operation system and the hardware associated with it. An environment is created to allow software development including test runs using development tools that are present within that particular service provider's cloud infrastructure [18] & [22]. It also facilitates speed of programming by automating some coding tasks and allows programmers to work on their programming languages and associated tools. Hence, technical programming knowledge and skills are necessary for most use of PaaS offerings. Therefore this service type is suitable for companies that choose to cloud compute or development of software although it can be restrictive in terms of resources provided by the cloud provider leading to the problem of vendor lock-in. A vendor lock-in is a situation created when a user of a service or product fails to easily change to another competitor's service or product due to incompatible proprietary technologies. An example of PaaS is the App Engine offered as service by Google which can allow any user to write new cloud applications and be able to deploy them to the web using the Google's cloud infrastructure [18] & [22].

The IaaS service type is a major cloud computing development meant for IT operators. It has a capability of offering services of processing, storage, networks and many other vital computing resources where a user is able to deploy and run arbitrary software [14]. It includes services such as operating systems and applications. Without control of the underlying hardware in the cloud infrastructure, the user has control over the operating systems, storage, deployed applications and some limited control over networking components. Cloud providers of this service rent out servers using a process called virtualization. Server virtualization involves masking and pooling of server resources. For example, one physical server may be configured using a special administrator software into multiple virtual servers (machines) and each acts like a distinctive physical device, capable of running its own operating system [18]. In cloud computing, these virtual servers are mostly referred to as instances. The IaaS service provider can either offer dedicated physical servers or virtual server instances. Although, these two services can perform the same functions, virtual instances are sometimes regarded as insecure especially by users who do not want to share server hardware with others. For this reason, some

customers may choose to use specific deployment models like private cloud only or a combination depending on the security requirements of their services or products. One example of IaaS vendors is the Amazon Web Services [18] & [22].
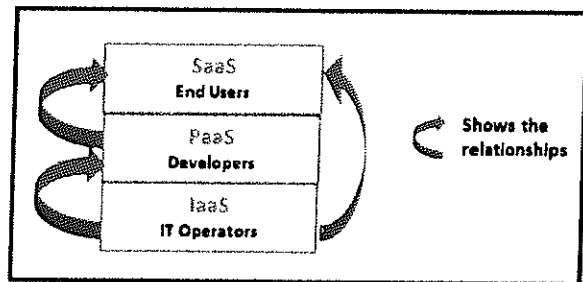
Figure 1: Relationships between Service Types (Adapted from [22])

D. Cloud Computing Adoption and Growth

The European Commission technical report on ICT — Information and communication Technologies - Work programme 2013 suggested building industrial strength in software and services technologies by exploiting Internet-based services such as cloud computing. It also recommended adoption of cloud computing at the same time taking into account of legal, socioeconomics and technical issues. The report generally concluded that the potential of cloud computing and its models has not yet been fully exploited in terms of development and research to the degree of full utilisation by stakeholders [23].

The South African e-government initiative strongly supports IT research in development of solutions that are directed to the future IT trends and offering [24]. Although there are elements of scepticism, cloud computing, an emerging technology, has in the recent past entered the mainstream industry due to its competitive edge [25]. Considering current demand from work and personal needs for online engagements and growth of the web, cloud computing could be a manifestation of a new paradigm of a large-scale distributed computing utility for business and society solutions [13].

In contrast to utilities such as electricity, cloud computing is still in the limelight of innovative research from service provision to technology developments. This contributes to a problem of identifying appropriate tools and practices in cloud environments [13] & [25]. Some companies that adopted cloud computing without much consideration have ended up losing out on some benefits such as those of new technology for reasons such as lock-ins. With cloud computing, there are opportunities and risks that need careful analysis [25].

Apart from giant development companies such as Google and Microsoft moving their application and services into the cloud, the academic community has recently been very active with a number of research work in the area of cloud computing as a multi-disciplinary research field. It is regarded as multidisciplinary because it is an amalgamation of several independent computing aspects and trends such as Internet delivery, utility computing "pay-as-you-go", elasticity, virtualization, grid computing, distributed computing, storage, security, Web 2.0 and content outsourcing [13]. The study by [9] on cloud adoption by SMMEs in South Africa showed 53% respondents used the service type of PaaS and IaaS; and 40% were adopting cloud computing for application development. It is also thought-provoking to note [26] prediction that cloud computing will grow and that application developers should start to consider its offerings at all levels.

Statistics from [27], an active partner for early-stage entrepreneurs providing seed-to-growth financing for innovative companies looking to disrupt big markets in America, indicated that SaaS has taken the main role in cloud computing adoptions although the fastest in terms of growth is the IaaS. This implies providing way to growth in the PaaS. The report indicates that SaaS is the most popular with current (year 2013) 63% from 55% a year before. However, IaaS recorded a 29% annual increase making it the fastest while PaaS is forecasted to grow fastest in the next five years. A growth in IaaS or PaaS indicates application development activities.

Some of the reasons or benefits that have led organizations migrating to cloud computing are:
- Cloud computing is being perceived as a new paradigm or next generation platform for future practices and philosophy of computing.
- Cost savings in operation, development and fast deployment of software with less failovers. There is no consideration for hardware or software for cloud services.
- Resources such as data, applications, tools and web services can be accessed from anywhere on the Internet and offers a one-stop facility for software development. It also offers easy integration of these resources with other enterprise solutions.
- Offers highly customized computing infrastructure online using the Web 2.0 strategy. These are provisioned in a convenient, task-centric, on-demand manner to a shared pool of configurable computing resources such as networks, servers, storage and applications.
- Cloud computing is collaborative, facilitating software development practices such as those of agile development methodologies.

- Cloud computing offers legal and good conditions to use less energy and waste fewer resources [2] - [3] & [14].

Certain drawbacks that are associated to cloud computing especially in the absence of a cloud computing adoption framework are as follows:
- Security concerns
- Data ownership concerns
- Lock-in and interoperability concerns
- Enterprise Support and Service Maturity
- Requirement for online connectivity
- Anxiety within developers about a new cloud computing platform without appropriate guidance and understanding of how to effectively utilize cloud computing standard architecture [4] - [5].

E. Software Engineering and Agile Development Methodologies

The early software applications until the 1960s were largely developed devoid of an explicit information system development methodology. These practices brought about a number of challenges in user satisfaction ranging from cost, time and scope perspective. After this era a number of thoughtful efforts such as Systems Development Life Cycle (SDLC) have been made to understand the software development process. These efforts were mainly done in order to improve the quality of software during and after its development by addressing challenges of the previous unconventional era [28].

The result of these efforts has been value addition to the final software product and improvement in delivery times. However, these achievements could not preclude technical challenges as well as development process skills that continue to affect the SDLCs [29]. In South Africa, it is common to find problems within developing organizations such as software failures, budget over runs and late delivery to satisfy clients who are in need of quality software due to problems that are everywhere within the development environment. Mostly, these are associated with incomplete user requirements.

Newer approaches such as agile methodologies were introduced to software development in order to address issues of software quality although the quality aspect has been and continues to be subject of research in the software engineering domain. In agile development, the quality aspect is inherent in the development process. Agile methodologies are an alternative to traditional waterfall approach of software development. It can be defined theoretically as a group of software development processes that are iterative, incremental, self-organizing, and emergent [30].

With agile methodologies, prescribed values, principles and practices are recommended for successful software project implementation [30]. Agile development requires distinctive tools such as feedback, transparency in communications, and time-boxing. Therefore, organizations that adopt agile methodologies need to implement an environment with an integrated toolset comprising tools for measurement, bug tracking, design, analysis, testing, coding, business intelligence and critiquing, just to mention a few. In addition, open source tools and proprietary tools need to be carefully coordinated to deliver successful projects [11]. Success in this context means delivering a software product within the agreed time and budget constraints and at the same time meeting the anticipated user requirements from the project sponsor [31].

In principle, cloud computing environment facilitates speedy provision of tools and infrastructural resources to agile development teams who also add value by continuous development of a software product through iterations and incremental approach.

Research shows an increase in the adoption of agile methods by developers in South Africa. However, there is little evidence to show which specific agile methodology is being adopted. The development platform has mostly been on stand-alone and traditional client-server architectures. However, as observed from [9], application development within the cloud environment by SMMEs within South Africa is evident but it is not clear that these adoptions involve agile methodologies. World-wide agile development in cloud environment has been successful although these experiences are only for large companies [32].

Considering the benefits of cloud computing, SMMEs agile software development adopters can enjoy faster, production, improved quality and more flexible and collaborative processes that embrace change. Some benefits include the following:

- Automated build in the cloud. Development organizations would reduce costs by using virtualization in accelerating their work through existing images residing on multiple platforms. This reduces utility pricing on servers as compared to the use of dedicated servers.
- In the cloud environments, access to production environments is quicker and supports automated production deployment. This results in reduction of feedback cycle within the technical team and business owners.
- Development teams are able to use virtualization aspect of cloud computing for unlimited number of servers and be able to do parallel work within the agile philosophy. Successful Agile development projects depends on strong and extensive communications.

- The virtualization aspect of cloud computing will facilitate quicker provisioning and testing of code while at the same time developing and testing a new version. Cloud testing allows substantial advances in speed and agility by using multi-platform testing on virtual images. Unit tests can be done in parallel on cloud machines which also results in cost serving as compared to using dedicated servers.
- Exploration and innovation within a team by trying new ideas on server working environments [25].

While cloud computing has the capability of facilitating agile development practices in theory, the actual practical aspect has some challenges arising from non-technical and technical assumptions and constraints. Some challenges as depicted from an industry expert [33] include non-technical problems such as inadequate training, poor leadership, and rigid adherence to agile principles that do not fit into the project. Technical problems arise from Internet access and its assumptions about co-locations, latency, and errors cannot be easily made. As a result, problems such as not having required meetings, inadequate documentation and issues related to short iterations are experienced. In addition, due to the fact that computing resources can shrink and grow on demand requires proper planning if the benefit of cost saving are to be realised while keeping good qualities of service, otherwise this may affect development processes [1]. Some guidelines in form of a framework on migration are necessary to aid these SMMEs in making decisions on how to maximize benefits and optimize usage of cloud environment.

III. ANALYSIS

The current rate of emergence of cloud computing poses a big challenge for the need to embrace it. For many reasons outlined by [2], [4]-[5], [13], [15]; [23], [25]-[26] & [32], it is an indication that we are sitting at a critical stage of the most significant trend in information technology industry. Despite the explosion, there has been no clear contextual definition of cloud computing while at the same time it is crucial to understand the requirements and challenges of cloud applications if one has to fully benefit from its environment [13]. This is a problem, for instance, agile development proponents would like to emphasize certain characteristics of cloud computing to meet their goals. Hence the need to define its own cloud computing framework within their requirements and use.

Without a framework and specific cloud computing description, there are a number of challenges that are likely to be experienced especially by SMMEs as they decide to migrate to the cloud environment such as anxiety within developers about a new cloud computing platform without appropriate guidance and understanding of how to effectively utilize cloud computing standard architecture. These problems are likely to emerge from the perspective of

technical and non-technical limitations [9] & [11]. Literature has shown that there are several frameworks and decision models for cloud migration [34]. However, agile migration is the most desired and concerns raised by the researchers are on some critical aspects associated to agile that are lacking in current frameworks.

IV. PROPOSED FRAMEWORK

Based on literature surveyed in this research on current trends in cloud computing and agile software development practices, we propose to develop a framework that addresses the following problems:

- Identify factors necessary for successful migration of SMMEs that are using agile development to cloud computing;
- Determine effective interactions among the factors that contribute to successful migration; and
- Provide guidelines to SMMEs agile developers in South Africa for effective transition into use of cloud without compromise on software quality.

In order to achieve the above, an innovative approach is required to leverage all the benefits of cloud when used with agile software development so as to mitigate technical and non-technical challenges. We therefore hypothesize framework building with the following considerations:

- Important factors to consider in migrating agile development methodologies to cloud computing.
- Management of the process of migrating agile development methodologies to cloud.
- Roles of different stakeholders within and outside the organization in ensuring successful migration.

Table 1 shows a framework exposition that addresses proposed activities and information required for the framework in order to address envisaged challenges during the migration process.

Activity	Information Required for Framework	Variable(s) and/or Relationships measured
DETERMINE EXISTING ENVIRONMENT	Agile methodology in use Cloud computing services in use/required Type of applications and tools in use/required to develop software in cloud computing environment Perceptions held by agile software developers with respect to cloud computing	These will be identified through the coding of interviews transcripts, observation schedules. Literature and document reviews. Tests : Content Analysis and Correspondence Analysis
DETERMINE AND EVALUATE CONDITIONS FOR SUCCESSFUL MIGRATION	Factors responsible for success in migrating organisation's agile development to cloud computing Difficulties or weaknesses encountered during the process of migrating to cloud computing Factors responsible for the difficulties and weaknesses during the process of migrating to cloud computing	These will be identified through the coding of interviews transcripts, observation schedules. Literature and document reviews. Tests : Content Analysis and Correspondence Analysis
DETERMINE ACTION/INTERACTION BETWEEN MIGRATION SUCCESS FACTORS	Interaction between factors that are responsible for success in migrating to cloud computing Interaction between factors that are responsible for the difficulties/weaknesses in successful migration Relationship between factors that account for success and those that account for difficulties and weaknesses?	These will be identified through the coding of interviews transcripts, observation schedules. Literature and document reviews Tests : Content Analysis and Correspondence Analysis

Table 1: Activity versus Information Requirement for Framework

V. CONCLUSION/FUTURE WORK

Developing software in a cloud computing environment differs from the traditional approach. It makes it even more challenging when methodologies such as agile are used due to the fact that there is great need for interaction both technical and non-technical (such as sharing applications or development tools, communication and coordination) during development and deployment processes.

In this paper, a conceptual framework is proposed yet to be tested empirically through further investigation. The main thesis of this paper is that the migration process to cloud computing by SMMEs should be guided by a framework in order to mitigate all the challenges that are associated to cloud computing environments.

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CLOUD COMPUTING FRAMEWORK FOR AGILE DEVELOPMENT

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Abstract

The emergence of cloud computing is influencing how businesses develop, re-engineer, and implement critical software applications. The cloud requires developers to elevate the importance of compliance with security policies, regulations and internal engineering standards in their software development life cycles. Cloud computing and agile development methodologies are new technologies that have come with new approaches in the way computing services are provisioned and development of quality software respectively. However, the synergy between the two is bonded with technical and non-technical challenges. In this paper, a conceptual framework is proposed to support the process of migration of South African small, medium and micro enterprises (SMMEs) who are using agile software development methodologies to cloud computing environment. The framework is also analysed based on critical cloud computing adoption factors as recommended from previous studies on SMMEs adoption practices.

Keywords: Cloud Computing, Agile Development Methodologies, SMMEs.

1. INTRODUCTION

Cloud computing is trending within social and corporate realms and experts believe that it will reshape information technology processes in the next few years (Armbrust et al., 2009). Cloud computing affords traditional and ubiquitous smart end user devices such as PCs, tablets and mobile smart phones to access computing services that include software applications, storage facilities, processing and application development by connecting to the Internet through Web 2.0 (Buyya, Yeo, Venugopal, Broberg, & Brandic, 2009). These resources are provided and kept by providers who are remotely situated. There are generally four cloud deployment models: *private cloud* - the company owns and controls its infrastructure and applications running behind a firewall with virtualization, tools and policies including deployments; *public cloud* - resources and applications are offered as services on a subscription basis by providers; *hybrid cloud* – a mix of public and private clouds and *Community cloud* provides an infrastructure shared by more than one organisation. Each of these deployments have advantages and disadvantages associated with them (Marinescu, 2012; Mell, Grance, & Grance, 2011).

The whole cloud computing model is attractive to users of different needs as it provides the following benefits: cost saving in operation, development and fast deliveries; resources such as data, applications and tools can be accessed anywhere and by any Internet ready device with Web 2.0; offer customized computing infrastructure with convenient task-centric, on-demand way of sharing configurable shared pool of resources; facilitates collaboration and provides good conditions for green computing (Buyya, Yeo, Venugopal, Broberg, & Brandic, 2009; Marinescu, 2012).

Despite being endowed with benefits, cloud computing has challenges such as security concerns; data ownership concerns; lock-in and interoperability concerns; enterprise Support and Service Maturity; requirement for online connectivity and; anxiety among developers about a new cloud computing platform without appropriate guidance and understanding of how to effectively utilize cloud computing standard architecture (Conway & Curry, 2012; Venkatraman & Wadhwa, 2012).

In spite of significant challenges that the technology platform faces, many users, vendors and industry observers predict an optimistic future for cloud computing (Buyya et al., 2009). Worldwide, some agile developers have migrated to cloud computing environment. For instance, the R&D of Salesforce motivated migration of all software development to the cloud environment (Salesforce, 2008). However, it is evident that this migration to private cloud has mainly involved large scale companies that have the capability to create private cloud infrastructures of their own with easy access to resources and tools. Small, medium and micro enterprises (SMMEs) on the other hand have challenges in adopting private cloud computing for reasons such as lack of capital base for investing in cloud infrastructure that will accommodate all resources needed for their development activities. This leaves them with the option of subscribing to

public clouds only. This puts them at a disadvantage and subjected to the challenges of cloud computing associated with public clouds.

The South African Government currently considers SMMEs as vital enterprises for the economy (Berry et al., 2002). They contribute 56% of private sector employment and 36% of gross domestic product (Fatoki & Smit, 2011). According to the National Small Business Act (1996), an SMME in South Africa's finance and business services sector is an organisation of micro-business which employs up to 5 employees, or a very small business employing of up to 10 employees, or a small business employing up to 50 employees, or a medium sized business employing up to 100 employees.

A significant adoption of cloud computing solutions in South Africa especially for business owners who are technologically proficient has been observed. These adoptions have mainly been in web hosting and ecommerce (94%), email hosting/archiving (75%), customer Relationship Systems (58%), configuration and data backup (58%) and application development with 40% (Hinde & Van Belle, 2012). It will be interesting to investigate application methodologies, programming environments and tools used by these organisations who have adopted cloud computing as it was not part of Hinde & Van Belle (2012)'s study. Reason being that, certain development methodologies such as agile emphasize specific practices that may bring about issues in the form of non-technical and technical problems associated to cloud computing environment. User/developer communication limitations and programming environment lock-in are examples of non-technical and technical problems respectively (Khajeh-hosseini, Greenwood, Smith, & Sommerville, 2012; Sillitti & Succi, 2004).

It is against this background that this research paper aims at proposing a framework based on apparent characteristics, practices and contexts that are critical in agile development processes in order to determine successful migration to cloud computing specifically for SMMEs in the South African context. According to Sahandi, Alkhalil, and Opara-Martins (2013), a global phenomenon of cloud computing adoption in the SMMEs sector is evident; however, this research is specific to the South African context due to its unique standards and regulatory frameworks that guide Internet use.

It is envisaged that the framework will contribute to; 1. Theoretical knowledge and perceptions of technological innovation adoption frameworks as applied to agile development methodologies and cloud computing environment; 2. Determine effective interactions among the factors that contribute to successful migration; 3. Will provide guidelines to SMMEs in South Africa who are

using agile development methodologies in effective transition into use of cloud computing without compromise on software quality.

The rest of this paper is organized as follows: Section 2 reveals the available literature on cloud computing environments and software engineering with a focus on agile development methodologies. In Section 3, an analysis of problems arising from developing on the cloud environment are discussed. Section 4 proposes a framework. Finally, the paper ends with a conclusion and recommendation for future work.

2. BACKGROUND

Cloud computing has over the last decade been a catchword in the computing circles and has escalated promises of a new paradigm shift in the manner in which computing services are provisioned to users individually as well as an organisation computing (Buyya et al., 2009; Pallis, 2010). Its use currently involves users using services on different levels of its architecture computing (Buyya et al., 2009; Marinescu, 2012; Mell et al., 2011). Users get access to services that include storage, access to application software, processing and application development by using various devices such as smart phones, laptops, personal computers etc. (Buyya et al., 2009). In addition to this, there are other benefits such as cost savings, increased capacity and capabilities to Information Technology departments.

While there has been apparent significant benefits in the use of cloud computing, adoption of cloud technologies is still faced with doubts by many would-be users due to some challenges such as those of security, privacy, lock-ins and uncertainties in the regulatory frameworks (Conway & Curry, 2012; Venkatraman & Wadhwa, 2012). However, there has also been substantial research in this area especially addressing challenges of the technology offerings as it will be discussed in this literature review.

2.1 HISTORICAL PERSPECTIVE AND DEFINITION OF CLOUD COMPUTING

The dawning age of cloud computing spans long before the advent of the Internet where researchers had a vision of what was termed as computer utility. For instance, in 1961, Professor John McCarthy predicted that computing would in future be structured like any other public utility such as telephone or electricity (Arutyunov, 2012). The cloud computing ideology can also be traced back to Advanced Research Projects Agency Network (ARPANET) in 1969 when Joseph Carl Robnett Licklider visualized a network of data and programs interconnected for everyone to use globally (DARPA, 1981). All these ideas had a theoretical concept of commoditizing computing services by providers who would make available services according to user requirements.

The philosophical ideas of the 1960s were introduced in the mainframes or datacentres managed by computer companies such as IBM from single installations. These were characterized by "dumb terminals" that never had any processing capacity but totally dependent on connectivity with the mainframe or minicomputer (Marshall, 1990). The target users were mainly corporate or Government institutions who also actually set them up internally due to the complexity and huge cost of maintaining them.

However, during the early 1980s, most organisations started acquiring personal computers and workstations which emerged within affordable levels. This technological landscape was perceived as bringing to an end the original utility computing philosophy. The personal computers brought about the second wave of computer revolution that focussed on digitalization where users were increasingly using computers for documents, spreadsheet and databases (Barnatt, 2010). By the 1990s, as digitalization extended to storage of pictures, company documentation, music, video etc., it started to become almost impossible to store these forms of digitized information on stand-alone computers. This led to traditional systems of client-server architectures that accommodated a dedicated storage or application server of which individual PCs would connect to and access required information (Berson, 1996).

Since the beginning of the new millennium, a new wave of computer revolution started to emerge. This new revolution calls for "atomization" and "ubiquitous computing". Atomization is the opposite of digitization that entails digital content to be turned back into atoms that can be realised by vision, touching and hearing. Ubiquitous computing involves development of non-traditional computing devices that promote atomization Barnatt, 2010. For instance, smart phones and iPods are ubiquitous computing devices.

This type of requirements has led to the rise of cloud computing which in a way also has evolved through a number of stages that includes grid and utility computing, application service provision (ASP) and Software as a Service (SaaS) (Marinescu, 2012; Desai & Currie, 2003).

Cloud computing creates a situation where a user application accesses computing resources through a type of service and not necessarily directly by talking to the specific CPU for processing or hard drive for storage. A precise definition of cloud computing can be difficult to define due to the fact that different technology specialists would go for different emphasis in their definition rather than most end-users. Gartner defines cloud computing as a style of computing where massively scalable IT related capabilities are provided "as a service" across the Internet to multiple external customers while Forrester defines it as a pool of

abstracted, highly scalable, and managed infrastructure capable of hosting end-customer applications and billed by consumption (Gartner, 2013); while IBM states that it is an emerging computing paradigm where data and services reside in massively scalable data centres and can be ubiquitously accessed from any connected devices over the internet (Gartner, 2013; Staten, 2008).

The world's developer of international standards, The International Organisation for Standardization (ISO) is still crafting cloud computing definition paradigms (ISO/IEC JTC 1/SC. 2011, August). Currently, The National Institute of Standards and Technology (NIST) offers a succinct definition which describes cloud computing as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Mell et al., 2011). Building on this, the user's perspective can in this manner mean cloud computing being dynamically scalable, device-independent and provides task-centric resources that are accessed from the Internet at a charge as per use basis from service provider's infrastructure (e.g., Google Apps. Amazon EC2, or Salesforce.com.

With the evolution of the web to 2.0, it is prudent to speculate that cloud computing technology is geared to achieve the philosophical objective of making computing services as the 5th utility after water, electricity, gas and telephony computing (Buyya et al., 2009). It entails a radical move from the traditional client-server architecture into web service.

Figure 1 below shows the difference between a traditional computing (client-server) model and the cloud computing model. The first part (1a) in Figure 1 shows traditional client-server settings where local software is installed and data stored on personal computers. Users of these personal computers have access to enterprise applications, data storage including processing power from corporate servers (data centres). In case of software development, all the development tools and necessary databases are either stored on the local server or personal computers. The Internet is not a critical requirement until deployment time or only if there is need to access some websites and communication in terms of emails.

The second part (1b) of Figure 1 shows the cloud computing model. In this scenario, software applications and data are not stored on user's or corporate computing devices but in the cloud. In this case, Internet connectivity is critical to have access to the required resources. Unlike in the traditional architecture, the cloud computing model requires third parties in order to facilitate access to resources. That is, you need an Internet service provider and a cloud

services provider. Challenges of cloud services provision emanate from around these third parties (Ren, Wang, and Wang, 2012). For example; trust on how secure a connection is and not to allow intrusion.

Figure 1. Comparison of Traditional and Cloud Computing Models
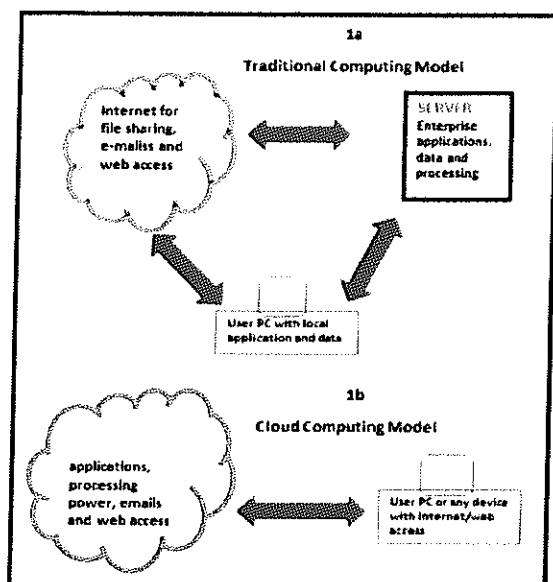
Source: (Barnatt, 2010)

Cloud computing has essentially five characteristics that are supposed to be available in its infrastructure, namely; on-demand self-service, broad network access, resource pooling, rapid elasticity and; measured service (Sitaram & Manjunath, 2012).

On-demand self-service aims to reduce the configuration tasks from the user's point of view where resources such as the compute, storage or platform are self-provisioned or automatically configured. Other than creating accounts on a service provider, a user may not interact physically with the service provider's staff to have access to resources. Broad network access is a ubiquitous characteristic that allows access to resources using any device such as phones, PCs etc. as long as it is connected to the Internet and running a web browser. Resource pooling implements virtualization and multi-tenancy by supporting many concurrent users. Rapid elasticity creates a service platform or resource that increases or decreases according to user requirements. It is possible to declare the number of servers that one needs. This significantly aids cost saving in capital investments where organisations would not invest in computing resources that are often idle. Measured service is a "pay as

you go" facility that literally removes the element of computing equipment being a fixed cost (Barnatt, 2010; Sitaram & Manjunath, 2012).

2.2 CLOUD DEPLOYMENT MODELS

There are four different ways in which cloud services can be deployed depending on the structure of an organisation and the provisioning location. Mell et al. (2011) defined cloud computing deployment models as private cloud, public cloud, community cloud and hybrid cloud.

Private cloud is the most secure and risk-averse cloud that has the whole cloud infrastructure belonging only to a single organisation (Armbrust et al. 2010). Normally, private clouds are considered a step to the growth of a corporate data centre where the organisation shares in-house infrastructure for cloud services. Mainly targets virtualization solutions for mission critical applications with demands for high security and low latency, and custom service levels. The main advantage is that the organisation has full control over its data, security aspects and performance. Ideally, the cloud user owns this infrastructure. This implies that such organisations should have the necessary capital outlay to host such infrastructures which in some cases result in poor economies of scale. Usually SMMEs do not have such capability, making this option unfeasible for them.

Public cloud are in real sense the early manifestation of cloud computing. The cloud infrastructure owned by a service provider that offers cloud services to the public on commercial basis, available through a public network; the Internet. Cloud services are usually sourced from very large resource pools that are shared by many other clients specializing in elastic workloads such as software development and testing application. They are synonymous to plants or factories that cater for services or utilities to clients on as demand and with size of requirement arises. Structurally, they are distributed systems consisting of one or more data centres. They are normally considered an attractive option for SMMEs because they provide an economical plan for organisations to reduce IT costs and capital expenditure. SMMEs are capable of starting up or running a business with a rent an infrastructure option without an upfront capital investment in IT services. However, since public clouds are meant to serve many users on the same infrastructure, a multitenancy characteristic is created. A number of issues such as security, QoS performance management etc. are associated to this multi-tenancy effect (Ren et al. 2012). Other concerns evident in the public cloud are issues of data ownership, lock-ins, interoperability, support maturation and connectivity (Sitaram & Manjunath, 2012). Most popular public cloud providers are proprietary overlooking the challenges mentioned due to lack of cloud computing standardization.

Examples of some well-known public clouds are the Amazon Web Services (AWS) comprising of the Elastic Compute Cloud (EC2) and the Simple Storage Service (S3) which form an IaaS cloud offering and the Google App Engine which offers PaaS to its clients.

Community cloud provides an infrastructure shared by more than one organisation that have similar interests for serving a particular community. Interests can be of an industry or a business sector nature. According to NIST, "the infrastructure is shared by several organisations and supports a specific community that has shared concerns (e.g. mission, security requirements, and policy or compliance considerations). It can be managed by organisations or third parties and may exist on premise or off premise". It differs from public cloud in the sense that cloud services are provided for a certain need of end users rather a multitude of needs to different users as in the public cloud. It also differs from the private cloud due to the fact that cloud services are not provided and owned by one organisation. Architecturally, community clouds are usually implemented over various administrative domains. An example of a community cloud would be a scientific research community sharing a large distributed infrastructure. Another example would be a community of SMMEs sharing common infrastructure in application development. However, the problem is that community clouds would require hosting standard software which may not be appropriate for organisations with different approaches to software development.

Hybrid clouds are a combination of different deployments (Armbrust et al. 2010). For example, a company may decide to run its software applications on a public cloud but make storage on its private cloud. This arises in cases where private clouds are unable to meet user's quality of service requirements. They allow organisations to exploit their own IT infrastructure for maintaining sensitive information within locations at the same time be able to grow and shrink by provisioning external resources which they are able to release when not needed. Common workloads are those of regulated data that require elasticity and agility such as Business Intelligence solutions. They are sometimes referred to as heterogeneous cloud due their heterogeneity nature in distributing integrated services or resources from one or more clouds (Buyya, Vecchiola & Selvi, 2013). Being hybrid make them inherit problems of associated deployment models.

In this study we focuses on public clouds as SMMEs do not have capacity to invest in private clouds.

2.3 Cloud Technologies

In order to replace the traditional client-server approach with cloud computing, there are basically three options or service types in which services can be provisioned. These

are: 1. Software as a Service (SaaS); 2. Platform as a Service (PaaS) and; 3. Infrastructure as a Service (IaaS) (Marinescu, 2012).

Figure 2 shows the services types and their relationships. SaaS is designed to provide applications as a service to end users. The approach is to provide off-the-shelf and existing web applications. Users can access the applications and still be able to customise it to their conditions and requirements. In case of off-the-shelf application not being present in the cloud infrastructure, then the SaaS becomes unsuitable. Then the user may have to use other service types that allow application development. SaaS is currently the most noticeable and used in the cloud as it mostly deals with end user software packages such as word-processing and spreadsheets. Example SaaS services are those from Google Docs and email services such as Gmail, Hotmail and Yahoo mail (Barnatt, 2010; Sitaram & Manjunath, 2012).

PaaS is designed to provide a platform service mainly for online application deployment for developers. The platform entails the operation system and the hardware associated with it. An environment is created to allow software development including test runs using development tools that are present within that particular service provider's cloud infrastructure (Barnatt, 2010; Sitaram & Manjunath, 2012). It also facilitates speed of programming by automating some coding tasks and allows programmers to work on their programming languages and associated tools. Hence, technical programming knowledge and skills are necessary for most use of PaaS offerings. Therefore this service type is suitable for companies that choose to cloud compute or development of software although it can be restrictive in terms of resources provided by the cloud provider leading to the problem of vendor lock-in. A vendor lock-in is a situation created when a user of a service or product fails to easily change to another competitor's service or product due to incompatible proprietary technologies. An example of PaaS is the App Engine offered as service by Google which can allow any user to write new cloud applications and be able to deploy them to the web using the Google's cloud infrastructure (Barnatt, 2010; Sitaram & Manjunath, 2012).

The IaaS service type is a major cloud computing development meant for IT operators. It has a capability of offering services of processing, storage, networks and many other vital computing resources where a user is able to deploy and run arbitrary software (Mell et al., 2011). It includes services such as operating systems and applications. Without control of the underlying hardware in the cloud infrastructure, the user has control over the operating systems, storage, deployed applications and some limited control over networking components. Cloud providers of this service rent out servers using a process called virtualization. Server virtualization involves masking and

pooling of server resources. For example, one physical server may be configured using a special administrator software into multiple virtual servers (machines) and each acts like a distinctive physical device, capable of running its own operating system (Barnatt, 2010). In cloud computing, these virtual servers are mostly referred to as instances. The IaaS service provider can either offer dedicated physical servers or virtual server instances. Although, these two services can perform the same functions, virtual instances are sometimes regarded as insecure especially by users who do not want to share server hardware with others. For this reason, some customers may choose to use specific deployment models like private cloud only or a combination depending on the security requirements of their services or products. One example of IaaS vendors is the Amazon Web Services (Barnatt, 2010; Sitaram & Manjunath, 2012).

Figure 2. Relationships between Service Types
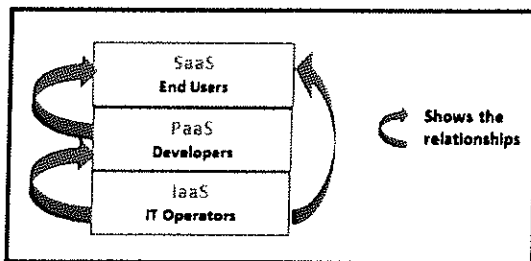
Source: (Barnatt, 2010; Sitaram & Manjunath, 2012).

2.4 CLOUD TECHNOLOGIES.

Considering current demand from work and personal needs for online engagements and growth of the web, cloud computing could be a manifestation of a new paradigm of a large-scale distributed computing utility for business and society solutions (Pallis, 2010).

The South African e-government initiative strongly supports IT research in development of solutions that are directed to the future IT trends and offering (Department of Public Service and Administration-Republic of South Africa, 2001). Research studies on SMMEs using cloud computing have been conducted widely in South African and at an international level. We reviewed a few studies and decided to cite two local studies mainly because most of the studies had a common approach and presented the similar results although in different contexts.

The first local study was conducted by Hinde and Van Belle (2012) on cloud adoption by SMMEs in South Africa. The study showed a potential growth in cloud computing and that slightly over 52% of respondents accepting cloud adoptions. In the same study, 65% were aware of cloud

computing existence, 25% thought it was for bigger companies and 34% had an adoption model in place.

The second study by Schofield (2013) conducted with the research team of Johannesburg Centre of Software Engineering (JCSE) summed up surveys conducted in the last two years of the study which included SME Survey 2012 (Goldstuck, 2012) involving 2,000 respondents; Microsoft SMB Cloud Adoption Study 2011 (Microsoft, 2011) involving 3,258 respondents and IDG Cloud Computing Survey 2013 (IDG Enterprise, 2013) involving 1,358 respondents. The majority of companies considered in these studies belonged to the SMME category (employing up to 100 employees).

The study results agreed with Hinde and Van Belle (2012)'s findings on cloud computing adoptions. The study concluded that company owners, who were technologically capable, appreciated the value of cloud computing in usage as well as economical use as compared to those who did not understand it. Further, challenges of cloud computing such as security, bandwidth connections were also highlighted as impediments to making adoption decisions.

Going further, a study based in UK showed that SMMEs stand to benefit in reducing, costs, improving flexibility and scalability when they decide cloud computing migration. However, issues relating to security, vendor lock-in, and technical hitches with data privacy and data protection need attention (Sahandi et al. 2013). In another report, The European Commission technical report on ICT – Information and communication Technologies - Work programme 2013, a recommendation was made to strengthen software and services technologies by exploiting Internet-based services such as cloud computing. It also recommended that adoption of cloud computing should be taken with careful consideration of legal, socioeconomics and technical issues. In conclusion, the report indicated that the potential of cloud computing and its models has not yet been fully exploited in terms of development and research to the degree of full utilisation by stakeholders (European Commission, 2013).

Based on industry commentaries, it is interesting to note that although South African organisations have approached adoption of cloud computing with scepticism, South Africa has however taken a critical role in cloud computing adoptions in Africa. This is according to Sudarshan Roongta, vice-president of Oracle's Industry Strategy and Insight programme for Europe, the Middle East and Africa (EMEA) (itWeb, (n.d.).

SMMEs have taken a leading role in adoption followed by large enterprises. Roongta reported that 66% of enterprises in South Africa have shown "very high" confidence in the security aspect of the cloud services and only one in 10 of the decision-makers have no trust in cloud

security. This has made the security concern dropping to the third on the list of other challenges. The recent investment in the Telcos and access to international bandwidth has improved the reliability of cloud computing. He noted that by end of 2014, adoption rate in South Africa will increase from the current 56% to 66% being led by the retail and mining sectors. According to him, the Compound Annual Growth Rate (CAGR) of 35% and an investment worth $215 million would be realized in 2017. Some other useful statistics that Roongta also reported are:

- Globally, cloud computing is taking the mainstream with 82% adoptions in SaaS; 52% cloud storage; 36% IaaS; and 21% adopting hybrid cloud;
- In terms of cloud usage, most organisations (57%) are using it for human resources; 54% for e-mail collaboration; 52% for sales and marketing; 51% for customer care; 42% for supply chain; 41% for finance; 36% for sourcing; and 35% for operations management.
- 70% of the respondents indicated that cloud computing is providing tangible cost savings.

On an international arena of industry analysis, statistics from North Bridge (2013), an active partner for early-stage entrepreneurs providing seed-to-growth financing for innovative companies looking to disrupt big markets in America, indicated that SaaS has taken the main role in cloud computing adoptions although the fastest in terms of growth is the IaaS. This implies providing way to growth in the PaaS. The report indicates that SaaS is the most popular with current (year 2013) 63% from 55% a year before. However, IaaS recorded a 29% annual increase making it the fastest while PaaS is forecasted to grow fastest in the next five years. A growth in IaaS or PaaS indicates application development activities.

[44] predicts IT cloud services will have a CAGR of 23.5%, five times that of the IT industry as a whole over the 2013–2017. Another study on current actual adoption rate from a study by TheInfoPro (2013), a service entity of 451 Research, predicts an average growth rate of 36 % from this year until 2016. This study was conducted during the first six months of 2013 and involved IT management and primary decision makers of medium sized to large organisations in Europe and North America. Some notable findings in this study were:

- That sixty percent respondents believe that cloud computing is a natural evolution of IT service delivery and do not need to allocate a budget it. Out of those with a separate budget for cloud computing also believe that their spending will increase in 2013 and 2014 as compared to previous years.
- Iaas and SaaS activity has doubled to levels between 35% and 33% on projects declared, with 35%

respondents indicating that private cloud activity are dominating.
- Despite increased cloud computing activity, 83% of the respondent have challenges in deploying their cloud computing initiatives. Mostly the challenges are non-technical but lie with the domain of processes, people, policy and organisational issues.

Jacobs (2013) of ITWeb, indicated that Gartner's predictions has positioned cloud computing to number four out of the top ten technological trends for 2014 with a bulk of new IT spend in 2016.

Considering Schofield (2013), Hinde and Van Belle (2012) and Roongta's report, we can confidently conclude that there is a positive trend in the growth of cloud computing in the South African context. However, we still not clear on the levels of cloud adoption of PaaS services specifically for software development purposes.

Some of the reasons or benefits that have led organisations migrating to cloud computing are:

- Cloud computing is being perceived as a new paradigm or next generation platform for future practices and philosophy of computing.
- Cost savings in operation, development and fast deployment of software with less failovers. There is no consideration for hardware or software for cloud services.
- Resources such as data, applications, tools and web services can be accessed from anywhere on the Internet and offers a one-stop facility for software development. It also offers easy integration of these resources with other enterprise solutions.
- Offers highly customized computing infrastructure online using the Web 2.0 strategy. These are provisioned in a convenient, task-centric, on-demand manner to a shared pool of configurable computing resources such as networks, servers, storage and applications.
- Cloud computing is collaborative, facilitating software development practices such as those of agile development methodologies.
- Cloud computing offers legal and good conditions to use less energy and waste fewer resources computing (Buyya et al., 2009; Marinescu, 2012; Mell et al., 2011).

Certain drawbacks that are associated to cloud computing especially in the absence of a cloud computing adoption framework are as follows:

- Security concerns
- Data ownership concerns
- Lock-in and interoperability concerns

- Enterprise Support and Service Maturity
- Requirement for online connectivity
- Anxiety within developers about a new cloud computing platform without appropriate guidance and understanding of how to effectively utilize cloud computing standard architecture (Conway & Curry, 2012; Venkatraman & Wadhwa, 2012).

Generally, technology innovation adoption models and frameworks have been thoroughly invested and applied in information technology projects. For instance, the Technology, Organisation and Environment model (TOE) (Tornatzky, Fleischer & Chakrabarti, 1990; Hage, 1980), Diffusion of Innovation (DOI) (Rogers, 1995) and the Technology Acceptance Model (TAM) (Wixom & Todd, 2005). These models have also been combined in certain adoptions just to meet the requirement of the technology situation (Oliveira & Martins, 2011).

In most of these models, an element of social context has been considered very critical (Tornatzky et al., 1990). More recently, Werfs, Robert, Baxter, Allison and Sommerville (2013) considers that adaptive social-technical issues can inform adoption processes of disruptive technologies such as cloud computing. These involve complex interaction among humans, technology and the environment.

With specific reference to cloud computing, we found a wealth of literature on cloud computing adoptions of which may also be applicable to SMMEs in the South African context. We reviewed the Cloud Computing Toolkit by Khajeh-Hosseini et al., (2012) which has not yet reached maturity, the cloud adoption Goal-Oriented Requirements Engineering Approach (GORE), an interactive process of adoption (Zardari & Bahsoon, 2011), Bidgoli (2011)'s six step process model that does not pay much attention to organisational issues and finally the Alshamaila and Papagiannidis (2013) analysis of the TOE based on the SMEs in the UK.

In this research we, consider the cloud computing adoption using Alshamaila and Papagiannidis (2013) analysis. The reason for this choice is motivated by the fact that it is more recent, involved SMEs and the process framework addresses most of issues associated to information technology companies. The main factors which were found to be playing a critical role in the adoption process were relative advantage, uncertainty, geo-restriction, compatibility, trialability, size, top management support, prior experience, innovativeness, industry, market scope, supplier efforts and external computing support.

Those that fall in the technology context are as follows:

- **Relative advantage:** refers to as: "the degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers, 2003). It is considered as a central indicator to adopting a new technology in information systems innovation. The probability of adoption is enhanced when a business realizes a relative advantage in an innovation (Thong, Yap & Raman, 1994; Lee, 2004).
- **Uncertainty:** referred to as "the extent to which the results of using an innovation are insecure (Fuchs, 2005). This indicates knowledge deficiencies on an innovation by stakeholders. In the case of cloud computing lack knowledge expertise in areas such as security, privacy and lock-in are evident especially for SMMEs.
- **Geo-restriction** is the uncertainty factor about data location. There is a possibility that consumers may not be able to know the exact location where their data is stored and processed. Depending on need, consumers should be allowed to sign SLAs with an option of knowing about data location.
- **Compatibility:** Refers to: "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (Rogers, 2003). Compatibility is considered an important factor of an IT innovation (Rogers, 2003).
- **Trialability:** Refers to: "The degree to which an innovation may be experimented with on a limited basis" (Rogers, 2003).

The organisation context has the following factors:

- **Organisation Size:** this refers to the organisational size (Alshamaila & Papagiannidis, 2013). Small businesses are more motivated to adopt cloud services.
- **Top management support:** Refers to: the plan of action that dedicates time for ICT program in relation to cost and potential, plan reviews, results follow-ups and coordinating integration of ICT with management processes of business (Young & Jordan, 2008).
- **Prior technology experience:** Refers to "the extent of a user's experience with previous similar technologies" (Lippert & Forman, 2005).
- **Innovativeness:** Refers to: "the extent to which a client adopts innovations earlier than other members of the same social context" (Rogers & Shoemaker, 1971).

Finally, the environmental context involves the following factors:

- **Industry:** Refers to: "the sector to which the business belonged" (Goode & Stevens, 2000).
- **Market scope:** Refers to: "the horizontal extent of a company's operations" (Zhu, Kraemer & Xu, 2003).

- **Supplier efforts and external computing support:** Refers to: "the supplier activities that can significantly influence the probability that an innovation will be adopted "(Frambach, Barkema, Nooteboom, & Wedel, 1998).

2.5 SOFTWARE ENGINEERING AND AGILE DEVELOPMENT METHODOLOGIES

Software can be classified as a product of a design process by software engineers. It is a systematic amalgamation of programs that are made to run within a computer system that can be of any size, and architecture. Today's business can hardly optimally be operational without a presence of software in their systems. The choice of software by companies varies depending on the requirement which has a direct influence in the way software is created. Pressman (2010) gives a textbook definition of software as one that consists of three pillars as follows: 1. instructions consisting of programs that when executed provide function and performance, 2. data structures that enable the programs to adequately manipulate information, and 3. documents that describe the operation and use of the programs. However, it is paramount to understand software when you consider its characteristics. The basic characteristics are that software systems are abstract and intangible. As a product, it is developed, does not wear out and mostly it is custom built. These characteristics are varied from those of hardware engineered products. It is usually developed for a particular customer even when concepts such as re-usability are encouraged.

The early software applications until the 1960s were largely developed devoid of an explicit information system development methodology. These practices brought about a number of challenges in user satisfaction ranging from cost, time and scope perspective. After this era a number of thoughtful efforts such as Systems Development Life Cycle (SDLC) have been made to understand the software development process. These efforts were mainly done in order to improve the quality of software during and after its development by addressing challenges of the previous unconventional era (Avison & Fitzgerald, 2006).

The result of these efforts has been value addition to the final software product and improvement in delivery times. However, these achievements could not preclude technical challenges as well as development process skills that continue to affect the SDLCs (White & Leifer, 1986). In South Africa, it is common to find problems within developing organisations such as software failures, budget over runs and late delivery to satisfy clients who are in need of quality software due to problems that are everywhere within the development environment. Mostly, these are associated with incomplete user requirements.

Newer approaches such as agile methodologies were introduced to software development in order to address issues of software quality although the quality aspect has been and continues to be subject of research in the software engineering domain. In agile development, the quality aspect is inherent in the development process. Agile methodologies are an alternative to traditional waterfall approach of software development. It can be defined theoretically as a group of software development processes that are iterative, incremental, self-organizing, and emergent (Keith, 2002).

With agile methodologies, prescribed values, principles and practices are recommended for successful software project implementation (Keith, 2002). Agile development requires distinctive tools such as feedback, transparency in communications, and time-boxing. Therefore, organisations that adopt agile methodologies need to implement an environment with an integrated toolset comprising tools for measurement, bug tracking, design, analysis, testing, coding, business intelligence and critiquing, just to mention a few. In addition, open source tools and proprietary tools need to be carefully coordinated to deliver successful projects (Sillitti & Succi, 2004). Success in this context means delivering a software product within the agreed time and budget constraints and at the same time meeting the anticipated user requirements from the project sponsor (Mnkandla, 2008).

In principle, cloud computing environment facilitates speedy provision of tools and infrastructural resources to agile development teams who also add value by continuous development of a software product through iterations and incremental approach. However, Werfs et al. (2013) classifies cloud computing among disruptive technologies. They further claim that when making decisions to adopt cloud computing, careful analysis should be made in light of 1. The type of cloud that is intended for use; 2. How the product's functionality will be offered; 3. The cloud service provider to use and; 4. The pricing structure to be used for the services and products. As much as one would be keen to make decisions of cloud exploitation, a decision making process based on the above could complex depending nature of activities or services required.

Research shows an increase in the adoption of agile methods by developers in South Africa. However, there is little evidence to show which specific agile methodology is being adopted. The development platform has mostly been on stand-alone and traditional client-server architectures. However, as observed from Hinde and Van Belle (2012), application development within the cloud environment by SMMEs within South Africa is evident but it is not clear that these adoptions involve agile methodologies. World-wide agile development in cloud environment has been successful although these experiences are only for large

companies (Vaquero, Rodero-Merino, Caceres, Lindner, 2009).

Considering the benefits of cloud computing, SMMEs agile software development adopters can enjoy faster, production, improved quality and more flexible and collaborative processes that embrace change. Some benefits include the following:

- Automated build in the cloud. Development organisations would reduce costs by using virtualization in accelerating their work through existing images residing on multiple platforms. This reduces utility pricing on servers as compared to the use of dedicated servers.
- In the cloud environments, access to production environments is quicker and supports automated production deployment. This results in reduction of feedback cycle within the technical team and business owners.
- Development teams are able to use virtualization aspect of cloud computing for unlimited number of servers and be able to do parallel work within the agile philosophy. Successful Agile development projects depends on strong and extensive communications.
- The virtualization aspect of cloud computing will facilitate quicker provisioning and testing of code while at the same time developing and testing a new version. Cloud testing allows substantial advances in speed and agility by using multi-platform testing on virtual images. Unit tests can be done in parallel on cloud machines which also results in cost serving as compared to using dedicated servers.
- Exploration and innovation within a team by trying new ideas on server working environments (Brynjolfsson, Hofmann & Jordan, 2010).

While cloud computing has the capability of facilitating agile development practices in theory, the actual practical aspect has some challenges arising from non-technical and technical assumptions and constraints. Some challenges as depicted from an industry expert include non-technical problems such as inadequate training, poor leadership, and rigid adherence to agile principles that do not fit into the project (Stafford, 2013). Technical problems arise from Internet access and its assumptions about co-locations, latency, and errors cannot be easily made. As a result, problems such as not having required meetings, inadequate documentation and issues related to short iterations are experienced. In addition, due to the fact that computing resources can shrink and grow on demand requires proper planning if the benefit of cost saving are to be realised while keeping good qualities of service, otherwise this may affect development processes (Armbrust et al., 2009).

Ramesh, Cao, Mohan and Xu (2006) also identified five specific challenges that apply to agile distributed software development as follows: 1. Communication need vs. communication impedance, 2. Fixed vs. evolving quality requirements, 3. People- vs. process-oriented control, 4. Formal vs. informal agreement, and 5. Lack of team cohesion. Distributed software development is modelled around IT development teams spread out geographical locations but collaborate with each other on applications through mini-projects in order to develop final software. Modern web based techniques and tools such as cloud computing facilitate smooth running of activities in a distributed manner.

Communication need vs. communication impedance.

As indicated earlier, agile development methodologies do not depend on formal documentation but informal interactions within the team of developer and users. The distributed software development environment however requires that formal mechanisms such as designs are put in place for geographically separated locations. This raises a question on how you can balance formality of communication in agile distributed software development platforms.

Fixed vs. evolving quality requirements.

Distributed software development will normally require fixed and upfront agreements on quality requirements because of limited capability to control activities of distantly located teams. On the other hand agile requires an ongoing negotiations environment between developers and users as in the process of arriving at acceptable levels of quality on different phases of development. The issue of balancing between fixed and evolving quality requirements need to be addressed in these circumstances.

People- vs. process-oriented control.

The question of concern here is how you apply a suitable balance between people and process-oriented control in agile distributed development. The reasoning behind this question is based on the nature of distributed environments that are process oriented while agile is more of people oriented through informal processes and practices.

Formal vs. informal agreement.

Agile development environments normally involve informal contracts while distributed development requires formal agreements especially on targets, milestones and requirement specifications. This situation requires a balancing act between levels of contract formality appropriate in the agile environment.

Lack of team cohesion.

Team cohesion in distributed development where developers and users are in different locations is not as binding as in co-located environments. This even makes it worse when agile development processes are used because they emphasises on continuous collaboration on all stages and aspects of the development project.

Some guidelines in form of a framework on migration are necessary to aid these SMMEs in making decisions on how to maximize benefits and optimize usage of cloud environment.

3. ANALYSIS

The current rate of emergence of cloud computing poses a big challenge for the need to embrace it. For many reasons outlined by computing (Buyya et al., 2009; Conway & Curry, 2012; Venkatraman & Wadhwa, 2012; Pallis, 2010; Arutyunov, 2012; European Commission, 2013; Brynjolfsson et al. 2010; Armbrust et al. 2010; (Vaquero et al., 2009), it is an indication that we are sitting at a critical stage of the most significant trend in information technology industry. Despite the explosion, there has been no clear contextual definition of cloud computing while at the same time it is crucial to understand the requirements and challenges of cloud applications if one has to fully benefit from its environment (Pallis, 2010). This is a problem, for instance, agile development proponents would like to emphasize certain characteristics of cloud computing to meet their goals. Hence the need to define its own cloud computing framework within their requirements and use.

Without a framework and specific cloud computing description, there are a number of challenges that are likely to be experienced especially by SMMEs as they decide to migrate to the cloud environment such as anxiety within developers about a new cloud computing platform without appropriate guidance and understanding of how to effectively utilize cloud computing standard architecture. These problems are likely to emerge from the perspective of technical and non-technical limitations (Hinde & Van Belle. 2012; Sillitti & Succi, 2004). Literature has shown that there are several frameworks and decision models for cloud migration (Oliveira & Martins, 2011). However, agile migration is the most desired and concerns raised by the researchers are on some critical aspects associated to agile that are lacking in current frameworks.

4. PROPOSED FRAMEWORK

Based on literature surveyed in this research on current trends in cloud computing and agile software development practices, we propose to develop a framework that addresses the following problems:

- Identify factors necessary for successful migration of SMMEs that are using agile development to cloud computing;

- Determine effective interactions among the factors that contribute to successful migration; and
- Provide guidelines to SMMEs agile developers in South Africa for effective transition into use of cloud without compromise on software quality.

In order to achieve the above, an innovative approach is required to leverage all the benefits of cloud when used with agile software development so as to mitigate technical and non-technical challenges. We therefore hypothesize framework building with the following considerations:

- Important factors to consider in migrating agile development methodologies to cloud computing.
- Management of the process of migrating agile development methodologies to cloud.
- Roles of different stakeholders within and outside the organisation in ensuring successful migration.

Table 1 shows a framework exposition that addresses proposed activities and information required for the framework in order to address envisaged challenges during the migration process.

Table 1. Activity Versus Information Requirement for Framework

Activity	Information Required for Framework	Variable(s) and/or Relationships measured
DETERMINE EXISTING ENVIRONMENT	Agile methodology in use

Cloud computing services in use/required

Type of applications and tools in use/required to develop software in cloud computing environment

Perceptions held by agile software developers with respect to cloud computing | These will be identified through the coding of interviews transcripts, observation schedules. Literature and document reviews.

Tests ; Content Analysis and Correspondence Analysis |

DETERMINE AND EVALUATE CONDITIONS FOR SUCCESSFUL MIGRATION	Factors responsible for success in migrating organisation's agile development to cloud computing	These will be identified through the coding of interviews transcripts, observation schedules. Literature and document reviews.
	Difficulties or weaknesses encountered during the process of migrating to cloud computing	Tests ; Content Analysis and Correspondence Analysis
	Factors responsible for the difficulties and weaknesses during the process of migrating to cloud computing	
DETERMINE ACTION/INTERACTION BETWEEN MIGRATION SUCCESS FACTORS	Interaction between factors that are responsible for success in migrating to cloud computing	These will be identified through the coding of interviews transcripts, observation schedules. Literature and document reviews.
	Interaction between factors that are responsible for the difficulties/weaknesses in successful migration	Tests ; Content Analysis and Correspondence Analysis
	Relationship between factors that account for success and those that account for difficulties and weaknesses?	

Based on literature, we analyze each activity in the proposed framework in order to give further information and clarity as in Tables below:

Table 2.1 shows the approach to determine existing environment.

Table 2.1 Existing Environment

Information Required for Framework	Possible factors for analysis
Agile methodology in use	Extent to which an agile methodology such as scrum/Extreme Programming is used
Cloud computing services in use/required	Extent to which developers use PaaS, IaaS Service Types
Type of applications and tools in use/required to develop software in cloud computing environment	Extent of programming experience with programming tools in the cloud

Perceptions held by agile software developers with respect to cloud computing	Perceived usefulness and perceived ease of use with respect to cloud migration

Table 2.2 shows the approach to evaluate conditions for successful migration. It addresses information required for factors responsible for success in migrating organisation's agile development to cloud computing with specific reference to technology factors.

Table 2.2 Technology factors

Information Required for Framework	Possible factors for analysis (Alshamaila & Papagiannidis, 2013)

Factors responsible for success in migrating organisation's agile development to cloud computing	• **Relative advantage:**
	  o The degree to which an innovation is perceived as being better than the idea it supersedes.
	• **Uncertainty:**
	  o The extent to which the results of using an innovation are insecure.
	• **Geo-restriction:**
	  o The degree of uncertainty about data location.
	• **Compatibility:**
	  o The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters.
	• **Trialability:**
	  o The degree to which an innovation may be experimented with on a limited basis.

Table 2.3 shows the approach to evaluate conditions for successful migration. It addresses information required for factors responsible for success in migrating organisation's agile development to cloud computing with specific reference to organisational factors.

Table 2.3 Organisational factors

Information Required for Framework	Possible factors for analysis (Alshamaila & Papagiannidis, 2013)
Factors responsible for success in migrating organisation's agile development to cloud computing	• **Organisation Size:** ○ The size of a business in terms of: ➤ The market share of the business; ➤ The level of sales turnover ➤ The number of employees. ➤ The value of the business ➤ The value of capital employed • **Top management support:** ○ The degree of support from management on: ➤ The plan of action that dedicates time for ICT program in relation to cost and potential. ➤ Plan reviews, ➤ Results follow-ups and coordinating integration of ICT with management processes of business • **Prior technology experience:** ○ The extent of a user's experience with previous similar technologies. • **Innovativeness:** ○ The extent to which a client adopts innovations earlier than other members of the same social context. Environmental Factors • **Industry:** ○ Determine a business sector within software development. • **Market scope:** ○ The horizontal extent of a company's operations. • **Supplier efforts and external computing support:** ○ Determine supplier activities that can significantly influence the probability that an innovation will be adopted.

Table 2.4 shows the approach to evaluate conditions for successful migration. It addresses information required for factors responsible for success in migrating organisation's agile development to cloud computing with specific reference to environmental factors.

Table 2.4 Environmental factors

Information Required for Framework	Possible factors for analysis (Alshamaila & Papagiannidis, 2013)
Factors responsible for success in migrating organisation's agile development to cloud computing	• **Industry:** ○ Determine a business sector within software development. • **Market scope:** ○ The horizontal extent of a company's operations. • **Supplier efforts and external computing support:** ○ Determine supplier activities that can significantly influence the probability that an innovation will be adopted.

Table 2.5 shows the approach to evaluate conditions for successful migration. It addresses information required for assessing difficulties and weaknesses for the framework.

Table 2.5 Difficulties and weaknesses

Information Required for Framework	Possible factors for analysis
Difficulties or weaknesses encountered during the process of migrating to cloud computing	The extent of system weaknesses and difficulties in the migration process.
Factors responsible for the difficulties and weaknesses during the process of migrating to cloud computing	Decode from the weaknesses identified earlier.
Difficulties or weaknesses encountered during the process of migrating to cloud computing	Decode from the difficulties identified earlier.

Table 2.6 shows the approach to evaluate interactions of successful factors for the framework.

Table 2.6 Interaction of Success factors

Information Required for Framework	Possible factors for analysis
Interaction between factors that are responsible for success in migrating to cloud computing	Analysis of interactions of identified factors in "Factors responsible for success in migrating organisation's agile development to cloud computing".
Interaction between factors that are responsible for the difficulties/weaknesses in successful migration	Analysis of interactions of identified factors in "Factors that are responsible for the difficulties/weaknesses in successful migration".
Relationship between factors that account for success and those that account for difficulties and weaknesses?	Analysis of relationships of identified factors in "Factors that account for success and those that account for difficulties and weaknesses".

5. CONCLUSION/FUTURE WORK

Developing software in a cloud computing environment differs from the traditional approach. It makes it even more challenging when methodologies such as agile are used due to the fact that there is great need for interaction both technical and non-technical (such as sharing applications or development tools, communication and coordination) during development and deployment processes.

In this paper, a conceptual framework is proposed yet to be tested empirically through further investigation. The main thesis of this paper is that the migration process to cloud computing by SMMEs should be guided by a framework in order to mitigate all the challenges that are associated to cloud computing environments.

6. ACKNOWLEDGEMENT

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development methods, the broader issues of software process improvement (SPI) and predictive analytics and project management intelligence. He is passionate about improving the quality of software development and has a focus on software defects management.

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APPENDIX V

Axial codes and Quotations

Codes-quotations list
Code-Filter: All

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HU: Agile&Cloud2
File: [C:\Users\gardner.mwansa\Documents\Scientific Softw...\Agile&Cloud2.hpr7]
Edited by: Super
Date/Time: 2015-12-02 13:50:01

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Code: Communication Strategy {12-1}

PARTICIPANT 1 PODCASTS.rtf - 1:36 [As an Agile Consultant I put a..] (29:29)   (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation] [Top Management Support - Families
(2): Adoption - Substantive, Organisation]
No memos

As an Agile Consultant I put an effort for people to have face to face communication. Now I belong
to an organization that is quite distributed and it's been a core focus for us since last year to figure
out how we collaborate without face to face communication.

PARTICIPANT 1 PODCASTS.rtf - 1:42 [My first taste of this was whi..] (36:36)   (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation] [Resource Availability - Families (2):
Adoption - Substantive, Environment]
No memos

My first taste of this was while I was living in the USA. What I realised is that Americans are generally
effusive in their enthusiasm. For someone coming from a more austere culture, one influenced for
example by an English culture, this can come across as insincere. Contrarily, our more austere
reactions to an American can come off as cold and rude.

PARTICIPANT 1 PODCASTS.rtf - 1:44 [Software Development is a very..] (35:35)   (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation] [Resource Availability - Families (2):
Adoption - Substantive, Environment]
No memos

Software Development is a very English speaking culture, and it is usually the language used in off-
shore development. To take this familiarity with a common language as also being a shared culture is
where things can go badly wrong.

PARTICIPANT 1 PODCASTS.rtf - 1:45 [What we do at organization lev..] (9:9)   (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

What we do at organization level is we have an organization review week. The Captain gets us
together and we take a look at all our projects as an organization. We have an opportunity to show
what we have done and every 2 weeks we have a Kaizen meeting.

PARTICIPANT 1 PODCASTS.rtf - 1:46 [so being able to up the level ..] (30:30)   (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

so being able to up the level of communication from email, instant messaging, to voice call and video conference. It is vital in terms of navigating those challenges and communication and challenges to collaboration when working in an agile way.

PARTICIPANT 1 PODCASTS.rtf - 1:47 [The opportunity is to create d..] (32:32) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

The opportunity is to create deep connections with other people but need traditional things like face to face communication. The big one for me is sharing meals, it hacks our monkey brain we evolved to eat together as groups and it helps us to feel like family. It creates work connections people particularly making celebrations and it's also good to connect with our customers as well.

PARTICIPANT 1 PODCASTS.rtf - 1:48 [When you move this interaction..] (37:37) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

When you move this interaction into economically sensitive activity, the potential for misunderstanding and misreading is significant. One important example is that when outsourcing to India which is a strongly paternalistic culture, it is very rude to disagree with someone in authority.

PARTICIPANT 3 PODCASTS.rtf - 5:25 [We have a Scrum Meeting every ..] (8:8) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

We have a Scrum Meeting every Monday and the customer changes a certain functionality, we have to go back and change certain processes that require or interact with that functionality.

PARTICIPANT 3 PODCASTS.rtf - 5:26 [How we normally use it is that..] (11:11) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

How we normally use it is that the client will then request reports from his Mobile phone, so like Android. We develop our reporting platform on Android Tools, that reporting platform will then connect to SQL Azure. You do not have to connect to a specific SQL database, your Android Application can connect to SQL and you can access that data from any point.

PARTICIPANT 3 PODCASTS.rtf - 5:27 [In terms of human interactions..] (28:28) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

In terms of human interactions we have day to day meetings. We have an 8 o'clock meeting in terms of what part of the Application needs to be done for that day. We then go through the issue log with customers or the Managers of the Application.

PARTICIPANT 7 PODCASTS.rtf - 7:15 [communication is one of the bi..] (24:24) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

 communication is one of the biggest problems as far as Agile is concerned cause when you are moving into Cloud Computing or enablement you need to address that effectively.

PARTICIPANT 7 PODCASTS.rtf - 7:16 [We have a Team that works here..] (7:7) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation]
No memos

We have a Team that works here in Pretoria and a Team that works in Mozambique. They will be working together on a Project, communication was much better and everyone was quoting efficiently and resources were accessed much better.

_____

Code: compatibility {8-2}

PARTICIPANT 2 PODCAST.rtf - 2:2 [So which means you can adapt p..] (4:4)   (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology] [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

So which means you can adapt plans while you busy building

PARTICIPANT 4 PODCASTS.rtf - 3:4 [Am glad you said that everyone..] (17:17)   (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology]
Memos: [compactibility issues]

Am glad you said that everyone uses it to their purpose and the extreme case e.g. Western Digital have their personal cloud that's basically a portable hard drive that does not make a definition there.

PARTICIPANT 3 PODCASTS.rtf - 5:21 [We treat Cloud technology as l..] (28:28)   (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology]
Memos: [Compactibility]

We treat Cloud technology as localized technology, the only difference is that we can access them either in the office on the customer side, we do not really treat them as different technology to our development tech.

PARTICIPANT 6 PODCASTS.rtf - 6:1 [What technology will be used a..] (6:6)   (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology]
No memos

What technology will be used at this stage its irrelevant, this has a direct link back to your Project Manager Principle .It speaks of people first, data then technology.

PARTICIPANT 6 PODCASTS.rtf - 6:8 [The resource you require doubl..] (16:16)   (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology]
No memos

 The resource you require double if you are going to be developing Online, let's say you are developing locally and in deploying and building in the Cloud. Doing all your testing in the Cloud. That is almost like a once off it is not regular and it does not require a Continuous connectivity to the internet.

PARTICIPANT 6 PODCASTS.rtf - 6:14 [That inter-operability does no..] (24:24)   (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology]
No memos

That inter-operability does not exist. It reminds me of when networking was starting. Apple had its own network, Microsoft and Novell. Those proprietor sort of systems and you were forced to use their Vendor Specific Applications, Hardware etc. It reminds of the same type of thinking that has been implemented. We could call it Cloud Technology just another form of Private network. We are back at that day again.

PARTICIPANT 6 PODCASTS.rtf - 6:15 [My questions would be how you ..] (26:26) (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology]
No memos

My questions would be how you planning to implement this cause they are a lot of considerations such as provision of tools. Practicality of small business may not work very well.

PARTICIPANT 7PODCASTS.rtf - 7:7 [It's mostly a question of adap..] (16:16) (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology] [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

It's mostly a question of adaptability, adapting to the current standards of design and development.

_____

Code: Geo-restriction {12-2}

PARTICIPANT 1 PODCASTS.rtf - 1:22 [As a result we got this kind o..] (25:25) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

As a result we got this kind of impendence mismatch between stockholders that still very tied to physical infrastructure basically treating the cloud as second classes something not to be trusted or something less secure than physical systems.

PARTICIPANT 1 PODCASTS.rtf - 1:25 [One of the things of vital imp..] (30:30) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]
No memos

One of the things of vital importance is decent code of afterwards ...so being able to up the level of communication from email, instant messaging, to voice call and video conference. It is vital in terms of navigating those challenges and communication and challenges to collaboration when working in an agile way.

PARTICIPANT 2 PODCAST.rtf - 2:7 [It's quite a challenge I have ..] (11:11) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]
No memos

It's quite a challenge I have been basically depending on infrastructure and resources provided by somebody else and that is always a challenge.

PARTICIPANT 2 PODCAST.rtf - 2:9 [If you look at guys like Faceb..] (12:12) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

If you look at guys like Facebook, Google and Amazon these companies have data centers almost everywhere. They are able to fall back if you acquire data services from them, they are able to fall back on another data center if the main one experiences problems

PARTICIPANT 4 PODCASTS.rtf - 3:10 [The data centers are based in ..] (23:23) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Resource Availability - Families (2): Adoption - Substantive, Environment] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

The data centers are based in Western Europe in Ireland both Amazon and Microsoft and am not sure of Google and there's latency. If you hosting a Website or Application or API over there, there is a slight bit of latency. This is the most important thing for me to know and for most applications it's not disruptive.

PARTICIPANT 4 PODCASTS.rtf - 3:15 [As People Orientated, communic..] (30:30) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]
No memos

As People Orientated, communication is key to making it work. First the problem for me is not where the infrastructure is hosted, it is not related to where your infrastructure is hosted.

PARTICIPANT 5 PODCAST .rtf - 4:5 [Existing developers don't want..] (19:19) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Existing developers don't want to learn how to use the cloud and there is this weird idea that data in your building is safer than data on a cloud server.

PARTICIPANT 5 PODCAST .rtf - 4:12 [The important point is that th..] (39:39) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]
No memos

The important point is that the only thing that "cloud" means is that you don't really know where your physical server is located. Using the cloud is an economical decision, not a technical one.

PARTICIPANT 3 PODCASTS.rtf - 5:2 [It's better to have a localize..] (3:3) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]
No memos

It's better to have a localized server plant process the data and once the data is been processed then push it up to the Cloud then access it from the Cloud.

PARTICIPANT 6 PODCASTS.rtf - 6:4 [To the enterprise it empowers ..] (14:14) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

To the enterprise it empowers Teams not to be geographically dependent. Agile due to the people element requires you to be together.

PARTICIPANT 6 PODCASTS.rtf - 6:5 [So the system driven process o..] (14:14) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]
No memos

So the system driven process on a Cloud platform is more lenient and forgiving as far as the people element is concerned. There is not that heavy reliance that the entire team should be here. You can have your team spread out geographically across the world even.

PARTICIPANT 6 PODCASTS.rtf - 6:16 [Because the question would com..] (30:30) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology]
No memos

 Because the question would come one of the benefits would be your geographic independence.

_____

Code: Industry {6-2}

PARTICIPANT 2 PODCAST.rtf - 2:19 [Which is quite difficult, most..] (31:31)   (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment]
No memos

Which is quite difficult, most developer houses are Agile, PhP, Java or python or confusion it's only where they can find integration that multi skilled people who are able to do that. So you can imagine if you are in that environment where the DevOps is supposed to do all this

PARTICIPANT 2 PODCAST.rtf - 2:22 [Nowadays if you look at techno..] (34:34)   (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 Nowadays if you look at technology industry it's demanding too much, there's a big gap on research to be able to focus on these guys.

PARTICIPANT 2 PODCAST.rtf - 2:28 [In terms of Cloud Computing, t..] (9:9)   (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment]
No memos

In terms of Cloud Computing, tools themselves, they range from open source to commercial. Depending with the size of the computer and their requirements you can be able to fit easily.

PARTICIPANT 4 PODCASTS.rtf - 3:23 [Cloud is every Developers drea..] (20:20)   (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

Cloud is every Developers dream, it makes everything you did in any way easy. Its very Developer orientated the way things are documented.

PARTICIPANT 7PODCASTS.rtf - 7:2 [We are part of the Microsoft B..] (5:5)   (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

We are part of the Microsoft Bizbug so we have about R60 000 of access to the Cloud Services. In small companies, it is easy individually experiment with innovative tools such as Intel cloud development tools

PARTICIPANT 8PODCASTS.rtf - 8:7 [They are very few organization..] (10:10)   (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

They are very few organizations that are not already using Agile in some way, shape or form and most of them bad.

_____

Code: Innovativeness {7-2}

PARTICIPANT 1 PODCASTS.rtf - 1:32 [We also started investigating ..] (30:30)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]

No memos

We also started investigating on tools that would allow Developers to pair remotely, to be looking at the same piece of code and be able to manipulate it in less times so others can be able to get feedback.

PARTICIPANT 1 PODCASTS.rtf - 1:38 [Most organizations are startin..] (16:16)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation]
No memos

Most organizations are starting to look for devOps to do sysadmin work rather than having separate development writing tools for the support organization and business interfaces, and sysadmins doing the more low-level and hardware work.

PARTICIPANT 2 PODCAST.rtf - 2:23 [As a small organization people..] (35:35)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation] [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

As a small organization people are attached to their innovations.

PARTICIPANT 4 PODCASTS.rtf - 3:8 [Cloud is every Developers drea..] (20:20)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation]
No memos

Cloud is every Developers dream, it makes everything you did in any way easy. Its very Developer orientated the way things are documented. For instance am talking about Zero, Amazon Web services, it's not a disruptive thing.

PARTICIPANT 4 PODCASTS.rtf - 3:16 [I can tell you one big move th..] (30:30)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation]
No memos

I can tell you one big move that happened in the more Agile focused companies they introduced DevOps concept. It's a developer in operations and in an Agile sense that person becomes the part of the feature development team.

PARTICIPANT 3 PODCASTS.rtf - 5:22 [need to understand limitation ..] (34:34)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation] [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

need to understand limitation of cloud technologies. As for now every company need to migrate to the cloud technologies as it is the next frontier and in addition they need to fully understand resources and constraints at play.

PARTICIPANT 8PODCASTS.rtf - 8:4 [IBM has a software called Blue..] (4:4)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation]
No memos

IBM has a software called Bluemix.net where you can look at their site and see that you can actually provision a little development for yourself. At this stage IBM development tools are for free but maybe at a later stage they will start charging for it.

The only offering that I know that you can go in and get access to development tools is Bluemix from IBM and no one is using it in South Africa.

_____

Code: Market Scope {8-3}

PARTICIPANT 1 PODCASTS.rtf - 1:40 [It's still kind of traditional..] (27:27)   (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment]
Memos: [Market]

It's still kind of traditional and equally undistributed for example in USA and Europe it's perfectly acceptable to run very large cloud for example the UK has its own private cloud that it uses and its migrating all of its services, whereas in South Africa you still have large organizations that are theoretically into Agile but are still tied to the nature.

PARTICIPANT 1 PODCASTS.rtf - 1:41 [As an Agile Consultant I put a..] (29:29)   (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

As an Agile Consultant I put an effort for people to have face to face communication. Now I belong to an organization that is quite distributed and it's been a core focus for us since last year to figure out how we collaborate without face to face communication

PARTICIPANT 2 PODCAST.rtf - 2:25 [Usually, small companies are b..] (36:36)   (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment] [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

Usually, small companies are being bought off by big companies. We have a small organization called iKubu (Pty) Ltd it was bought by Garmin they sponsored and developed all the technology.

PARTICIPANT 4 PODCASTS.rtf - 3:18 [I would rather ask a more cruc..] (34:34)   (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

I would rather ask a more crucial question based on how you can use the Cloud and the opportunities the Cloud gives as a competitive advantage.

PARTICIPANT 4 PODCASTS.rtf - 3:23 [Cloud is every Developers drea..] (20:20)   (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

Cloud is every Developers dream, it makes everything you did in any way easy. Its very Developer orientated the way things are documented.

PARTICIPANT 7PODCASTS.rtf - 7:2 [We are part of the Microsoft B..] (5:5)   (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

We are part of the Microsoft Bizbug so we have about R60 000 of access to the Cloud Services

PARTICIPANT 8PODCASTS.rtf - 8:6 [Most of the companies we consu..] (8:8)   (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

Most of the companies we consult with have very big development infrastructure and own machines.

PARTICIPANT 8PODCASTS.rtf - 8:7 [They are very few organization..] (10:10)   (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Market Scope - Families (2): Adoption - Substantive, Environment]
No memos

They are very few organizations that are not already using Agile in some way, shape or form and most of them bad.

_____

Code: Organisation Size {20-3}

PARTICIPANT 1 PODCASTS.rtf - 1:34 [I think it always easier for s..] (19:19)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

I think it always easier for smaller firms to do so, when you contemplating a large infrastructure like a Bank wanting to move into the Cloud. The need for Security and so on are quite greater than the small firms, there's a distinct challenge in the sheer scale of things.

PARTICIPANT 1 PODCASTS.rtf - 1:39 [Some of the challenges we face..] (24:24)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
Memos: [Stakeholder support]

Some of the challenges we face are things like in multi nationals and large organizations where they have multiple companies in their portfolios and they want to centralize things. Basically it creates an issue such that you find yourself working for a company that is fast moving and happy with Cloud Technologies but they have to integrate with some 3rd party within the stable of companies, who isn't quite of there yet.

PARTICIPANT 2 PODCAST.rtf - 2:5 [If the company is small these ..] (7:7)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

If the company is small these roles do not necessarily have to be independent, one person can fulfill these roles.

PARTICIPANT 2 PODCAST.rtf - 2:8 [most organizations offering Cl..] (11:11)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

most organizations offering Cloud Computing Services, you have to look at how big the organization is, what kind of mechanism do they have in terms of backup, disaster recovery, in terms of load balancing and how many data centers do they have. Are they start up people who are hunger resourced in terms of infrastructure?

PARTICIPANT 2 PODCAST.rtf - 2:9 [If you look at guys like Faceb..] (12:12)   (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

If you look at guys like Facebook, Google and Amazon these companies have data centers almost everywhere. They are able to fall back if you acquire data services from them, they are able to fall back on another data center if the main one experiences problems

PARTICIPANT 2 PODCAST.rtf - 2:13 [Small scale companies in terms..] (23:23)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

Small scale companies in terms of productivity they are quick to ship, produce but undermine processes, security, quality and all those kind of things. If you a small guy you do not have resources. They do not follow normal corporate investments.

PARTICIPANT 2 PODCAST.rtf - 2:21 [Much research has to be concen..] (34:34)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

Much research has to be concentrated on the small firms, do things right. How to incorporate all these demanding things within their small resources

PARTICIPANT 2 PODCAST.rtf - 2:23 [As a small organization people..] (35:35)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation] [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

As a small organization people are attached to their innovations.

PARTICIPANT 2 PODCAST.rtf - 2:24 [When you need to expand and th..] (35:35)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

When you need to expand and the little tools you were using, you also need to expand need to increase massively. You are still a small organization that was operating from home but now need to expand to meet the demand.

PARTICIPANT 2 PODCAST.rtf - 2:25 [Usually, small companies are b..] (36:36)   (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment] [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

Usually, small companies are being bought off by big companies. We have a small organization called iKubu (Pty) Ltd it was bought by Garmin they sponsored and developed all the technology.

PARTICIPANT 2 PODCAST.rtf - 2:26 [Facebook just bought a company..] (36:36)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

 Facebook just bought a company called Parse marking its entry into a new business of providing tools and services for developing mobile applications. And as a small guy they could not adapt to that. If the research is not done and these guys learn to adapt and cope when things get out of hand they will always be bought out by the bigger guys.

PARTICIPANT 2 PODCAST.rtf - 2:29 [We have small licenses per use..] (9:9)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

We have small licenses per user and corporate licenses. Once you do that gap analysis in terms of the tools and skill sets and tools, you can be able to fit within those options.

PARTICIPANT 4 PODCASTS.rtf - 3:5 [The first Agile Project I did ..] (18:18)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
Memos: [Data Centres]

The first Agile Project I did was for Branch Banking Software for Standard Bank which is based on applications and it's quite faraway from software as a service. I have done a lot for bigger financial companies and for various reasons they all had their own data centers. Most of the work I have done was for our own company data Centre. The software products we build ourselves are all in the Cloud so its Cloud based.

PARTICIPANT 4 PODCASTS.rtf - 3:9 [For a simple setup not really ..] (22:22)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

For a simple setup not really and I had a lot less issues than I had in physical location, it has few clicks and lots of tutorials. It has a lot less red tape and a few things you have to be aware of as a South African Company specifically

PARTICIPANT 4 PODCASTS.rtf - 3:17 [Maybe DevOps as a Developer te..] (32:32)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Maybe DevOps as a Developer team becomes easier when you host infrastructure service as opposed to having in house infrastructure. You tend to have big teams and there's big processes between the teams.

PARTICIPANT 4 PODCASTS.rtf - 3:19 [As a smaller company how can t..] (34:34)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

As a smaller company how can they use the practices like continuous delivery with the cloud to outsmart the bigger players? Small companies have access to infrastructure that Standard Bank does not have.

PARTICIPANT 3 PODCASTS.rtf - 5:7 [Agile development in itself if..] (15:15)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

Agile development in itself if you find it in small companies it might work but in terms of large corporates what ends up happening is that the Project ends up running longer than expected and the amount of changes that are required on a weekly basis by customers the customer does not usually know what they want from that Application.

PARTICIPANT 3 PODCASTS.rtf - 5:9 [In large corporates the requir..] (15:15)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

In large corporates the requirements stay static, you can come back and review whether those requirements have been met. And then develop the new requirements, it's easier to handle the Application Development process rather than changing the Application during every week and then trying to get your end goal

PARTICIPANT 3 PODCASTS.rtf - 5:14 [On small companies if you runn..] (18:18)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

On small companies if you running you have to worry about bandwidth if you running Cloud Services.

PARTICIPANT 8PODCASTS.rtf - 8:9 [It's easy to organize people i..] (13:13)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation]
No memos

It's easy to organize people into teams but it's not easy to organize infrastructure for them to fall in line with those teams.

_____

Code: Prior technology experience {32-5}

PARTICIPANT 1 PODCASTS.rtf - 1:5 [You do not need the additional..] (8:8)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

 You do not need the additional overheads associated with heavy solution of design tasking.

PARTICIPANT 1 PODCASTS.rtf - 1:21 [Basically it creates an issue ..] (24:24)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Stakeholders]

Basically it creates an issue such that you find yourself working for a company that is fast moving and happy with Cloud Technologies but they have to integrate with some 3rd party within the stable of companies, who isn't quite of there yet.

PARTICIPANT 1 PODCASTS.rtf - 1:37 [And the critical success facto..] (14:14)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
Memos: [DevOps]

And the critical success factor for me is really an understanding and appreciation of the emergence of DevOps. DevOps offers middle ground where we start treating server infrastructure and configuration as code and as a result bring those things under management where they perhaps have not be in the past.

PARTICIPANT 2 PODCAST.rtf - 2:3 [First of all when you moving i..] (7:7)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

First of all when you moving into agile and Cloud Computing there's a different Project Manager.

PARTICIPANT 2 PODCAST.rtf - 2:4 [With agile, you need additiona..] (7:7)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

With agile, you need additional roles for project management and therefore more skillsets required. For small businesses what they have to look at are these roles like Project Manager, Scrum Master, serious roles like Technical Lead and Development Team. They have to look at these roles and see if they are able to upskill

PARTICIPANT 2 PODCAST.rtf - 2:6 [You also need to have tracking..] (7:7)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

You also need to have tracking mechanism cause most of these tools especially those found in the Cloud.

PARTICIPANT 2 PODCAST.rtf - 2:14 [DevOps is your traditional sys..] (25:25)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

DevOps is your traditional system administration that requires to also have let's say a major amount of knowledge of the products they support.

PARTICIPANT 2 PODCAST.rtf - 2:16 [Because he doesn't have the ex..] (25:25)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

 Because he doesn't have the experience or know how once the packaging of the application and software is, he can't go further than that then you can pass over to the Developers.

PARTICIPANT 2 PODCAST.rtf - 2:17 [Which will actually make a swi..] (26:26)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Which will actually make a switch into more of your system administration. Coming from that space of building software you understand the programming language, you understand Release Management, Applications behavior, change management, Continuous integration. It is a fairly new field that's coming up of the weaknesses that are there. You have guys you have been doing a great as System Administration

PARTICIPANT 2 PODCAST.rtf - 2:20 [Besides the infrastructure the..] (31:31)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Besides the infrastructure they are supposed to know all this. There is a very big gap, it ups the standard of developers and the entire developer team plus the infrastructure team. Which is trained to bridge the gap.

PARTICIPANT 2 PODCAST.rtf - 2:27 [The skill sets that are needed..] (8:8)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

The skill sets that are needed to actually deliver that particular feature and assign the appropriate people. Daily standups means time should be considered and not be long, any issues that arise you need to resolve them within the small time frame. If they have an understanding, it's much easier cause you can have more roles fulfilled by less resources and just need the necessary skills.

PARTICIPANT 4 PODCASTS.rtf - 3:2 [Continuous Delivery, described..] (12:12)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
Memos: [Expertise]

Continuous Delivery, described in the book by Jezz Humble can be simplified with an elastic computing environment. Not all agile teams focus on these practices, but for me a better question would be: How does PaaS and IaaS enable Continuous Delivery of value?

PARTICIPANT 4 PODCASTS.rtf - 3:3 [f by the migration we also mea..] (14:14)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

f by the migration we also mean that the development team takes ownership of their own infrastructure (a company structure rather than technology change), then an important factor is that the team has the Ops skills. See the DevOps movement comes to mind.

PARTICIPANT 4 PODCASTS.rtf - 3:7 [I have to say what has not cha..] (19:19)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

I have to say what has not changed, a lot of my career I worked on Microsoft Stack that needs visual studio and all that, if you move into the Cloud your underlying technology does not change, the same platforms we run on our servers are the ones we run in the Cloud. You do not need to learn new programming languages you do not need to know any other platforms. There's definitely new technology but whether it's in the Cloud or not that's beside the point

PARTICIPANT 4 PODCASTS.rtf - 3:14 [Depending on the time you need..] (28:28)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

 Depending on the time you need to experiment and that's if you already have basic knowledge. This is the key challenge of these Cloud environments and 2 clicks you have new PC up and running it does not cost much.

PARTICIPANT 4 PODCASTS.rtf - 3:17 [Maybe DevOps as a Developer te..] (32:32)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Maybe DevOps as a Developer team becomes easier when you host infrastructure service as opposed to having in house infrastructure. You tend to have big teams and there's big processes between the teams.

PARTICIPANT 4 PODCASTS.rtf - 3:22 [Just understanding Agile is a ..] (38:38)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Just understanding Agile is a challenge on it's on. Forget about how your services are hosted. It's important to find the overlap if we go into normal agile way it's a vas topic for our different cultures and getting different people to work together.

PARTICIPANT 5 PODCAST .rtf - 4:2 [The hard part is agile, not cl..] (13:13)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

The hard part is agile, not cloud computing. So many companies claim to be agile but really don't understand the concept.

PARTICIPANT 5 PODCAST .rtf - 4:3 [You need good testing methodol..] (14:14)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

You need good testing methodologies, performance monitoring tools, strategies to grow, market analysis, customer understanding and more.

PARTICIPANT 5 PODCAST .rtf - 4:8 [Agile is quite a holistic appr..] (23:23)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]

Memos: [Expertise]

Agile is quite a holistic approach that is probably the biggest key to any successful migration, regardless of the technology (cloud or not). Many employees will fight agile methodologies as much as cloud technologies so a migration may fail because a migration to agile failed

PARTICIPANT 5 PODCAST .rtf - 4:9 [Testing, performance monitorin..] (29:29)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Testing, performance monitoring, scalability, client analysis and understanding. This is all about understanding your market and delivering a product in a timely fashion.

PARTICIPANT 3 PODCASTS.rtf - 5:3 [We are using Agile Methodology..] (6:6)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
Memos: [Expertise]

We are using Agile Methodology and to be honest we are having huge problems with agile methodology.

PARTICIPANT 3 PODCASTS.rtf - 5:5 [We have Moon Desktop on SQL Az..] (10:10)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

We have Moon Desktop on SQL Azure, you can have the Cloud Infrastructure or your Windows Platform in the Cloud. My main base is Microsoft, so you can use SQL Azure. How we develop is that we have centralized large data Centre, we will then develop, compress data because our bandwidth in terms of office cannot handle large amounts of the data being transferred from Texas or London wherever. And then be calling back for the Application

PARTICIPANT 3 PODCASTS.rtf - 5:10 [knowledge base, how familiar a..] (18:18)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

 knowledge base, how familiar are you with the technology you are using. Before we used SQL Azure we did a test bench on how much data we can store on SQL Azure. How much data we can access untimely basis. We went through the whole bench mark process on how much we can run our full Application on SQL Azure.

PARTICIPANT 3 PODCASTS.rtf - 5:22 [need to understand limitation ..] (34:34)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation] [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

need to understand limitation of cloud technologies. As for now every company need to migrate to the cloud technologies as it is the next frontier and in addition they need to fully understand resources and constraints at play.

PARTICIPANT 6 PODCASTS.rtf - 6:11 [Another thing I can point out ..] (21:21)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Another thing I can point out is when you move up your Cloud Technology Stack more experience is required. Because if you simply using services online you only need to know essentially your own tools.

PARTICIPANT 6 PODCASTS.rtf - 6:12 [Now if you go into your platfo..] (21:21) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

Now if you go into your platform, you need to know OS and there is some skill level that is required. But these 2 platforms are not requirements for developers because platforms are essentially a backbone operating system, you are responsible for software's development environments and data frameworks.

PARTICIPANT 7PODCASTS.rtf - 7:1 [In terms of Cloud Computing, y..] (3:3) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

In terms of Cloud Computing, you need Tools like Gigs and all those. We also use Microsoft Azure for development and storage

PARTICIPANT 7PODCASTS.rtf - 7:5 [Security would be the first th..] (12:12) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Security would be the first thing, am looking for efficiency then speed, am looking for continuous allocation of resources. Am looking for an easier way of the platform maintainability and also looking for something that would allow me to work with a Team that works in USA.

PARTICIPANT 7PODCASTS.rtf - 7:6 [I think we need to invest more..] (14:14) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

I think we need to invest more on human skills, build capacity on human skills on people who can work on security. I see an inclusive investment on all this.

PARTICIPANT 7PODCASTS.rtf - 7:7 [It's mostly a question of adap..] (16:16) (Super)
Codes: [compatibility - Families (2): Adoption - Substantive, Technology] [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
No memos

It's mostly a question of adaptability, adapting to the current standards of design and development.

PARTICIPANT 7PODCASTS.rtf - 7:11 [I communication is one of the ..] (24:24) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation]
Memos: [Communication needs]

I communication is one of the biggest problems as far as Agile is concerned cause when you are moving into Cloud Computing or enablement you need to address that effectively

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Code: Relative Advantage {28-2}

PARTICIPANT 1 PODCASTS.rtf - 1:1 [One of the biggest problems yo..] (3:3) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [Developers now have direct a faster collaborative with third parties]

One of the biggest problems you face in trying to deliver software in short increments is that you typically run into environments where you have to collaborate with 3rd parties to deploy software. E.g. back in early 2000 my wife was working with Mosque Ceiling. They had a 3rd party responsible

for their hosting and as a result they had to submit a change request like a month in advance in order to get a code deployed.

PARTICIPANT 1 PODCASTS.rtf - 1:2 [The time period has shrunk dra..] (4:4) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

The time period has shrunk dramatically because of the Cloud technology

PARTICIPANT 1 PODCASTS.rtf - 1:3 [Being able to spin up an insta..] (4:4) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

 Being able to spin up an instance with your latest future branch and being able to test it and then tearing the server down is all made possible through the Cloud Technology, as before it would be sharing resources and have to schedule and inform colleagues am going to put my branch this afternoon no one touch the server.

PARTICIPANT 1 PODCASTS.rtf - 1:4 [Your ability to scale the appl..] (5:5) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [Cloud environmnet]

Your ability to scale the application in cloud technology means you do not have to invest in over architecting systems to make sure you have enough physical servers hooked up.

PARTICIPANT 1 PODCASTS.rtf - 1:5 [You do not need the additional..] (8:8) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

 You do not need the additional overheads associated with heavy solution of design tasking.

PARTICIPANT 1 PODCASTS.rtf - 1:6 [And increasingly we paying a l..] (12:12) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [Cloud Tool]

And increasingly we paying a lot of attention to DevOps areas where we are starting to make use of tool chains like Ansible for configuration management that are able to set up development environments quicker and be able to run in the Virtual machines within Developers laptops.

PARTICIPANT 1 PODCASTS.rtf - 1:7 [What used to happen in the pas..] (15:15) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

What used to happen in the past was systems administrators working on hardware boxes and really keep the lights on, manage hardware/networks, rack and stack, install/manage software on servers and/or clients, etc.

PARTICIPANT 1 PODCASTS.rtf - 1:8 [DevOps offers a philosophy tha..] (17:17) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [DevOps]

DevOps offers a philosophy that a tool chain enables you to deal with large scale Cloud based infrastructure in a very cost effective and very risk averse approach.

PARTICIPANT 1 PODCASTS.rtf - 1:9 [The biggest thing small firm h..] (20:20) (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]

Memos: [Expenditure]

 The biggest thing small firm have to take into consideration is that you move from a capital expenditure to a monthly expenditure for services.

PARTICIPANT 1 PODCASTS.rtf - 1:10 [Once you get your head around ..] (20:20)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [Cost of ownership]

Once you get your head around the total cost of ownership and the amount of business risks associated with email going down, it's actually a no brainer. It's more a question of understanding what the impact is on your capex and how that changes

PARTICIPANT 1 PODCASTS.rtf - 1:11 [Increasingly technology like D..] (22:22)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

Increasingly technology like Docker and Ansible basically make you Vendor Independent.

PARTICIPANT 1 PODCASTS.rtf - 1:12 [There's more technology emergi..] (22:22)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

There's more technology emerging in that space that basically reduces Cloud Computing into a commodity service. Which is not great for providers. At the moment what they doing is somebody has to buy these things and try to compare offerings across of Cloud Providers.

PARTICIPANT 1 PODCASTS.rtf - 1:13 [It's incredibly hard. The pric..] (22:22)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [Pricing]

 It's incredibly hard. The pricing strategies are a pain and hard to compare.

PARTICIPANT 1 PODCASTS.rtf - 1:14 [The tooling that's coming out ..] (22:22)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

The tooling that's coming out will allow you to turn a knob to scale up and turn a knob to scale down. Being able to dynamically cope with the traffic surges and really minute control over spending that you have in a Cloud.

PARTICIPANT 1 PODCASTS.rtf - 1:15 [We could turn the corner in a ..] (26:26)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

 We could turn the corner in a perspective that we could demonstrate that the Cloud is viable, that is financially of interest to the organization because it would end up investing large amounts of Capex into servers.

PARTICIPANT 1 PODCASTS.rtf - 1:16 [Now I belong to an organizatio..] (29:29)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
Memos: [Face2face comm]

 Now I belong to an organization that is quite distributed and it's been a core focus for us since last year to figure out how we collaborate without face to face communication

PARTICIPANT 2 PODCAST.rtf - 2:1 [You can ship that out into pro..] (3:3)   (Super)

Codes:　　[Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

You can ship that out into production very fast. You will also allow the business to change functionality, as you are busy doing those, when you release a few subsets of functions you are able to see if this is what they really meant.

PARTICIPANT 2 PODCAST.rtf - 2:2 [So which means you can adapt p..] (4:4)   (Super)
Codes:　　[compatibility - Families (2): Adoption - Substantive, Technology] [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

So which means you can adapt plans while you busy building

PARTICIPANT 2 PODCAST.rtf - 2:15 [A DevOps when he reports a pro..] (25:25)   (Super)
Codes:　　[Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

A DevOps when he reports a problem he does not just tell you that the application is not working. He has to give you information because he has looked into the laws and he has identified exactly where the problems is.

PARTICIPANT 2 PODCAST.rtf - 2:32 [Companies like IBU have their ..] (19:19)   (Super)
Codes:　　[Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

Companies like IBU have their own data centers for some of their cloud tools. Availability is always a challenge, availability means the infrastructure has to be redundant. Redundancy is expensive because you have to duplicate and it's only the larger companies that can afford that. They are not perfect as well because they also get outages now and then.

PARTICIPANT 4 PODCASTS.rtf - 3:1 [My expectations are the same a..] (11:11)   (Super)
Codes:　　[Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

My expectations are the same as without a cloud environment. One thing I would expect is no dependency on another team for infrastructure provisioning – the development team should take ownership of their infrastructure.

PARTICIPANT 4 PODCASTS.rtf - 3:21 [In my mind that was my point o..] (37:37)   (Super)
Codes:　　[Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

In my mind that was my point of continuous delivery using the tools given by the Cloud. Hats a space where real opportunities are and it's not a different process in terms of company structure the openings still apply

PARTICIPANT 5 PODCAST .rtf - 4:1 [However, various software as a..] (9:9)   (Super)
Codes:　　[Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

However, various software as a service offerings (Github, Slack and Travis in our case) which are cloud services assist considerably with the agile methodologies. Another factor is deployment speed. On the cloud, I can scale our service by a factor of 100 in an hour. You cannot do that on your own server farm.

PARTICIPANT 3 PODCASTS.rtf - 5:6 [I think on Agile Development i..] (13:13)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

I think on Agile Development in terms of Management point of view it has added more benefits, it's easier for Management to access their reports from their Tablets and Mobile phones cause they do not have to be at a specific location.

PARTICIPANT 6 PODCASTS.rtf - 6:6 [So the system driven process o..] (14:14)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

So the system driven process on a Cloud platform is more lenient and forgiving as far as the people element is concerned. There is not that heavy reliance that the entire team should be here. You can have your team spread out geographically across the world even. The focus is no longer on the individual but on the output.

PARTICIPANT 6 PODCASTS.rtf - 6:7 [The most basic one would be ac..] (16:16)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

The most basic one would be access and primary need, reliable access is very important and Cloud Computing in its nature is very resource intensive, not only resource on your computing but also connectivity wise.

PARTICIPANT 8PODCASTS.rtf - 8:1 [Cloud Computing technology is ..] (3:3)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

 Cloud Computing technology is becoming more in the field of provision infrastructure for the development effort.

PARTICIPANT 8PODCASTS.rtf - 8:2 [The machines you going to be d..] (4:4)   (Super)
Codes: [Relative Advantage - Families (2): Adoption - Substantive, Technology]
No memos

The machines you going to be developing on and the environment you going to be testing on that's where Cloud Computing becomes very valuable.

_____

Code: Resource Availability {14-2}

PARTICIPANT 1 PODCASTS.rtf - 1:42 [My first taste of this was whi..] (36:36)   (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation] [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

My first taste of this was while I was living in the USA. What I realised is that Americans are generally effusive in their enthusiasm. For someone coming from a more austere culture, one influenced for example by an English culture, this can come across as insincere. Contrarily, our more austere reactions to an American can come off as cold and rude.

PARTICIPANT 1 PODCASTS.rtf - 1:43 [When you move this interaction..] (37:37)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

When you move this interaction into economically sensitive activity, the potential for misunderstanding and misreading is significant. One important example is that when outsourcing to India which is a strongly paternalistic culture, it is very rude to disagree with someone in authority. As a result, the Indian team will never say "no" to a request from a customer.

PARTICIPANT 1 PODCASTS.rtf - 1:44 [Software Development is a very..] (35:35) (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation] [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

Software Development is a very English speaking culture, and it is usually the language used in off-shore development. To take this familiarity with a common language as also being a shared culture is where things can go badly wrong.

PARTICIPANT 2 PODCAST.rtf - 2:30 [if you look at most organizati..] (11:11) (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 if you look at most organizations offering Cloud Computing Services, you have to look at how big the organization is, what kind of mechanism do they have in terms of backup, disaster recovery, in terms of load balancing and how many data centers do they have. Are they start up people who are hunger resourced in terms of infrastructure?

PARTICIPANT 2 PODCAST.rtf - 2:33 [We have got infrastructure iss..] (20:20) (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

We have got infrastructure issues and loomed issues, when you come to cases you always have to establish who is your provider and how much expertise, experience and what services do they have and what tools they provide that you are interested in.

PARTICIPANT 4 PODCASTS.rtf - 3:10 [The data centers are based in ..] (23:23) (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Resource Availability - Families (2): Adoption - Substantive, Environment] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

The data centers are based in Western Europe in Ireland both Amazon and Microsoft and am not sure of Google and there's latency. If you hosting a Website or Application or API over there, there is a slight bit of latency. This is the most important thing for me to know and for most applications it's not disruptive.

PARTICIPANT 5 PODCAST .rtf - 4:6 [Finally, Internet connectivity..] (19:19) (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

Finally, Internet connectivity is expensive and slow compared to most industrial countries. Poland and Thailand leave us in the dust.

PARTICIPANT 5 PODCAST .rtf - 4:14 [Government needs to open the t..] (36:36) (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

Government needs to open the telecommunications sector to greater competition.

PARTICIPANT 3 PODCASTS.rtf - 5:13 [The problem with South Africa ..] (18:18)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 The problem with South Africa in perspective is that the amount of bandwidth that we working with. With large corporates you can get pretty fast lines, you can about hundred megabytes and that enables you to run large processes on SQL Cloud. You can run large calculations on SQL Azure or SQL Cloud and you do not have to worry about your bandwidth.

PARTICIPANT 3 PODCASTS.rtf - 5:14 [On small companies if you runn..] (18:18)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 On small companies if you running you have to worry about bandwidth if you running Cloud Services.

PARTICIPANT 3 PODCASTS.rtf - 5:24 [The reliability with SQLAzure ..] (4:4)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

The reliability with SQLAzure is up to 95 % reliability Online, there are times when you cannot access it ,the speed of the connection is too slow to do actual live processing. How we use Cloud Technology is more on a reporting basis.

PARTICIPANT 6 PODCASTS.rtf - 6:4 [To the enterprise it empowers ..] (14:14)   (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

To the enterprise it empowers Teams not to be geographically dependent. Agile due to the people element requires you to be together.

PARTICIPANT 7PODCASTS.rtf - 7:12 [The reliability and availabili..] (25:25)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

The reliability and availability do affect the Project at the end of the day. An experience we had with this is we had a case of where 2 members of a Team, one was based in Mozambique another in eNkangala close to Mpumalanga and another team member was based in Pretoria. It happened that 2 members that were based in another location were playing a major role in the project e.g. in Mozambique there was an Internet shutdown for the whole country so that became a problem cause we needed resources from him we needed him to take his Code to the Cloud and he couldn't do that for 2 days and it did delay us

PARTICIPANT 7PODCASTS.rtf - 7:14 [Already the issues of latency ..] (27:27)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment]
No memos

Already the issues of latency cause delay for us to converse.

_____

Code: Supplier Efforts and external computing support {17-3}

PARTICIPANT 1 PODCASTS.rtf - 1:39 [Some of the challenges we face..] (24:24)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
Memos: [Stakeholder support]

Some of the challenges we face are things like in multi nationals and large organizations where they have multiple companies in their portfolios and they want to centralize things. Basically it creates an issue such that you find yourself working for a company that is fast moving and happy with Cloud Technologies but they have to integrate with some 3rd party within the stable of companies, who isn't quite of there yet.

PARTICIPANT 2 PODCAST.rtf - 2:22 [Nowadays if you look at techno..] (34:34)   (Super)
Codes: [Industry - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 Nowadays if you look at technology industry it's demanding too much, there's a big gap on research to be able to focus on these guys.

PARTICIPANT 2 PODCAST.rtf - 2:25 [Usually, small companies are b..] (36:36)   (Super)
Codes: [Market Scope - Families (2): Adoption - Substantive, Environment] [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

Usually, small companies are being bought off by big companies. We have a small organization called iKubu (Pty) Ltd it was bought by Garmin they sponsored and developed all the technology.

PARTICIPANT 2 PODCAST.rtf - 2:30 [if you look at most organizati..] (11:11)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 if you look at most organizations offering Cloud Computing Services, you have to look at how big the organization is, what kind of mechanism do they have in terms of backup, disaster recovery, in terms of load balancing and how many data centers do they have. Are they start up people who are hunger resourced in terms of infrastructure?

PARTICIPANT 2 PODCAST.rtf - 2:33 [We have got infrastructure iss..] (20:20)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

We have got infrastructure issues and loomed issues, when you come to cases you always have to establish who is your provider and how much expertise, experience and what services do they have and what tools they provide that you are interested in.

PARTICIPANT 5 PODCAST .rtf - 4:6 [Finally, Internet connectivity..] (19:19)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

Finally, Internet connectivity is expensive and slow compared to most industrial countries. Poland and Thailand leave us in the dust.

PARTICIPANT 5 PODCAST .rtf - 4:7 [Government policy on telecommu..] (21:21)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]

No memos

Government policy on telecommunications and an aging IT professional cohort that is resistant to change

PARTICIPANT 5 PODCAST .rtf - 4:11 [Mostly, they should focus on t..] (36:36)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

Mostly, they should focus on the product and not on the technology. Government needs to open the telecommunications sector to greater competition. Change resistent personnel need to wake up to the fact that change is the only constant in this business.

PARTICIPANT 3 PODCASTS.rtf - 5:13 [The problem with South Africa ..] (18:18)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 The problem with South Africa in perspective is that the amount of bandwidth that we working with. With large corporates you can get pretty fast lines, you can about hundred megabytes and that enables you to run large processes on SQL Cloud. You can run large calculations on SQL Azure or SQL Cloud and you do not have to worry about your bandwidth.

PARTICIPANT 3 PODCASTS.rtf - 5:14 [On small companies if you runn..] (18:18)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 On small companies if you running you have to worry about bandwidth if you running Cloud Services.

PARTICIPANT 3 PODCASTS.rtf - 5:20 [If you encrypting data you put..] (24:24)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

If you encrypting data you putting more processes that make the Application slower than it should be. The minute your data is on the Internet you have no control of the data. You should acknowledge that you have no control over it, yes you do have certain control in terms of user account. The Company can do as they please, if the USA government tells Microsoft that they want to excess what's on your server. Microsoft has the obligation to give the USA government and whoever asks for it.

PARTICIPANT 6 PODCASTS.rtf - 6:9 [You need to consider the type ..] (17:17)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

You need to consider the type of computing power you have got on your backend. The cost is connected directly in relation to that. Your connectivity comes into question I also recommend 10 megabits for such a business Online.

PARTICIPANT 6 PODCASTS.rtf - 6:13 [There are various user License..] (22:22)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Uncertainity about service providers]

There are various user License Agreements that do get signed. The commitment is that the data belongs to you and you can at any time opt out of the service. I do not think data ownership should be a worry.

PARTICIPANT 7PODCASTS.rtf - 7:4 [Maybe the Service Providers th..] (10:10)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Maybe the Service Providers themselves must bring credibility to their systems by showing people they can be secure. I think we need more hackers who could test their systems.

PARTICIPANT 7PODCASTS.rtf - 7:10 [Let's face it we are in Africa..] (22:22)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

Let's face it we are in Africa so there's been a problem most of the times, there's a member who's working somewhere and u need to work together on a project and they complain about network or they complain about their machines so the only thing about Cloud now is a matter of infrastructure resources.

PARTICIPANT 7PODCASTS.rtf - 7:12 [The reliability and availabili..] (25:25)   (Super)
Codes: [Resource Availability - Families (2): Adoption - Substantive, Environment] [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

The reliability and availability do affect the Project at the end of the day. An experience we had with this is we had a case of where 2 members of a Team, one was based in Mozambique another in eNkangala close to Mpumalanga and another team member was based in Pretoria. It happened that 2 members that were based in another location were playing a major role in the project e.g. in Mozambique there was an Internet shutdown for the whole country so that became a problem cause we needed resources from him we needed him to take his Code to the Cloud and he couldn't do that for 2 days and it did delay us

PARTICIPANT 8 PODCASTS.rtf - 8:5 [IBM has a software called Blue..] (4:4)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment]
No memos

 IBM has a software called Bluemix.net where you can look at their site and see that you can actually provision a little development for yourself. At this stage IBM development tools are for free but maybe at a later stage they will start charging for it.

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Code: Top Management Support {5-0}

PARTICIPANT 1 PODCASTS.rtf - 1:35 [Our CEO is very passionate abo..] (14:14)   (Super)
Codes: [Top Management Support - Families (2): Adoption - Substantive, Organisation]
No memos

Our CEO is very passionate about hardware and we had a bunch of servers laying around which hosted our Code Repositories and our mail.

PARTICIPANT 1 PODCASTS.rtf - 1:36 [As an Agile Consultant I put a..] (29:29)   (Super)
Codes: [Communication Strategy - Families (2): Adoption - Substantive, Organisation] [Top Management Support - Families (2): Adoption - Substantive, Organisation]
No memos

As an Agile Consultant I put an effort for people to have face to face communication. Now I belong to an organization that is quite distributed and it's been a core focus for us since last year to figure out how we collaborate without face to face communication.

PARTICIPANT 2 PODCAST.rtf - 2:18 [What you find is that most org..] (31:31) (Super)
Codes: [Top Management Support - Families (2): Adoption - Substantive, Organisation]
No memos

What you find is that most organization support multiple vendor and multiple technologies what you are asking from a Dev ops is to understand all that

PARTICIPANT 5 PODCAST .rtf - 4:10 [The CEO needs to communicate a..] (33:33) (Super)
Codes: [Top Management Support - Families (2): Adoption - Substantive, Organisation]
No memos

The CEO needs to communicate a very clear strategy and back it all the way. The CTO needs to have a deep understanding of agile methodology and have the ability to architect and deliver a scalable product. The cloud is somewhat irrelevant from a technological point of view

PARTICIPANT 3 PODCASTS.rtf - 5:4 [There's a conflict between you..] (6:6) (Super)
Codes: [Top Management Support - Families (2): Adoption - Substantive, Organisation]
No memos

There's a conflict between you the Developer, the customer and Management. What the Management thinks they want I would then go about Developing. They will come back and say I see what you have done, can you please change it, add this or takeaway this.

_____

Code: Trialability {19-2}

PARTICIPANT 1 PODCASTS.rtf - 1:21 [Basically it creates an issue ..] (24:24) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Stakeholders]

Basically it creates an issue such that you find yourself working for a company that is fast moving and happy with Cloud Technologies but they have to integrate with some 3rd party within the stable of companies, who isn't quite of there yet.

PARTICIPANT 1 PODCASTS.rtf - 1:26 [We work extensively with Digit..] (12:12) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

We work extensively with Digital Ocean which has proven to be a very competitive product in terms of getting things up and running quickly.

PARTICIPANT 1 PODCASTS.rtf - 1:27 [We also looking at technologie..] (12:12) (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

 We also looking at technologies such as Docker in combination with Ansible, that's the stack that we think we going to need both for our own products and services we use plus application that we build for our customers.

PARTICIPANT 1 PODCASTS.rtf - 1:28 [When we were running on open s..] (20:20) (Super)

Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

When we were running on open source system for our calendar migrating that to Google, it took a really long time for us to get that because it involved suddenly from having zero costs to paying $5 per month.

PARTICIPANT 1 PODCASTS.rtf - 1:29 [At the moment what they doing ..] (22:22)   (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

 At the moment what they doing is somebody has to buy these things and try to compare offerings across of Cloud Providers.

PARTICIPANT 1 PODCASTS.rtf - 1:30 [There's still aspects of that ..] (26:26)   (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

There's still aspects of that I think we still kind of negotiating. We could turn the corner in a perspective that we could demonstrate that the Cloud is viable, that is financially of interest to the organization because it would end up investing large amounts of Capex into servers.

PARTICIPANT 1 PODCASTS.rtf - 1:31 [in USA and Europe it's perfect..] (27:27)   (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

in USA and Europe it's perfectly acceptable to run very large cloud for example the UK has its own private cloud that it uses and its migrating all of its services, whereas in South Africa you still have large organizations that are theoretically into Agile but are still tied to the nature.

PARTICIPANT 1 PODCASTS.rtf - 1:32 [We also started investigating ..] (30:30)   (Super)
Codes: [Innovativeness - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

We also started investigating on tools that would allow Developers to pair remotely, to be looking at the same piece of code and be able to manipulate it in less times so others can be able to get feedback.

PARTICIPANT 1 PODCASTS.rtf - 1:33 [what parts of your non-essenti..] (39:39)   (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
Memos: [Phasesd migration]

what parts of your non-essential, non-IP producing aspects of your business can be moved to SaaS firstly (e.g. email, CRM, accounting etc.). Increasingly this allows businesses to leverage inter-operability within these applications as more and more open API's are out there allowing devs to hook these things up. Add to that services like Zapier allow even more integration between these applications

PARTICIPANT 4 PODCASTS.rtf - 3:10 [The data centers are based in ..] (23:23)   (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Resource Availability - Families (2): Adoption - Substantive, Environment] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

The data centers are based in Western Europe in Ireland both Amazon and Microsoft and am not sure of Google and there's latency. If you hosting a Website or Application or API over there, there is

a slight bit of latency. This is the most important thing for me to know and for most applications it's not disruptive.

PARTICIPANT 4 PODCASTS.rtf - 3:13 [It becomes tricky if you movin..] (26:26)   (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

It becomes tricky if you moving partially , also a complex environment with 30 servers doing different things, hats going to be a complex move, complex to move it to a different data center but to move it to the cloud it's so level even more complex. People in phases just build a new system to the cloud it's easy

PARTICIPANT 4 PODCASTS.rtf - 3:14 [Depending on the time you need..] (28:28)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

 Depending on the time you need to experiment and that's if you already have basic knowledge. This is the key challenge of these Cloud environments and 2 clicks you have new PC up and running it does not cost much.

PARTICIPANT 3 PODCASTS.rtf - 5:7 [Agile development in itself if..] (15:15)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

Agile development in itself if you find it in small companies it might work but in terms of large corporates what ends up happening is that the Project ends up running longer than expected and the amount of changes that are required on a weekly basis by customers the customer does not usually know what they want from that Application.

PARTICIPANT 3 PODCASTS.rtf - 5:9 [In large corporates the requir..] (15:15)   (Super)
Codes: [Organisation Size - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

In large corporates the requirements stay static, you can come back and review whether those requirements have been met. And then develop the new requirements, it's easier to handle the Application Development process rather than changing the Application during every week and then trying to get your end goal

PARTICIPANT 3 PODCASTS.rtf - 5:11 [We found out that we could not..] (18:18)   (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

We found out that we could not and we had to scale our benchmarks down to a point where we could run our Application without any glitches to minimum glitches.

PARTICIPANT 3 PODCASTS.rtf - 5:19 [If you encrypting your data, y..] (23:23)   (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

If you encrypting your data, you are adding another process or functionality on top of a layer that makes it more difficult to excess your data. I would not advise encrypting unless the servers that you

are running on a very top notch and paying for a higher level account that you no longer have power over that data cause it's on someone else's server

PARTICIPANT 3 PODCASTS.rtf - 5:23 [Full migration can be in part ..] (34:34)   (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

Full migration can be in part basis where they some resources or tools on their localized server whilst others can be in the cloud. This allows a balance in migration into two different infrastructural environments.

PARTICIPANT 6 PODCASTS.rtf - 6:9 [You need to consider the type ..] (17:17)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

You need to consider the type of computing power you have got on your backend. The cost is connected directly in relation to that. Your connectivity comes into question I also recommend 10 megabits for such a business Online.

PARTICIPANT 7PODCASTS.rtf - 7:8 [I think maybe we need to show ..] (18:18)   (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology]
No memos

I think maybe we need to show them more real Applications of Cloud enablement, we need to show them what works. We need to get practical with things and we need to show them it works. Obviously the transition would not be easy and I think with enough education it can work.

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Code: Uncertainty {31-3}

PARTICIPANT 1 PODCASTS.rtf - 1:17 [When we start talking the impa..] (5:5)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

When we start talking the impact of Lean Software Development and if you wanted to build a Minimum Viable Product (MVP), you were not sure of what impact it would have in the market place and what potential it would attract

PARTICIPANT 1 PODCASTS.rtf - 1:18 [The need for Security and so o..] (19:19)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Security]

 The need for Security and so on are quite greater than the small firms, there's a distinct challenge in the sheer scale of things

PARTICIPANT 1 PODCASTS.rtf - 1:19 [It's more a question of unders..] (20:20)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

It's more a question of understanding what the impact is on your capex and how that changes. That is really a big challenge for us.

PARTICIPANT 1 PODCASTS.rtf - 1:20 [At the moment what they doing ..] (22:22)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

At the moment what they doing is somebody has to buy these things and try to compare offerings across of Cloud Providers. It's incredibly hard. The pricing strategies are a pain and hard to compare

PARTICIPANT 1 PODCASTS.rtf - 1:21 [Basically it creates an issue ..] (24:24)   (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Stakeholders]

Basically it creates an issue such that you find yourself working for a company that is fast moving and happy with Cloud Technologies but they have to integrate with some 3rd party within the stable of companies, who isn't quite of there yet.

PARTICIPANT 1 PODCASTS.rtf - 1:22 [As a result we got this kind o..] (25:25)   (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

As a result we got this kind of impendence mismatch between stockholders that still very tied to physical infrastructure basically treating the cloud as second classes something not to be trusted or something less secure than physical systems.

PARTICIPANT 1 PODCASTS.rtf - 1:23 [We have asked to see a lot of ..] (26:26)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [un reliabity]

We have asked to see a lot of unreliability of the Cloud for example Facebook went down which took out Facebook authentication, which meant that they were a lot of services that relied on Facebook authentication that were effectively locked out a lot of their customers.

PARTICIPANT 1 PODCASTS.rtf - 1:24 [Building relations for me is a..] (32:32)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Building relations for me is about trust, it's incredibly hard but if you in an office with a person you can small talk with, have lunch together and you can see when they are upset. All those things disappear when you doing business communication remotely

PARTICIPANT 2 PODCAST.rtf - 2:10 [It is always good for the busi..] (12:12)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

It is always good for the business itself to have its own policy in terms of backup or disaster recovery.

PARTICIPANT 2 PODCAST.rtf - 2:11 [In terms of security nowadays ..] (14:14)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

In terms of security nowadays it's a big challenge, the most critical component of security is actually your own people. The infrastructure can be secured but remember all infrastructure and software is used by people.

PARTICIPANT 2 PODCAST.rtf - 2:12 [That is a difficult question, ..] (17:17)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

That is a difficult question, you know Amazon had outage last year and we were not able to access their Cloud Services for a day. So we do have several data centers, Facebook, Google and Amazon also have Data Centers.

PARTICIPANT 2 PODCAST.rtf - 2:31 [You need availability for all ..] (13:13)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

You need availability for all times, if you're Cloud Computing Services are not available that day, what do you do? If you look at these services themselves they provide a mechanism you can actually save so on a daily basis. It allows you to operate offline until they are back online. Once you adopt a service you need a mechanism to protect yourself that way you can function even if they are not available.

PARTICIPANT 4 PODCASTS.rtf - 3:10 [The data centers are based in ..] (23:23)   (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Resource Availability - Families (2): Adoption - Substantive, Environment] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

The data centers are based in Western Europe in Ireland both Amazon and Microsoft and am not sure of Google and there's latency. If you hosting a Website or Application or API over there, there is a slight bit of latency. This is the most important thing for me to know and for most applications it's not disruptive.

PARTICIPANT 5 PODCAST .rtf - 4:4 [Key is good internet connectiv..] (16:16)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Key is good internet connectivity, something South Africa is way behind on.

PARTICIPANT 5 PODCAST .rtf - 4:5 [Existing developers don't want..] (19:19)   (Super)
Codes: [Geo-restriction - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Existing developers don't want to learn how to use the cloud and there is this weird idea that data in your building is safer than data on a cloud server.

PARTICIPANT 3 PODCASTS.rtf - 5:1 [What I have noticed with local..] (3:3)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

 What I have noticed with localized infrastructure the reliability in terms of excessing the services.

PARTICIPANT 3 PODCASTS.rtf - 5:8 [It has been made much longer b..] (15:15)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

It has been made much longer by the client and am not really a fan of Agile Development space but in terms of quickness in getting Projects out there, for larger companies I would not advise it yet for small companies it can work

PARTICIPANT 3 PODCASTS.rtf - 5:15 [Last week you heard that the l..] (20:20)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Connectivity]

Last week you heard that the line that ran from Morocco to USA was cutoff and we were getting slow internet connection time. If that happens to a large corporate the ability to excess your data is limited, that has impact on your business in terms of the amount processes you can run.

PARTICIPANT 3 PODCASTS.rtf - 5:16 [Storing your data is then limi..] (20:20)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Storing your data is then limited and then the amount of productivity that you have in your company is then limited. Whereas running a local server the only thing between you and that server is a switch and then you can get access and process your data however you want.

PARTICIPANT 3 PODCASTS.rtf - 5:17 [I think for me, currently it's..] (21:21)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Important comment on uncertainty]

I think for me, currently it's still limited to the fact that it's not a platform where I can fully develop my whole Application and run it from a Cloud. It is only for allowing me to access my data from wherever I want, yes I can use Cloud Services for that.

PARTICIPANT 3 PODCASTS.rtf - 5:18 [I think there's a policy in th..] (23:23)   (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

I think there's a policy in the USA that if your data goes through the States the Government has the right to read or access the data. If you look at SQL Azure, most of the servers are in the USA, the other half of the servers are in Europe. Yes you do own a certain part of your data cause you have the security in terms of account that you use for your data.

PARTICIPANT 3 PODCASTS.rtf - 5:19 [If you encrypting your data, y..] (23:23)   (Super)
Codes: [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

If you encrypting your data, you are adding another process or functionality on top of a layer that makes it more difficult to excess your data. I would not advise encrypting unless the servers that you are running on a very top notch and paying for a higher level account that you no longer have power over that data cause it's on someone else's server

PARTICIPANT 3 PODCASTS.rtf - 5:20 [If you encrypting data you put..] (24:24)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

If you encrypting data you putting more processes that make the Application slower than it should be. The minute your data is on the Internet you have no control of the data. You should acknowledge that you have no control over it, yes you do have certain control in terms of user account. The Company can do as they please, if the USA government tells Microsoft that they want to excess what's on your server. Microsoft has the obligation to give the USA government and whoever asks for it.

PARTICIPANT 6 PODCASTS.rtf - 6:9 [You need to consider the type ..] (17:17)   (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Trialability - Families (2): Adoption - Substantive, Technology] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

You need to consider the type of computing power you have got on your backend. The cost is connected directly in relation to that. Your connectivity comes into question I also recommend 10 megabits for such a business Online.

PARTICIPANT 6 PODCASTS.rtf - 6:10 [Security is also an aspect tha..] (19:19) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Security is also an aspect that the cloud provider worries about because they are responsible for the Security, essentially it's a black box there's no access in here only through this VPN that you created yourself.

PARTICIPANT 6 PODCASTS.rtf - 6:13 [There are various user License..] (22:22) (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Uncertainty - Families (2): Adoption - Substantive, Technology]
Memos: [Uncertainity about service providers]

There are various user License Agreements that do get signed. The commitment is that the data belongs to you and you can at any time opt out of the service. I do not think data ownership should be a worry.

PARTICIPANT 7PODCASTS.rtf - 7:3 [One thing I can tell you about..] (10:10) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

One thing I can tell you about African Developers is that they do not have much trust into the Cloud

PARTICIPANT 7PODCASTS.rtf - 7:4 [Maybe the Service Providers th..] (10:10) (Super)
Codes: [Supplier Efforts and external computing support - Families (2): Adoption - Substantive, Environment] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Maybe the Service Providers themselves must bring credibility to their systems by showing people they can be secure. I think we need more hackers who could test their systems.

PARTICIPANT 7PODCASTS.rtf - 7:5 [Security would be the first th..] (12:12) (Super)
Codes: [Prior technology experience - Families (2): Adoption - Substantive, Organisation] [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

Security would be the first thing, am looking for efficiency then speed, am looking for continuous allocation of resources. Am looking for an easier way of the platform maintainability and also looking for something that would allow me to work with a Team that works in USA.

PARTICIPANT 7PODCASTS.rtf - 7:9 [When you are now with Cloud Co..] (22:22) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

 When you are now with Cloud Computing not everybody wants to associate themselves with the Cloud they have that fear.

PARTICIPANT 8PODCASTS.rtf - 8:8 [We currently helping some cust..] (13:13) (Super)
Codes: [Uncertainty - Families (2): Adoption - Substantive, Technology]
No memos

We currently helping some customers to go DevOps and its one of our biggest challenges. One of our biggest challenges is culture and organizational restructure.

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