A Tool to Assess the Feasibility of VOIP for Contact Centres

A DISSERTATION SUBMITTED TO THE DEPARTMENT OF COMPUTER SCIENCE, FACULTY OF SCIENCE AT THE UNIVERSITY OF CAPE TOWN IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF INFORMATION TECHNOLOGY

By
Anton Venter
January 2005

Supervised by
Prof. Gary Marsden

Abstract

With Voice-over-Internet-Protocol (VOIP), voice calls travel over the same network as data, potentially making the voice network redundant and thereby reducing an organisation's investment in network infrastructure and its support and administration costs. Since voice is the primary communication medium for customer servicing, other benefits could potentially be realized when VOIP is applied in contact centres. However the feasibility of VOIP depends on many factors and makes the evaluation of its feasibility a complex issue.

This research proposes an assessment tool to evaluate the feasibility of VOIP in the contact centre(s) of a business, given the current and intended characteristics of the contact centre and its technology infrastructure. Execution of the assessment requires input from an individual familiar with the current contact centre and its basic technology infrastructure, rather than VOIP itself. From past implementations of VOIP and literature available, this research identifies the relevant factors that influence the feasibility of VOIP. These are used to formulate questions that make up a questionnaire. The answers to the questionnaire are applied to a calculation to produce an overall rating of the feasibility of VOIP for the organisation's particular situation.

The assessment tool was implemented as a web-based interactive application, which interrogates a user by way of the questionnaire and immediately gives a "score" indicating the feasibility of VOIP as a new technology. The resulting tool also indicates which factors made a considerable negative contribution towards VOIP not being feasible for the particular organisation.

Acknowledgements

Completion of this dissertation would not have been possible without the help and advice of the individuals below. Whether significant or small, these contributions together achieved a significant result:

Steve Blood (Gartner)
Mike Brown (Dimension Data)
Johan Bruce (Genesys Labs)
Wayne Clary (Avaya)
Etienne Dauth (British Telecom)
Rod Gilchrist (Computer Sciences Corporation)
Gavin Hill (Dimension Data)
Franz Hirschberg (Woolworths)
Michael Leak (Dimension Data)
Jacques Malan (Spescom)
Prof. Gary Marsden (University of Cape Town)
Willie McLaverty (Nedcor)
Rene Montijn (Old Mutual)
Dr. Hussein Suleman (University of Cape Town)
Prof. Bill Tucker (University of Cape Town)
Roy Volkwyn (Telkom)

Table of Contents

List of Figures

Acronyms

AA	Auto Attendant
ACD	Automated Call Distribution
CTI	Computer Telephony Integration
IP	Internet Protocol
LAN	Local Area Network
PBX	Private Branch Exchange
PSTN	Public Switch Telephone Network
PTN	Private Telephone Network
QoS	Quality of Service
TDM	Time Division Multiplexing
URL	Universal Resource Locator
VOIP	Voice over IP
VPN	Virtual Private Network
VXML	Voice XML
WAN	Wide Area Network
XML	Extended Markup Language

1. Introduction

This research will describe Voice-over-Internet-Protocol (VOIP) and what the business and technology drivers are that make this new technology an attractive option for an organisations' contact centres. It will attempt to identify the factors that influence the feasibility of VOIP. The motivations for a tool to assess the feasibility of VOIP and the methodology followed to develop such a tool will be discussed. The assessment tool is the primary deliverable of the research and it should be useable by organisations to better position them to make informed decision about adopting VOIP in their contact centres.

A prerequisite for assessing the appropriateness of VOIP is knowledge about that technology and its potential benefits. This research can be described as aiding an understanding (knowledge) of the circumstances under which to deploy VOIP successfully in a contact centre.

1.1 Motivation and Objectives of research

The feasibility of adopting new technologies depends on complex factors. In many cases new technology in the contact centre is accompanied by abundant literature from vendors and analysts. VOIP is a set of technologies being hyped by vendors and the media **[1]**. Many wild claims are being made about VOIP **[32]**. Vendors in particular only publish the selling points of VOIP and advocate returns on investment regardless of a contact centre's characteristics and how feasible it would be. Gartner's total cost of ownership (TCO) assessment of VOIP systems is not nearly as positive as vendors claim; despite this Gartner believes enterprises should and will move to this technology — when it is appropriate for them, not at a vendor's insistence **[2]**. Enterprises must be aware not to get caught up in the hype surrounding the technology or become oblivious to the business reasons for moving to VOIP **[2]**.

The relevance of VOIP is increasing **[3]**, and therefore the relevance of this research and the usefulness of an accurate assessment tool should increase. Figure 1 **[30]** illustrates a projection of contact centre telephone switch types from 2003 to 2008. If this trend does materialize, IP switches will eventually displace conventional ones, resulting in more "all-VOIP" contact centres.

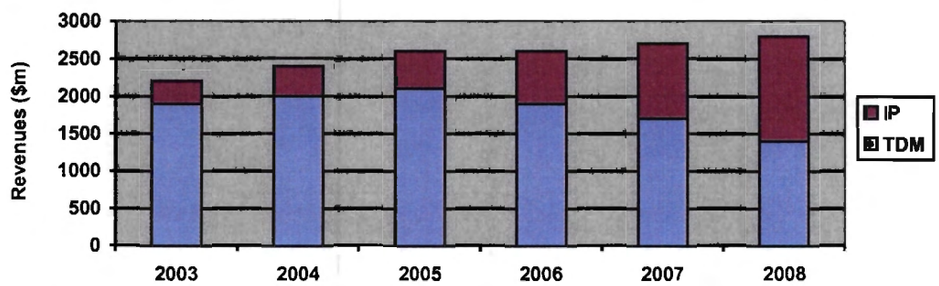

Figure 1: The Global switch market by technology, $m, 2003-2008 [Datamonitor]

This research uses as motivation that there are many complex factors that should be taken into account when assessing the feasibility of adopting a new technology and that a tool will be useful to carry out an accurate assessment of such feasibility. In the case of VOIP as a new technology, this research will develop a tool to assess its feasibility for an organisation's contact centre operation.

The research will attempt to support the statements that (1) a questionnaire can be used as a tool to assess the feasibility of a new technology for a business, and (2) in the case of VOIP for contact centres, a definitive set of factors exists that influences the feasibility of VOIP and these will be incorporated into the assessment tool.

2. Subject Background

2.1 Introduction to VOIP

The telephone is still the primary user device for customer service transactions **[4], [14]**. The voice infrastructure enables calls to be delivered via the Private Branch Exchange (PBX) to the next ready, most knowledgeable agent in the contact centre. (PBX - a telephone system within an organisation that switches calls between organisation users on local lines while allowing all users to share a certain number of external phone lines **[20]**).

Conventional contact centres rely on two networks – one for **voice (telephone)** and another for **data**. The data network transports data to the agent's desktop computer to be used in customer servicing.

Voice
The telephone network's primary purpose is to provide a call-by-call service, in which one telephone is linked via a bi-directional audio or digital path to another telephone. The "circuit-switched" telephone network provides a continuous bi-directional "pipe" to and from the other phone, which continually sends numbers or audio signals between them. The inter-exchange network is typically made of optical fiber links. Carriers initially constructed this inter-exchange network, and its international equivalents - which include geostationary satellites - to carry primarily circuit-switched telephone traffic. **[5]**
With circuit switching, an end-to-end temporarily dedicated connection path is set up from the time a call starts ringing at the called party's telephone until disconnection. No other caller has use of the transmission path for the duration of the call. **[32]**

Data
Systems are accessed over the data network to retrieve and update information during a customer servicing process. Before a call reaches an agent, advanced systems can determine from the caller's identification and/or a database query ("look-up") what agent skills are necessary to provide the fastest, most accurate, and most economical support. **[6]**

VOIP
With VOIP one can network voice (just as one would data) within or between locations **[7]**. When voice is carried over these data networks, bits of conversation are converted to digital data, and then sent as packets, just like normal data transmissions **[7]**. VOIP makes the voice network redundant and thereby potentially reducing a company's investment in total network infrastructure and its support and administration costs. A single converged network also makes it easier and more cost-effective to deploy new applications that increase productivity or enhance customer service **[8]**.

VOIP today is often used in broad terms to cover all forms of IP packetized voice transmission (over private, managed IP-based networks or the public Internet and

desktop-to-desktop, desktop-to-phone or phone-to-phone). Thus, confusion between IP telephony, Internet telephony and VOIP often exists. IP telephony refers to the delivery of the telephony application (for example, telephony features) over IP instead of circuit-switched or other modality. Internet telephony, on the other hand, refers exclusively to when voice traffic is sent over the public Internet. **[29]**

This research considers VOIP as an over-arching technology that includes the application of both IP Telephony and Internet telephony in contact centre environments.

2.2 Factors that influence the feasibility of VOIP in contact centres

One objective of this research is to arrive at a conclusive list of factors that influence the feasibility of VOIP. These factors were identified from literature as well as a survey completed by experts who have had experience with VOIP implementations. The factors identified from literature are discussed in this section and for each a conclusion is made regarding its contribution towards the overall feasibility of VOIP for contact centres. Of the nineteen factors identified, it is concluded that six have a crucial influence, two have a high influence, four have a medium influence and seven have a low influence on VOIP feasibility.

The following paragraphs will look at each of these factors in detail.

2.2.1 Intentions with "extended" agents and back-office experts

The effort to extend the resources of the contact centre into the organisation to remote workers, mobile users and knowledge workers is enhanced by the IP based contact centre **[21].** VOIP technology enables Computer telephony integration (CTI) features and voice processing applications to be delivered to each desktop in an organisation to support all knowledge worker applications. Home-based agents only need their PC or laptop, a softphone (which uses the PC for a GUI interface instead of the telephone touchtone pad), and a broadband connection to their corporate network **[9].**

When a contact centre is under-performing, the addition of just a few additional resources (e.g. home-based on a short notice) can make a huge difference in service level attainment **[10].** Using VOIP enables operations to easily deploy and re-configure services to meet fluctuating demands, such as for seasonal business peaks **[14].**

The flexibility to work at home or close to home potentially makes it easier to recruit and retain employees—especially if specific skill sets such as language or technical knowledge are required—and meet the needs of a geographically dispersed workforce. **[14]** Work-at-home options contribute to the ***second-largest cost savings*** of IP contact centres: a 50-percent reduction in turnover and absenteeism. Organisations deploying call centre agents working from home can make immediate savings on PSTN call charges by implementing VOIP over a single basic rate channel

instead of the previous approach of reserving one channel for voice and another for data communication **[13]**.

Tighter organisation-wide integration allows seamless transfers of interactions (voice and data) from the contact centre to an expert (escalation process) or offers callers a direct access to the right decision maker, or delivers interactions to extended agents when the contact centre is experiencing an unexpected volume of calls (peak of traffic management) **[30]**.

Enabling remote workers or "virtual offices" is one of the ***key situations*** that dictate the use of VOIP for almost every organisation **[12].** This factor is therefore considered to have a crucial influence on VOIP feasibility.

2.2.2 Intentions to implement multiple sites

A well-known fact of call centre management is that single large call centres run much more efficiently, from a staffing perspective, than several smaller centres. For a given service level, a single pool of agents is more efficient than several smaller groups, and the larger the agent pool, the higher the agent occupancy level. **[10]** This principle often drives the need for multi-site integration, which can become a complex and expensive undertaking that requires special software and interfaces **[9]**.

When conventional contact centres are deployed at multiple sites, branch offices are often less well served, frequently having a heterogeneous collection of locally sourced and administered small PBX and key systems. Sites are typically linked with a network routing solution and supported by site-specific adjunct applications (e.g. reporting, CTI). These environments are complex and costly to administer, operate and maintain. **[21]**

When integrating multiple sites, establishing remote branches or remote agents, there is significantly less effort with an IP-based solution **[21]**. IP telephony allows a small number of call servers to deliver telephony functionality to many branch locations. This can improve the level of voice functionality at the branches and allow them access to organisation-level services, such as voice mail or even call centre features **[13]**. Centralized management of these distributed applications can reduce administration and maintenance costs. Connecting branches using VOIP increases the potential of running a single virtual contact centre and thereby leveraging routing, reporting and workforce optimization – all of this over a data network.

With VOIP, a multi-site contact centre operation could accept calls locally at each office and then forward them over the corporate WAN to the centralized call centre. The savings on 800-number charges, combined with the ability to call between offices for "free", can be substantial despite the low cost of long distance **[11].**

The result of a VOIP deployment is that multisite operations mean lower cost and are easier to manage and maintain **[16].**

Having or planning multiple sites is one of the ***key motivators*** to consider VOIP. This factor is therefore considered to have a crucial influence on VOIP feasibility.

2.2.3 Equipment end-of-life or lease

It is most relevant to consider IP when building a new contact centre or when older conventional infrastructure has reached its end-of-life **[30]**. Transition to VOIP technology makes sense when an organisation is at end-of-life of its existing PBX or ACD technology **[24], [34]**. Replacing an aged PBX is a ***key event*** that dictates the use of VOIP for almost every organisation **[12].**

Apart from a requirement for a brand new system (e.g. as a result of relocation), or new cost/functionality advantages, Gartner regards this as ***the only other reason*** to implement VOIP **[13]**. This factor is considered to have a crucial influence on VOIP feasibility.

2.2.4 Implementation Approach to be followed

The underlying network infrastructure in a contact centre can be built on a choice of circuit-switched or IP technology, or a hybrid of both. With IP Technology voice calls travel over the same corporate network as data, which can reduce a company's investment in network infrastructure and its support and administration costs **[3]**.

An "IP contact centre" uses IP technology to operate contact centre services on a converged voice and data infrastructure. It might be an "IP-enabled" version of a conventional circuit-switched call centre, using existing circuit-switched systems while taking advantage of cost-effective, efficient IP links to connect agents and branch offices. Or it might be a "pure-IP" contact centre - built completely on IP-based components, including agent access devices, application servers, IP call control servers, and gateway mediation devices that interface with conventional telephone services. **[14]**

Given these foundations, an implementation can be planned in four different ways **[14], [23]**:

"Hybrid" scenario
Commonly referred to as a hybrid, this approach is merely an extension of the conventional environment. A conventional contact centre can be IP-enabled by supplementing its existing capabilities with VOIP. It is IP-enabled through the addition of IP trunk and/or line cards. It delivers only minor transport benefits, lowering costs of the connections between sites and to desktops where IP is used. **[15]**

Often, in the hybrid-IP approach, monitoring and reporting is disparate among contact centre sites and channels, requiring manual management and/or additional applications to provide centralized, comprehensive and integrated reporting **[27]**.
Hybrids typically rely on legacy architecture and may suffer from constrained scalability. With this approach VOIP solutions are based on legacy voice or data platforms and rolling one out at a new site could require involvement of specialists from the vendor and local reseller, which implies possible unwanted dependencies.
Hybrid implementations reduce the potential for cost savings, as two networks still have to be maintained. The approach inhibits a single platform setup across multiple sites and the benefits of the economies of scale that this brings **[27]**.

However, hybrid IP solutions cause minimal disruption, and make use of existing equipment such as standard telephones, instead of forcing an investment in IP phones. In hybrid scenarios there are no major architectural changes. Many contact centres will find that introducing a hybrid-IP approach will however lead to a longer migration to IP and at a greater expense for the contact centre **[27]**.

The cost of implementing a hybrid solution is greater than the cost of implementing a pure-IP approach. The cost and complexity inherent in the hybrid approach lead to more delayed or phased implementations, which in turn delay benefits. **[16]**

"Green Field" scenario
It can be built from scratch as a "pure-IP" contact centre. The potential benefits from VOIP are highest in "pure IP" scenarios (which imply end-to-end IP, IP phone applications and one single network). For Green Field deployments, there is only one network (for both voice and data) to install, manage and maintain. Also, holistic network management can be better achieved with a design from the ground up. A native VOIP architecture has built-in autonomy and survivability.

"Pure-IP" implementations can achieve benefits sooner by removing cost and complexity barriers **[16]**. They bring strategic benefits to the contact centre beyond just transport cost savings. These benefits include multi-site networking, multi-media handling on a single platform, and CTI Built-In at lower cost of acquisition. VOIP represents a leapfrogging opportunity for contact centres not using but considering CTI investment **[27]**.

Creating redundancy for a single network configuration is far easier than duplicating configuration and data paths for a hybrid network **[27]**.

"Replacement" scenario
Replacement entails a "Forklift" implementation, which carries the highest risk but delivers the full benefits of VOIP. In this scenario the existing conventional switched voice network is discontinued and replaced with an all-IP one.
VOIP does offer increased flexibility over conventional voice. However, companies with existing conventional contact centres who wish to establish remote contact centre functionality or take advantage of IP will likely implement IP in their newer contact centres and avoid a 'Forklift' upgrade to their existing ones.
"Forklift" upgrades often cause more issues than they're worth and could waste still functional resources.

"Conversion" scenario
Conversion can be described as a "slow" version of the replacement scenario where hybrid solutions can provide a migration path to an all-IP solution at low, per user monthly rates. This scenario offers low risk with the ultimate full benefits of VOIP. It is preferable for companies with an existing communications infrastructure to migrate over a period of time, easing the learning factors for personnel, maintaining the stability, and making the most use of existing equipment until the customer is ready. In a conversion scenario customers can evolve to IP at their own pace to avoid extensive retraining over a short time period.

According to Nemertes research **[17]**, 31 of 50 large companies surveyed in 2003 reported that they're using VOIP technology and the survey indicated that "pure" VOIP systems are about 22% less expensive to operate than circuit-switched networks (this research was not sponsored by any IT vendors).

In a 2002 survey conducted by Ashton, Metzler & Associates in conjunction with Key3Media **[18]**, respondents rated potential savings on the administering, upgrade and maintenance of VOIP systems as 17% of the total motivation for adopting VOIP. In the same survey potential savings as a result of avoiding wiring required for conventional applications was rated as 5% of the total motivation.

Apart from equipment reaching end-of-life and new cost/functionality advantages, Gartner regards a requirement for a brand new system (i.e. "Greenfield" approach), as ***the only other reason*** to implement VOIP **[13]**. For organisations planning a "Greenfield", "Replacement" or "Conversion" implementation, savings as a result of a single network is a major contributing factor towards VOIP feasibility and therefore the factor of which approach to follow is considered to have a high influence on VOIP feasibility.

2.2.5 Scope of Contact Centre Applications

A single converged network potentially makes it easier and more cost-effective to deploy new contact centre applications that increase productivity or enhance customer service. In a conventional contact centre examples of such applications are CTI, Interactive Voice Response (IVR) and Automated Call Distribution (ACD).

Computer telephony integration (CTI) enables communication between the phone system and any database that stores caller-related information **[19]**. CTI can be used to "attach" data retrieved over the data network to a voice call to ensure information related to the caller is delivered to the agent's desktop computer at the same time as the call **[32]**. CTI also enables intelligent routing, using its ability to retrieve routing information over the data network.

Interactive Voice Response (IVR) is a software application that accepts a combination of voice telephone input and touch-tone keypad selection and provides appropriate responses in the form of voice, fax, callback, e-mail and perhaps other media. IVR is usually part of a larger application that includes database access. **[20]**

An Automatic Call Distributor (ACD) is a telephone facility that manages incoming calls and handles them based on the number called and an associated database of handling instructions **[20]**. ACD functions include typical routing of calls based on the length of call queues, the agents available to take calls, and the skills they offer.

Traditionally, IVR, ACD and CTI usually remain islands of distinct applications, with little (or no) interplay among them. Maintaining the conventional separate environments in contact centres for them is typically very expensive. Usually, little overlap exists among these platforms and each functionality type requires a unique set of skills for programmers, installers and users. Overall system administration is far more complicated and expensive. To administer such a complex infrastructure, a

company usually must employ additional IT professionals who possess diverse skill sets that are not easily transferable among platforms.

The scope of applications becomes relevant to VOIP feasibility due to the fact that greater convergence offered by running voice and data over the same network allows for more sophistication and interaction between these applications **[1]**. With a single platform provided by IP, applications can interact much more easily and freely within and across IVR, ACD and CTI packages. The converged network will be a vastly improved network, and contact centre applications—if they're engineered to take advantage of it—will be much more capable than ever before. Contact centre applications will link the converged network directly to business goals, and convergence will, in turn, profoundly change the way contact centres function **[21]**.

The nature of IP networks allows for deploying an application once, and letting numerous users access the same application. The integrated ACD/PBX, CTI, IVR, Voice Mail, Reporting and multimedia are consolidated into a single application instance in a central location. **[21]**.
VOIP potentially enhances an organisation's ability to upgrade "building blocks" as needed and quickly deploy new innovative applications as they come to market, such as **[21]**:

- On-demand network IVR that make use of IP-based media servers and the Web
- IP-based video conferencing/video kiosk

VOIP enables easier integration with the desktop and a contact centre's core applications **[16].** An IP telephony system that provides or is being planned to provide a wide range of business and contact centre applications, along with the tools to easily create new applications, will maximize user productivity and improve customer service **[21]**.

Respondents in a 2002 survey **[18]** rated the ease of deploying new integrated applications as 13% of the total motivation for adopting VOIP. In the same survey the ability to deploy voice functionality was rated as 12%.

Apart from equipment reaching end-of-life and a requirement for a brand new system, Gartner regards new functionality advantages as ***the only other reason*** to implement VOIP **[13]**. This factor is considered to have a crucial influence on VOIP feasibility.

2.2.6 Execution of multi-media servicing

Voice is still the dominant channel for providing contact centre service, but customers will grow more conditioned to multi-channel communication, and the ability to meet that expectation—a key strength of IP—is becoming a key differentiator **[22].** The conventional telephone network cannot support bandwidth-intensive applications, such as streaming video. Video is not widely used by contact centres yet, but as broadband access becomes mainstream, customers could eventually expect to be able to view agents, interactive product demos, or informational broadcasts as part of their online experience.

When servicing requires agent interaction, it can take place over any IP-supported medium the customer prefers, including voice, chat sessions, and e-mail **[9]**. The same "packet technology" can be used to transport all these interactions **[32]**.
With adequate network performance, IP contact centres could readily support high-end services such as video—simply not feasible on conventional voice networks. **[14]**

Once the VOIP platform is in, an organisation can readily add media over time, as the customers and market demand it. The customer has choice and control, and receives optimized service regardless of media. **[16]**

For other organisations, the ease of installing and maintaining an IP contact centre is enough of a benefit, even without the additional channels. However, if large numbers of Internet channel contacts are handled and they're likely to increase, ***VOIP is feasible.***
The regular use of collaborative tools, including a high volume of video, audio, or Web conferencing calls is one of the ***key situations*** that dictate the use of VOIP for most organisations **[12]**. This factor is considered to have a crucial influence on VOIP feasibility.

2.2.7 Ease of scaling up or down

By definition, IP is highly scalable and flexible. The ubiquity of IP services means that almost any home or branch office can become an extension of the IP contact centre, with only minor investments in IP access devices and interfaces. Contact centre managers can therefore add agents whenever needed to meet seasonable business requirements or new promotions. Capitalizing on the reach of the Internet, contact centres can be easily set up and dismantled for transient requirements. **[14]**

With pure-IP, contact centres are able to quickly and efficiently scale up or down as needed on a site-by-site basis **[27]**.

Due to the fact that only one network supports both data and voice, simpler Moves, Adds, and Changes (MACs) are required when scaling contact centres up or down **[23]**. Users are able to make their own moves, adds and changes in minutes simply by unplugging their IP phones from their network ports and plugging them into others without having to rely on specialists to answer service requests, with no corresponding loss of productivity **[24]**.

Respondents in a 2002 survey **[18]** rated potential savings on MACs as 9% of the total motivation for adopting VOIP.

Some companies have justified VOIP rollouts ***entirely*** on the basis of MAC savings. Some IP telephony solutions can reduce the move/change part of MACs to virtually zero. **[25]**

Spending money to have a vendor or outside firm handle moves, adds, and changes is one of the ***key situations*** that dictates the use of VOIP for most organisations **[12]**. This factor is considered to have a crucial influence on VOIP feasibility.

2.2.8 Readiness and characteristics of existing data network

Although IP telephony can theoretically be implemented on any existing local area network (LAN) infrastructures, it is rarely the case - all existing LANs will require a certification process **[33]** and it is extremely rare for an organisation's LAN not to require some upgrading to be capable of supporting the organisation's voice requirements **[14], [13].** This additional effort required could disrupt the intended business case and can lead to high-level disillusionment with the project **[13].**

Gartner **[33]** offers the following rule of thumb: data networks between two and three years old will need about 30 to 50 percent of the equipment upgraded for successful voice over IP. The upgrade rate rises to 80 to 100 percent of equipment for data networks more than five years old.

Routing protocols (rules by which data is routed on a network), affect a network's performance. OSPF (Open Shortest Path First) is a router protocol used within larger autonomous system networks in preference to the Routing Information Protocol (RIP), an older routing protocol that is installed in many corporate networks. Older protocols like RIP will reconfigure the network, but cannot deliver the fast recovery times of OSPF. **[20]**

Ethernet is a technology and protocol for managing traffic on a LAN. It is currently the most popular, widespread and extremely cost-effective **[32].** Since VOIP builds on it **[32],** an Ethernet network is more suitable for VOIP than other technologies such as Tokenring and in fact ***critical to a successful VOIP implementation.***

The time-sensitive nature of VOIP applications requires collisions – a major contributor to delay and jitter – to be eliminated by having a ***switched as opposed to a shared*** network. The contention resulting from sharing leads to poor performance for VOIP and if the network isn't properly configured (fully switched and not shared), the results can be unpredictable **[26], [32].**

Some organisations implement Virtual Private Networks (VPNs). VPN is a method for using a public network (like the Internet) for an organisation's private business **[32].** To address security, information is encrypted and decrypted between sending and receiving sites **[32].** Large delays are typically inherent in some VPN products, mainly due to the encryption and decryption required; ***if VPN is run on the Internet, voice quality is at risk,*** as "in the world of VOIP, delay kills" **[32].**

In summary network readiness, type of network and network characteristics play a major role in VOIP success and this factor is considered to have a high influence on VOIP fasibility.

2.2.9 Intentions with Contact Routing

The inherently flexible IP environment makes it more feasible to create or dissolve groups, and to change agent assignments. The skills-based routing capability enables an almost unlimited level of differentiated services, and can have a huge impact on contact centre efficiency and efficacy **[9]**.

VOIP is therefore very relevant in a cost and volume environment where ***investments in routing,*** which lead to efficiency gains, will pay off **[30]**. Although still relevant, routing cannot be considered as a "key situation" for considering VOIP and this factor is therefore considered to have a medium influence on VOIP feasibility.

2.2.10 Savings on Toll Costs

IP contact centres no longer have to pay PSTN telephony charges when a call is routed from one contact centre to another. In addition, traditional telephony costs adhere to a utility pricing model where contact centres are charged on a pay-per minute basis, whereas IP services are generally priced on a flat- rate basis. Communication costs in an IP contact centre therefore transforms from a variable cost to a fixed-cost, providing for improved cost management in the contact centre **[27].**

With VOIP, ***desk-to-desk*** dialing could contain an organisation's overall telecoms costs **[13].** Some companies report savings on ***domestic long-distance*** charges, but this is typically limited to large companies that have huge volumes **[25]**. The tie trunks between company-owned PBXs could be replaced by an Intranet link and would provide large savings at a good quality of service **[28].**

Although perceived as such, savings in toll costs on ***long-distance*** calls is not one of the more significant cost saving factors of VOIP **[14]**, unless all calls are made from VOIP users to other VOIP users, thereby avoiding being switched to conventional telephone lines and carriers.

Potential regulatory impediments prohibit bypassing local operators (often partially or fully owned by the government) because VoIP is not measured or taxed (Internet access is taxed, but not voice usage), thus reducing the tax revenue available to local authorities, which are often used to fund public telecom projects or universal service. **[29]** In South Africa, Telkom has had a monopoly on the telecommunication infrastructure, limiting the possibility of using VOIP to avoid call costs.

Nevertheless, some research found that a high volume of ***international traffic*** is considered one of the ***key situations*** that dictate the use of VOIP for most organisations **[12]**. For international operations and 0800 numbers VOIP can generate significant cost savings **[14].** In most cases, costs will drop for international calls **[25]**.

In a 2002 survey **[18]** respondents rated potential savings on ***international calls*** as 10% of the total motivation for adopting VOIP. In the same survey respondents rated potential savings on ***domestic calls between national sites (within the organisation)*** as 17% of the total motivation for adopting VOIP and those on ***domestic calls outside the organisation*** as 4%.
Savings on toll costs are dependant on some factors (e.g. volumes of calls, whether they are domestic or international, the impact in South Africa of Telkom's strategy for VOIP), and therefore this factor is considered to have a medium influence on VOIP feasibility.

2.2.11 Size of Contact Centre Operation

An ideal candidate for an IP contact centre is ***a medium to large*** organisation that must connect with agents who are spread across multiple sites or remote offices **[14].** Small and medium sized organisations establishing new sites or expanding operations can also benefit **[14].** More seats increase the leverage from having all skills pooled and from optimizing workload across workforce – all of this over a data network

Companies considering IP telephony ***for larger contact centres*** should obtain and verify case studies of successful large-scale implementations from prospective vendors **[30]**.

For ***smaller*** contact centres with high ratios of Internet channel contacts, new contact centres and virtual contact centres, the case for investing in IP is also strong **[30].** Small businesses that are in need of a voice system should strongly consider an IP-based PBX. These solutions enable small businesses to implement functions such as unified messaging and CTI, capabilities that can be prohibitively expensive for them to implement with conventional PBXs and key systems. **[24]**

The size of a contact centre operation generally influences VOIP feasibility positively, as most other factors influence the feasibility of VOIP more as the size of the operation increases. This factor is considered to have a medium overall influence on VOIP feasibility.

2.2.12 Network Management Strategy

Organisations need to be aware of the network management issues involved in moving from a conventional voice environment to a packet environment. This requires organisations to prepare for ongoing management, monitoring and documentation of the network to assure quality is maintained **[21]**. It's imperative to consider network-optimization tools that help manage the bandwidth and prioritize traffic **[12]**. To avoid delays in voice conversations, network policies must be set to manage voice and data traffic efficiently to ensure that voice traffic is prioritized over data traffic **[7]**.

Network testing isn't just important at the start of a VOIP project, but is an ongoing requirement of any successful long-term VOIP implementation. The addition of new applications, the extension of the network to new locations, and increases in network utilization can all potentially impact VOIP quality.

It is important to implement VOIP quality monitoring using tools from a vendor or a third-party. These tools and an operational plan should be implemented to proactively react to changing network conditions **[21]**. Transitioning to voice and video over IP requires rock-solid quality of service **[31]**.

The customer (e.g. contact centre or customer service management) should preferably be in charge of bandwidth and the priority of voice over data. Quantifying the reach of the contact centre is important in understanding bandwidth requirements **[30]**. The reach of the contact centre is determined by the organisation's need to have specially trained personnel in the back office, the field or in home offices and these will need

network access.

Organisation voice and data groups should work closely to implement new IP telephony projects, yet political, budget and power battles can arise **[13]**. Organisational issues resulting from a change in technology as significant as the convergence of voice and data can well be the most difficult challenge that corporations will face. **[1]**

In a 2002 survey **[18]** it was noted that very few respondents (2–3 percent) either expect or have achieved any reductions in networking staff as a result of VOIP. Respondents rated potential savings on reduced networking staff as only 2% of the total motivation for adopting VOIP. In some cases companies might have to hire people with expertise in both voice and data - and that comes with a premium **[25]**.

Correct staffing and network management tools are considered critical to sustaining a successful VOIP implementation. However, organisations should not make immediate savings from a single network support team a critical feasibility factor for VOIP. This factor is considered to have a medium influence on VOIP feasibility.

2.2.13 Carrying voice on the WAN and/or LAN

LAN bandwidth is typically abundant, while WAN (wide area network) is typically a relatively small fraction of the LAN. The challenge of obtaining adequate quality of service is exacerbated when a data packet must traverse the WAN. Typical LANs run at 10 megabytes per second (Mbps), 100 Mbps, and some even have bandwidth of a gigabit per second (1000 Mbps) and higher **[31]**.
Latency (end-to-end network delay) is a lower risk in a LAN-only deployment because of higher bandwidth as well as internal control of the network. In a WAN deployment network control is usually ceded to a network service provider **[32]**. For cost reasons, bandwidth availability on the WAN is more finite compared to the LAN, hence it is necessary to have an established prioritization policy for voice and data flowing across these networks **[21]**.

VOIP implementations carry more risk in an organisation where WANs are used in addition to LANs. However these risks can be addressed by QoS management and ensuring adequate WAN bandwidth, therefore this factor is considered to have a low influence on VOIP feasibility.

2.2.14 IP Telephones

IP phones are relevant when new functionality is needed on the telephone, or on a softphone that the PBX does not provide.

Most IP telephones can be powered via an AC adapter or in-line via the Ethernet cable. Deploying in-line power in conjunction with Ethernet switches that have redundant power (either via UPS or other solutions) ensures that a phone system will work in the event of a power outage **[33]**. Powered switches can be beneficial for phones in common locations such as conference rooms and reception areas where

there may not be enough power outlets available. Ideally, mission-critical contact centres use ***line-powered*** phones **[32].**

The issue of IP phones is not critical and this factor is considered to have a low influence on VOIP feasibility.

2.2.15 Carry-over of ACD functions

The average PBX comes standard with more than 400 features, covering a broad and flexible spectrum of voice options. Features matter; features are far more than just conference, transfer, hold, and drop. Powerful features fuel productivity and efficiency. While it's unlikely that any single customer uses more than a few dozen features, collectively the universe of customers needs many hundreds of features. **[6]**

A "Conversion" implementation could allow legacy features to be carried over, which will result in a ***richer IP system***. This is not a critical factor and is considered to have a low influence on VOIP feasibility.

2.2.16 Easily support peak loads and 24/7 service.

By dynamically distributing calls among agents in many locations and time zones, contact centre managers can support extended business hours and dramatic shifts in demand at far less expense. This flexibility helps attract and retain customers by making it easier to do business with - any way and any time **[14]**.

The literature studied did not indicate any trends, but it is assumed that seasonal peaks are more challenging than daily peaks, as seasonal peaks might require temporary staff to be employed, or similar measures more drastic than scheduling a permanent workforce to cope with daily peaks.

This factor is considered to have a low influence on VOIP feasibility.

2.2.17 Disaster Recovery

Contact Centre operations that are faced with pressure to come up with a flexible disaster recovery or emergency overflow plan can benefit from VOIP **[14]**.

By centralizing application logic, disaster recovery sites and procedures can become much simplified with VOIP. In many cases, IP contact centre vendors such as Interactive Intelligence offer hosted disaster recovery services that essentially duplicate contact centre applications. Operationally, contact centre agents simply log into the disaster recovery systems that are hosted either from home or an alternate location and instantly have all applications that were on the production system. Since IP networks are typically build using multiple nodes for traffic re-routing, etc. and since IP phones can logically re-route voice to other proxies and services, a new element can be added to the conventional view of voice reliability. As a result, disaster-proofing telecommunications can very well end up being easier using VOIP

than conventional approaches, which can improve reliability over conventional system approaches. **[21]**

Although disaster recovery can benefit from VOIP, it is not a key situation for adopting VOIP and this factor is considered to have a low influence on VOIP feasibility.

2.2.18 Number of Skills and Queues across a Geography

IP-based contact centre technology offers new opportunities for distributed contact centres that include skills and queuing regardless of geographic location of the agent as well as business continuity **[21], [14]**. A higher number of call queues increases the benefits of leveraging IP for queue-specific Auto Attendants (AAs), contact routing, and data lookups. In a conventional operation, each different queue typically requires vendor/specialist involvement to develop or change AA, routing and CTI functions.

A high number of skills and queues can benefit from VOIP when geographically spread, but this is not a key situation for adopting VOIP and this factor is considered to have a low influence on VOIP feasibility.

2.2.19 Quality of Service (QoS)

QoS refers to the reliability and sound quality of a telephone conversation. Many people have a negative perception of VOIP because their initial exposure was with early Internet telephony services that provided free phone calls over the Web with marginal quality and less than optimal overall experience. The public Internet could not meet the stringent requirements of voice traffic, in terms of latency, jitter, and packet loss. **[14]**

Today still, a strong perception among enterprises is that VOIP quality is poor, and incumbent carriers often cite it as a reason to delay the introduction of VOIP. While this may have been a valid reason a few years back, VOIP quality on effectively peered and well-engineered IP networks is frequently now at, or near, par with conventional voice quality. **[29]**

When VOIP traffic is sent over a privately managed network or controlled Internet backbone, these quality-of-service issues can be mitigated or eliminated. In the five years since the first IP contact centre systems were introduced, vendors have invested considerable research and development into enhancing voice quality. With engineering and QoS measures in place, users should not experience a difference in voice quality between circuit-switched (conventional) and packet-switched (IP) telephony **[14].**

Better network bandwidth capacity decreases risks associated with QoS, resilience, etc. Voice quality on managed IP networks (controlled Internet backbones or an organisation's private network) can emulate that of the public voice network. With new codecs (devices in an IP phone that take the analog voice input and convert it to packetized voice **[32]),** some vendors have even improved voice quality on IP telephones beyond that of conventional telephones. New codecs typically use less

bandwidth— consuming only 8 kilobytes per second (kbps) to produce acceptable voice quality, compared to 64 kbps with conventional lines **[14].**

IP based systems with distributed architectures are redefining the metrics used to measure system performance – no contacts lost. By virtue of its distributed design, these systems provide built in redundancy of components. They use reliable off-the-shelf server components. And they can provide automatic call redirect in the event that a node on the network is taken out of service **[34].**

In a 2002 survey of VOIP implementations **[18],** respondents rated QoS as 28% of the total challenge for success.

Provided tools are implemented to manage QoS, it is considered to have a low influence on the feasibility of VOIP.

Summary

The following table (Figure 2) summarises the factors identified and their importance according to the literature surveyed.

The importance of each factor was ranked according to the conclusions made in the previous discussion on each factor. The conclusions in turn were made based on the literature and the opinions of Gartner where this organisation published comments on a particular factor.

Conclusions that described a factor as a key situation, motivator or event, or that described a factor as one of the main motivators for VOIP implementation resulted in a ranking of "crucial" for that factor. Factors that were concluded as playing a major role in VOIP success were ranked "high". Factors that were relevant to VOIP feasibility but only under certain circumstances were ranked "medium". Factors that could influence VOIP feasibility but where any associated risks could be mitigated were ranked as "low".

FACTOR THAT INFLUENCES VOIP FEASIBILITY	IMPORTANCE ACCORDING TO LITERATURE
Use of home-based agents and back-office experts	CRUCIAL
Intentions to implement multiple sites	CRUCIAL
Voice equipment is at end-of-life or end-of-lease lease	CRUCIAL
Implementation approach to be followed	CRUCIAL
Scope of Contact Centre Applications	CRUCIAL
Execution of multi-media servicing	CRUCIAL
Ease of scaling up or down	CRUCIAL
Readiness and characteristics of data network	HIGH
Existence or plans for advanced Contact Routing	MEDIUM
Savings on Toll Costs	MEDIUM
Size of Operation (number of seats and branches)	MEDIUM
Network Management Strategy	MEDIUM
Ratio of voice to be carried on the WAN vs. LAN	LOW
IP Telephones (new features, power supply, etc.)	LOW
Ability to carry-over ACD functions to VOIP systems	LOW
Easily support peak loads and 24x7 service	LOW
Disaster Recovery requirements currently or planned	LOW
Number of Skills and Queues	LOW
Quality of Service (QoS)	LOW

Figure 2: Importance of factors influencing VOIP feasibility, according to literature.

3. Description of Work

3.1 Approach Followed

From the abundant literature available on VOIP, a list was derived of factors that appear to influence its feasibility. For each factor a preliminary conclusion was made regarding its degree of influence on VOIP feasibility (four levels were used – crucial, high, medium and low).

In order to validate the reliability of the list derived from literature, contact centre industry specialists were surveyed to get a view of their perceptions regarding how much each factor influences VOIP feasibility. These experts were selected based on their real-life experience with VOIP implementations or their position to comment on the results of real-life VOIP implementations. They were also asked for factors in addition to those mentioned in the survey that in their opinion influence the feasibility of VOIP. These experts represented commercial, government and academic institutions. Commercial representation included organisations that make use of contact centre technology implementers as well as implementers themselves. **Appendix A** contains the survey questions and the details of participants.

The first step towards building a VOIP feasibility assessment tool was to formulate one or more questions for each feasibility factor on the list derived from literature and validated with the survey. These questions would have to be asked in order to ascertain whether each factor would contribute towards VOIP feasibility for a specific organisation and its contact centre operation, and if so, to what degree.

Using as an example the factor "Implementation approach to be followed" (sub-section 2.2.4), questions needed to be asked to identify whether an organisation is planning a "Hybrid", "Replacement", "Conversion" or "Greenfield" deployment of VOIP. If the answer was "Hybrid", this factor would contribute little or nothing towards VOIP feasibility as there will only be marginal savings depending on how aggressively the VOIP side of the operation is grown into the future. If the answer was "Replacement", this factor would contribute more towards VOIP feasibility as this approach carries a high risk, yet has the potential to deliver the full benefits of VOIP. If the answer was "Conversion", this factor would contribute highly towards VOIP feasibility since the existing two networks will be reduced to one, but over time, which means less risk than a "Replacement" approach. If the answer was "Greenfield", then the factor "Implementation approach to be followed" would contribute most towards VOIP feasibility as there is no operation to start with and hence the full benefits of VOIP can be realised from the start.

As can be seen from the above example, some questions in the assessment had multiple answers to choose from (a "selection" of answers). For this type of question each selection had a weight assigned to it out of ten and the scale used was the same as for the weight assigned to the factor that the question addresses (0, 2.5, 5, 7.5 or 10). In the example above, the selections were "Hybrid", "Replacement", "Conversion" or "Greenfield" and the weights assigned to them were 2.5, 5, 7.5 and

10. Weights assigned to selections were a "best effort" and based on the literature studied. They may change over time as VOIP matures.

The following examples illustrate how the scores for each factor were calculated.

Example 1:
The factor "Quality of Service" has an overall weight of 5 (medium influence on VOIP feasibility), it has one question and the possible selections (answers) are "yes" or "no".

Overall weight	Answer selected	Weight of selection	Score to be accumulated towards overall assessment score
5	Yes	10	5 * 10 = 50
5	No	0	5 * 0 = 0
	Maximum score towards overall assessment score for this factor		**50**

Example 2:
The factor "IP Telephones" has an overall weight of 2.5 (low influence on VOIP feasibility), it has two questions and the possible selections (answers) to each question are "yes" or "no".

Overall weight	Answer selected for first question	Weight of selection	Score to be accumulated towards overall assessment score
2.5	Yes	10	2.5 * 10 = 25
2.5	No	0	2.5 * 0 = 0
	Answer selected for second question		
2.5	Yes	10	2.5 * 10 = 25
2.5	No	0	2.5 * 0 = 0
	Maximum score towards overall assessment score for this factor		**(25 + 25) / 2 = 25**

Example 3:
The factor "Size of Operation" has an overall weight of 5 (medium influence on VOIP feasibility), it has one question and there are four possible selections (answers).

Overall weight	Answer selected	Weight of selection	Score to be accumulated towards overall assessment score
5	1 or 2 sites and few seats	0	0
5	1 or 2 sites and many seats	2.5	12.5
5	3 or more sites but few seats	5	25
5	3 or more sites and many seats	7.5	37.5
5	More than 5 sites and many seats	10	50
	Maximum score towards overall assessment score for this factor		**50**

Questions were arranged into logical sections and in logical sequence (i.e. questions that address a related topic were kept together).

The questions were divided into the following four sections:

- Section 1 attempted to gather information on the organisation's contact centre servicing capacity and the makeup of its centres.
- Section 2 gathered information on the functionalities supported (or intended) in the contact centres. This information is important due to the potential of VOIP to support applications that provide business functionality to the contact centre.
- Section 3 focused on infrastructure. It gathered information on the organisation's network capacity, and specifically in the contact centre area, where the focus was also on the contact centre agent's desktop PC capacity to support voice communication over a "soft" phone, earphones and microphones.
- Section 4 was further divided into 2 sub-sections, but only one was applied depending on the particular type of implementation planned for an organisation. The application of the appropriate section was driven by the participant's indication of the particular type of implementation.

Using the above questions, a prototype questionnaire was designed and developed into an assessment tool that would calculate a final score indicating VOIP overall feasibility. **Appendix B** contains the list of questions that make up the questionnaire for the assessment tool as well as how the weightings were arrived at for each. The formula for calculating the final assessment score is also described.

Initially the following interpretation of assessment results was adopted:

Scores below 50% - VOIP is definitely not appropriate.
Scores between 50% and 60% - VOIP is only appropriate if the organisation has specific objectives (e.g. establishing offshore servicing) that require VOIP infrastructure, otherwise it is not appropriate.

Scores between 60% and 70% - VOIP is appropriate but will require a strong business case to ensure ROI.
Scores between 70% and 80% - an ROI is attainable with reasonable certainty.
Scores between 80% and 90% - an ROI is almost guaranteed.
Scores higher than 90% - the organisation has a golden opportunity and should embrace VOIP in order to realise the guaranteed ROI.

As a last step the assessment tool was made available for evaluation purposes to individuals who make decisions or advise others on decisions to adopt a new technology for their organisation's contact centre operation. The results of this evaluation are discussed in chapter 5 – Conclusions.

Appendix C contains the details of the second survey, which was conducted to obtain feedback on the evaluation of the tool.

3.2 Methodologies Used

Questionnaires
The assessment tool is essentially a questionnaire and the following principles were applied in the design of the questionnaire:

- It is a made up of mostly closed questions (yes/no) or answers on a scale that are selected by radio buttons (this increases reliability – as defined by Kirakowski **[36]**, "the ability of the questionnaire to give the same results when filled out by like-minded people in similar circumstances").
  As the assessment immediately returns a rating on the feasibility of the technology, no open-ended questions are used.
- It was inappropriate to use techniques such as negative questions to check the user's intentions, as these were assumed to be honest, i.e. individuals using the assessment tool will do it for the sole purpose of getting an accurate opinion on whether VOIP is suitable for their organisation's contact centre.
- As far as possible the ordering of scales is kept intuitive and consistent.
- The maximum number of options to select on any question is 5. This is in line with findings from Kuter and Yilmaz **[35]** - "...there is considerable evidence to suggest that anything over a five point scale is irrelevant, this depends partially on education."
- An attempt is made to avoid jargon, but where unavoidable, help is provided in the form of "Tell me more" buttons to explain technical terms in more detail. (For example, "How many IVR and Web applications exist or are being planned" – the "Tell me more" button will provide a short explanation of IVR and Web applications).
  The questionnaire is divided into four sets of questions in such a way that general questions (first three sets) precede specific ones (fourth set).

Of the four kinds of data generally used in questionnaires (interval, nominal, ordinal and ratio data), most questions gather ordinal data. Each question requires one selection to be made (on a scale or a yes/no), which gets weighted and added to an

overall score. The total score is shown as a percentage and this indicates the organisation's readiness for the new technology.

The three basic types of questions as defined by Kirakowski **[36]** are represented as follows: Factual 82%, Opinion 18%, Attitude 0%. Questions that rely on opinion are about future intentions for the organisation's contact centre.

"Predictive" evaluation was used to ensure the usefulness of the tool (i.e. user-less testing that predicts how someone would react based on psychological insight into human behavior). Some design heuristics according to Jakob Nielsen **[37]**, were applied in the design of the questionnaire. This was achieved by the use of a standard web browser, which brought the benefits of (1) consistent visibility **of system status,** (2) following the Internet platform conventions for **consistency and standards,** and (3) **aesthetic and minimalist design** by using JavaScript. The design heuristic of **recognising, diagnosing and recovering from errors** was supported by the coding of a function to validate that the user does not skip any question(s) and if he/she does, to go directly to the skipped question.

Software Development Methodology

The final assessment tool evolved through phases. As a typical user-centered web application, the assessment tool was suited to the rapid application development (RAD) methodology. RAD is a programming system that enables programmers to quickly build working programs. **[38]** In general, RAD systems provide a number of tools to help build graphical user interfaces that would normally take a large development effort. RAD's iterative process of design (iteration in this context is a commitment to incremental development based on refinement **[39]),** development and testing, or evolutionary prototyping (an approach based on creating a demonstrable result as early as possible and refining that result **[39]**), was chosen above others such as the "waterfall" approach, which entails the execution of distinct chronological phases that are not repeated.

In the following section describing the evolution of the tool, some of the problems encountered and solutions found are listed.

The first phase entailed the formulation of the questions and designing the weightings and final score calculations.

Problem: Trials with some users at this point highlighted that many terms used in the questions were new - even to individuals familiar with contact centres and voice networks. Some new terms are introduced with VOIP, and contact centre staff was not actively concerned with data networks before - network capacity and performance are vital aspects of VOIP implementations.

Solution: Each question was provided with a button "Tell me more", which displays a window with a brief description of the terms used in the question.

Initially the assessment presented a single message at the end with the total score for VOIP feasibility as a percentage.

Problem:

The overall score was displayed using the "document.write" JavaScript statement, which does no rounding. No "rounding" statement was found in Java web material.

Solution:

A function "format_number", was eventually found and implemented with success.

Problem: A single score might give a useful indication of feasibility that can assist management in confirming whether to go ahead with VOIP exploration. However some users felt that they needed more information on where their particular organisation falls short or is well positioned for adoption of VOIP in its contact centres.
Solution: The solution to this problem was evolved. At first those topics where the organisation fell short were displayed. Thereafter Java was explored for functions that can display graphs, but nothing suitable was found. Eventually for each question together with its weighted score, a blue (positive score) or red (negative score) character string was displayed – the number of characters corresponding to the score for that question. Ultimately this created a visual effect of overall VOIP feasibility.

The next phase entailed the grouping of the questions into logical groups, for the following reasons:

- logical groupings would help the user focus on a particular aspect of their organisation at a time instead of covering multiple aspects in a random order
- it would break the monotony of having to answer a long list of questions
- some questions depended on the particular type of implementation, driven by the organisation's situation – four sub-groups of questions were created so that one would be selected depending on the type of implementation planned
- general questions could be grouped together, followed by ones specific to the organisation's environment

Problem: Introducing groups of questions did not reduce the total number of questions to be answered, resulting in some intimidation felt by users in reaction to such a long list of questions.
Solution: Although I tend to agree with Kirakowski **[36]** that "Long questionnaires will tend to produce good reliabilities with well-motivated respondents", messages were added at 20%, 40%, 60% and 80% intervals to indicate progress with answering the questions, in case some respondents lacked motivation to persevere to completion.

3.3 Discussion of Assessment Tool

Objectives
The decision to adopt or move to VOIP needs numerous factors to be taken into account. While contact centre specialists might develop or have an intuitive "feeling" whether VOIP is right for an organisation or not, managers will benefit from the scientific approach this tool follows and if used, they can be more confident that all factors have been taken into account in its evaluation and that a reasonably accurate score has been obtained.

Selection of Technology
To promote accessibility and to avoid specialized software and hardware, the tool has been developed as a web-based, JavaScript application that can be executed from any PC that has Internet connectivity and that can execute JavaScript. The simplicity of

the tool allows it to be easily converted to a spreadsheet-based application for users that do not have access to the Internet.

Design

The assessment model uses radio buttons and each answer therefore forces a selection of one option. Two weighting factors are used. Each optional answer to a question has a weighting on a percentage scale. The second weighting is assigned to the question as a whole in order to properly position its importance in relation to other questions in the assessment.

The questionnaire is not a survey in the sense of gathering information from a large number of users, but a tool for an organisation to "calculate" or assess their readiness for VOIP.

Implementation

Due to the browser-based technology, implementation consisted of loading the JavaScript file onto a hosted website and making the URL (Universal Resource Locator) available to users. The assessment displays its results in a browser window from where it can be printed as a report. No data is stored during or after the assessment.

Figures 3 and 4 illustrate the first and results pages of an example assessment.

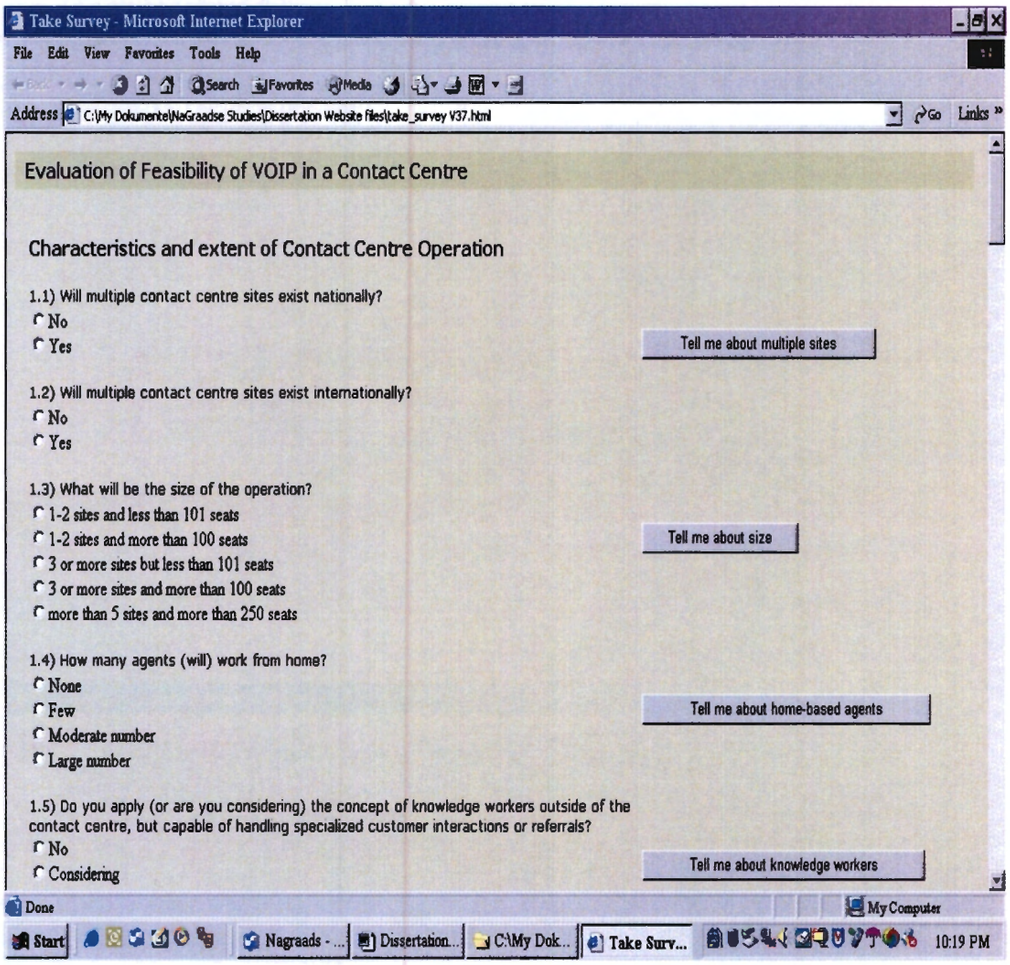

Figure 3: First page of an example assessment

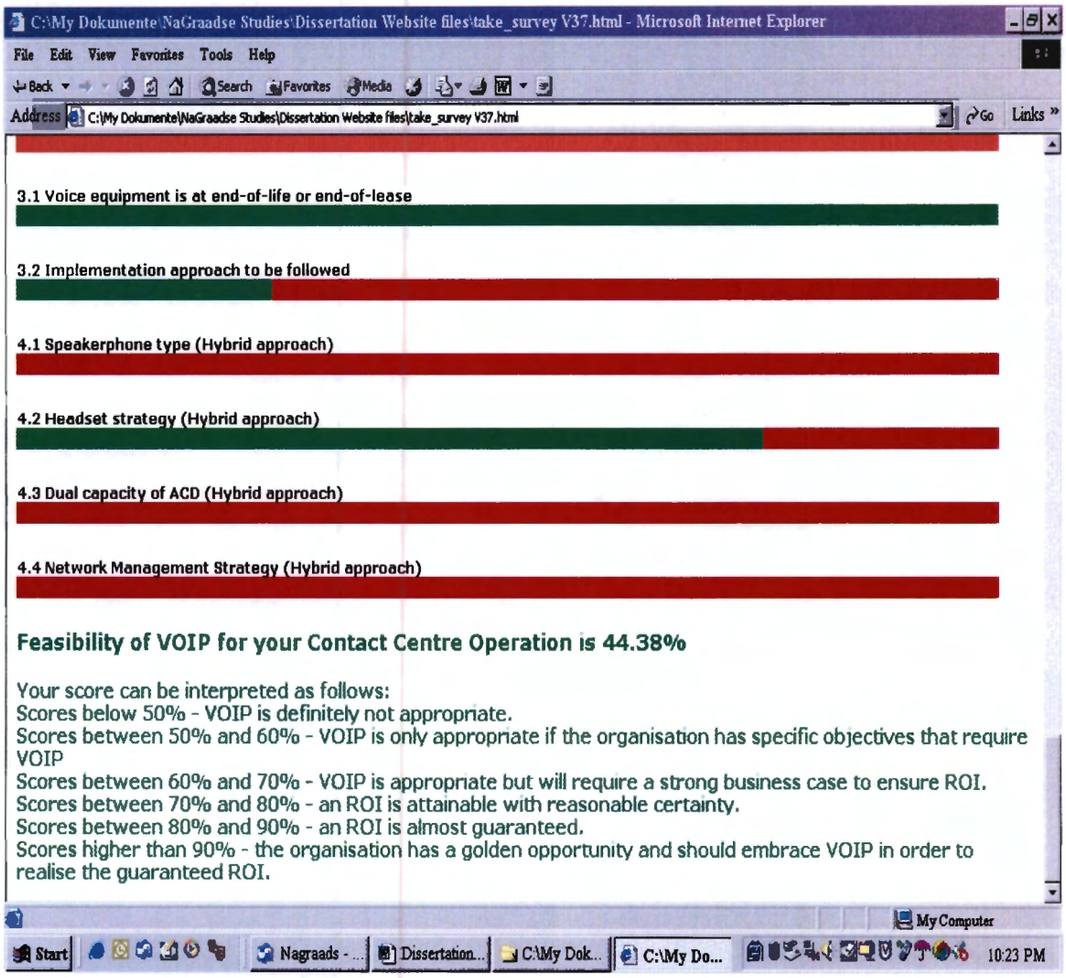

Figure 4: Results page of an example assessment

4. Findings

4.1 Factors that influence the feasibility of VOIP

As a first step in this research, a list was made of factors that influenced the feasibility of VOIP as indicated by the literature studied. In order to validate the reliability of the list derived from literature, contact centre industry specialists were surveyed to get a view of their perceptions regarding how much each factor influenced VOIP feasibility. No additional factors were reported by these specialists that could influence the feasibility of VOIP. The results of the survey were compared with those concluded from the literature (Figure 5). For the purposes of calculating averages for the survey answers, values of 4.5, 3.5, 2.5, 1.5 and 0.5 were assigned to the degrees of influence "crucial", "high", "medium", "low" and "no influence".

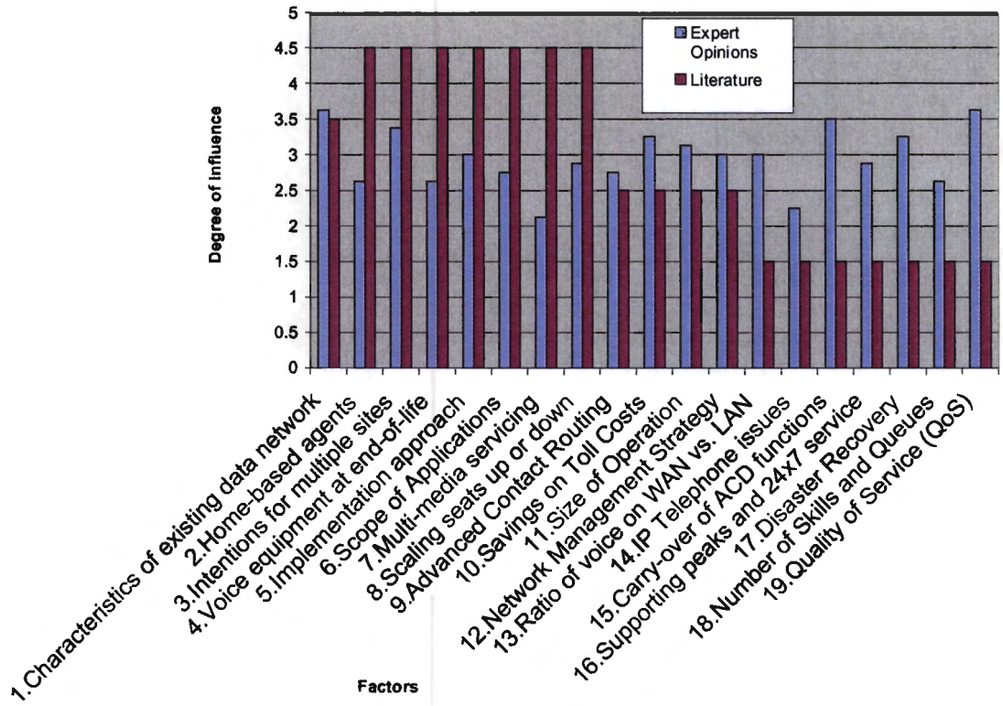

Figure 5: Comparison of degrees of influence on VOIP feasibility according to two sources: Literature and Expert opinions.

Of a total of nineteen factors, there were nine of which the degree of influence varied by more than two points between literature findings and experts' opinions. These were adjusted for the assessment tool to carry a weighting that is an average between literature findings and the expert opinions reflected in the survey. (Figure 6 contains the final weightings used in the assessment tool.)

FACTOR THAT INFLUENCES VOIP FEASIBILITY	IMPORTANCE ACCORDING TO LITERATURE	IMPORTANCE ACCORDING TO EXPERTS SURVEYED	WEIGHTING ASSIGNED IN ASSESSMENT TOOL
Use of home-based agents and back-office experts	CRUCIAL	MEDIUM	HIGH
Intentions to implement multiple sites (i.e. contact centre seats are geographically spread)	CRUCIAL	HIGH	CRUCIAL
Voice equipment is at end-of-life or end-of-lease lease	CRUCIAL	MEDIUM	HIGH
Implementation approach to be followed	CRUCIAL	MEDIUM	HIGH
Scope of Contact Centre Applications	CRUCIAL	MEDIUM	HIGH
Execution of multi-media servicing	CRUCIAL	MEDIUM	HIGH
Ease of scaling up or down	CRUCIAL	MEDIUM	HIGH
Readiness and characteristics of the existing data network	HIGH	HIGH	HIGH
Existence or plans for advanced Contact Routing	MEDIUM	MEDIUM	MEDIUM
Savings on Toll Costs	MEDIUM	HIGH	MEDIUM
Size of Operation (number of seats and branches)	MEDIUM	HIGH	MEDIUM
Network Management Strategy	MEDIUM	MEDIUM	MEDIUM
Ratio of voice to be carried on the WAN vs. LAN	LOW	MEDIUM	LOW
IP Telephones (new features, power supply, etc.)	LOW	MEDIUM	LOW
Ability to carry-over ACD functions to VOIP systems	LOW	HIGH	MEDIUM
Easily support peak loads and 24x7 service	LOW	MEDIUM	LOW
Disaster Recovery requirements currently or planned	LOW	HIGH	MEDIUM
Number of Skills and Queues across geographically spread centres	LOW	MEDIUM	LOW
Quality of Service (QoS)	LOW	HIGH	MEDIUM

Figure 6: Degrees of importance of factors influencing VOIP feasibility – weightings assigned for assessment tool.

The rules below were applied to arrive at the degrees of importance for the assessment tool. Let A = degree of importance according to literature, B = degree of importance according to experts and C = degree of importance for assessment tool. Where A and B differed by one degree, A was adopted as a more realistic value. The extent of the literature surveyed was considered to be more representative of reality than the opinions of eight experts and therefore a more accurate representation of the facts.

- If A is one degree higher or lower than B, let C = A
- If A is two degrees higher or lower than B, let C = average

4.2 Assessment Tool and use of Questionnaires

A second survey was conducted to evaluate the final assessment tool. (See appendix C for survey questions and details of participants.) Fewer responses were received when compared to the first survey. The first survey to determine which factors influence VOIP feasibility yielded responses from eight individuals representing eight organizations. The second survey yielded responses from four individuals representing three organizations. To eliminate the possibility that the second survey was sent at an awkward time of year (November), respondents were again asked for input late in January, which yielded one additional response. Reasons for the low response could be (1) the time it takes to complete an assessment (on average 3 minutes), (2) even January is an awkward time of the year or (3) some participants could feel intimidated by the fact that an assessment tool had been developed based on sound principles and thorough research.

The second survey was conducted to assess the assessment tool on the following critical success factors:

- The assessment is easy to use (and the conclusion can be made that taking the form of a questionnaire is acceptable)
- The assessment requires only basic contact centre, VOIP and network knowledge
- The assessment is complete in that it contains all relevant questions
- The assessment questions will remain relevant for the near future
- It can be used and recommended as an accurate assessment of the feasibility of implementing VOIP in a contact centre

Figure 7 shows the average results per individual question.

QUESTION	RESPONDENTS' ANSWERS	AVERAGE RESULT
1. User-friendliness and ease of use	AGREE: 2 STRONGLY AGREE: 2	AGREE
2. Requires only basic knowledge of contact centres, VOIP and networks	AGREE: 3 STRONLY AGREE: 1	AGREE
3. Contains all relevant questions	DISAGREE: 1 AGREE: 2 STRONGLY AGREE: 1	AGREE
4. Will remain relevant for near future	AGREE: 4	AGREE
5. Is an accurate assessment of VOIP feasibility	DISAGREE: 1 AGREE: 3	AGREE
6. Can be recommended confidently	DISAGREE: 1 AGREE: 2 STRONGLY AGREE: 1	AGREE

Figure 7: Results of second survey.

Discussion of findings of the second survey

The low response rate resulted in insufficient data to draw conclusions about the success factors listed in Figure 7. Nevertheless the responses received were generally positive and some specific concerns raised are discussed below.

Audience for Assessment Tool (relates to question 2 in Figure 7).
A concern was raised by one respondent that the audience for an assessment was not clear.

Conclusion:
The research identified VOIP feasibility factors that relate to the different areas of contact centre, VOIP and networks. The assessment tool questions are grouped together accordingly in an attempt to address these areas adequately (and for the reasons as discussed in section 3.2, sub-section "Software Development Methodology"). This grouping probably creates the impression that different audiences are targeted. Where a single individual cannot represent all areas it is recommended that the assessment be carried out by a group of two or three individuals who can each represent the areas in question.

Inclusion of all questions (relates to question 3 in Figure 7).
One participant indicated that the assessment did not contain all the relevant questions for the assessment of VOIP. This was probably the reason for the same respondent answering that the tool could therefore not be confidently recommended (questions 5 and 6).

Conclusion:
This was a surprising finding, considering that the same participant did not recommend additional questions for the assessment when surveyed in the first survey.

(The first survey specifically elicited comments on whether any questions were absent from those proposed by this research to evaluate the factors that influenced VOIP feasibility.) The respondent did not indicate which questions were missing from the assessment tool.

Use of number ranges.

Two respondents recommended that number ranges be used instead of "small/medium/large" and "low/moderate/high" for contact centre size, call volumes and number of skills and queues.

Conclusion:

The argument by one respondent that *"These specific questions are very subjective. Many customers believe their volumes are "high" but when compared to others they are not"* was accepted as valid and the related questions were changed.

Functionality relevant to VOIP.

One respondent questioned the relevance of functionality such as skill based routing and universal queuing.

Conclusion:

This research did confirm that a high number of skills and queues could benefit from VOIP when geographically spread, but that this is not a key situation for adopting VOIP. This research also agrees with the respondent's comment that a conventional voice platform can be upgraded to include this functionality and that it's not necessarily a driver for moving to VOIP. This is all in line with the low importance assigned to the factor "number of skills and queues across geographically spread centres" in the assessment tool.

Use of VOIP as a carrier only between locations.

One respondent commented that the application of VOIP in an "Internet Telephony" scenario might be feasible for a contact centre without any other application of VOIP in the centre itself. Consequently VOIP might be feasible without the assessment yielding any significant score.

Conclusion:

This research acknowledges the fact that voice can be carried on IP, thereby benefiting from reduced voice carrier costs. However, the assessment tool assesses the feasibility of VOIP when fully adopted by a contact centre. For the purposes of the assessment tool, merely carrying voice between two sites using IP does not constitute full VOIP adoption in the contact centre.

The tool seen as an education on VOIP.

Two respondents commented on the tool's usefulness as an education on VOIP. According to one respondent the tool "forces one to think logically through all the issues that pertain to VOIP". According to the other respondent "the questions are thought provoking and they provide the user with areas to be considered that might otherwise be overlooked".

The use of *"don't know"* as an answer to questions.

One respondent commented that the provision of a *"don't know"* option on certain questions might be appropriate.

Conclusion:

The comment was not taken up on the grounds that such an option could result in too many *"don't know"* answers, which would dilute the accuracy of the final score. A "best guess" answer would be more appropriate in circumstances where the assessor does not know the answer.

Other comments received in the survey.

"I especially liked the *"Tell me"* help function."

Conclusion:

This feedback confirms that jargon was successfully avoided as discussed in section 3.2, sub-section "Questionnaires", at the same time providing explanations of technical terms where required.

5. Conclusions

5.1 Assessment of new technology using a questionnaire

The success and accuracy of the assessment of the feasibility of new technology (in this case VOIP) depend largely on adequate knowledge of the new technology, or alternatively on the amount of credible literature available on the technology. In the latter instance successful assessment of feasibility depends on the thoroughness of interpreting the literature and arriving at a concise list of issues to be transformed into a questionnaire as well as appropriate weights for each question and in turn each possible answer. In the case of VOIP as a new technology, abundant literature was available due to timing – in 2003 VOIP was reaching the top of its "hype cycle" and attracted much attention in journals and vendor material. It is therefore recommended that the development for such an assessment tool for a new technology be properly timed to coincide with the peak of literature published on the technology.

5.2 Conclusions on VOIP feasibility

This research arrived at a conclusive list of factors that influence the feasibility of VOIP for contact centres. Figure 8 summarises these factors with their relative importance (degree of influence).

FACTOR THAT INFLUENCES VOIP FEASIBILITY	DEGREE OF INFLUENCE
Use of home-based agents and back-office experts	HIGH
Intentions to implement multiple sites	CRUCIAL
Voice equipment is at end-of-life or end-of-lease lease	HIGH
Implementation approach to be followed	HIGH
Scope of Contact Centre Applications	HIGH
Execution of multi-media servicing	HIGH
Ease of scaling up or down	HIGH
Readiness and characteristics of the existing data network	HIGH
Existence or plans for advanced Contact Routing	MEDIUM
Savings on Toll Costs	MEDIUM
Size of Operation (number of seats and branches)	MEDIUM
Network Management Strategy	MEDIUM
Ratio of voice to be carried on the WAN vs. LAN	LOW
IP Telephones (new features, power supply, etc.)	LOW
Ability to carry-over ACD functions to VOIP systems	MEDIUM
Easily support peak loads and 24x7 service	LOW
Disaster Recovery requirements currently or planned	MEDIUM
Number of Skills and Queues	LOW
Quality of Service (QoS)	MEDIUM

Figure 8: Conclusive degrees of importance of factors influencing VOIP feasibility.

The results of both surveys did not contradict the proposed interpretation of assessment results as stated in paragraph 3.1 ("Approach Followed").

5.3 Future Work

Possible enhancements to the assessment tool could be to export results and produce graphs in addition to the bar charts currently displayed at the end of an assessment. The tool could also be expanded to offer a suggestion for each question that attracted a low score to indicate how the score (feasibility factor) can be improved for that particular aspect.

As VOIP evolves, some complexities around its implementation will fall away (for example, issues with equipment compatibility, network performance, etc.) – this might result in some questions scoring lower or becoming irrelevant. It is not expected that more questions would need to be added to the tool, but rather removed as VOIP evolves. The result could be that the assessment tool will become shorter and quicker to execute.

An additional objective of this research was to conduct practical tests in a laboratory environment in order to get consensus on how and to what degree the key drivers listed above, impact the feasibility of VOIP. Most drivers could be linked to a cost saving and thus experiments could be done to measure the costs of specific contact centre functions in a traditional environment and compare them to the costs of deploying the same functionality in a VOIP environment. (For example, the costs of deployment off-site agents in a traditional environment could be compared to the costs of the same using "pure" IP.) Due to funding restrictions these practical tests did not take place.

In February 2005 VOIP will be deregulated in South Africa **[40]**. VAN (Value Added Network) licensees will from then on be allowed to carry voice as well as data over their networks, effectively increasing to ten or more the number of companies providing international voice connectivity. This could result in prices for international voice traffic to move in line with other countries. The implications of this in terms of the factor "Toll Costs" will have to be investigated to determine whether the importance of this factor will increase (which is very likely) and to adjust the weights for the related questions in the assessment tool.

5.4 Originality and Usefulness

The extensive literature surveyed did not reveal the existence of any tools to assess the feasibility of VOIP for a contact centre. This research delivered such a tool by consolidating and evaluating the abundant literature available on VOIP and condensing the valid criteria into one questionnaire that delivers a rating on a scale of "not appropriate" to "very appropriate". The assessment tool was developed interactively by taking into account expert opinions on what matters for VOIP feasibility.

The feasibility of VOIP and hence the relevance of this assessment tool have become important for contact centres in South Africa, as a result of the de-regulation of voice traffic announced by Telkom**[40]**.

One of the leading vendors on VOIP, Avaya, described what was delivered by this research as "...a nice job of putting together a tool that addresses most of the areas of concern when deploying an IP Contact Center. I can see that such a tool would be of benefit to Avaya personnel during the pre-sales process and beyond."

Appendix A

Survey Questions: Factors that influence VOIP feasibility

Participants:

Fifteen individuals were invited to participate. The eight responses received represented the following organisations:

Gartner
Dimension Data
Genesys Laboratories
Avaya
Computer Sciences Corporation
Woolworths
Nedcor
University of Cape Town

Instructions:

For each factor, indicate how much you think it influences the feasibility of a VOIP implementation. Select one of:

- No influence at all
- Lower degree than other factors
- Medium influence
- Higher than other factors
- Has a crucial influence

If you do not have an opinion, please leave the answer blank.

Factors:

1. **Readiness and characteristics of the existing data network**
   No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

2. **Use of home-based agents and back-office experts**
   No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

3. **Intentions to implement multiple sites (i.e. contact centre seats are geographically spread)**
   No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

4. **Voice equipment is at end-of-life or end-of-lease lease**
   No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

5. **Implementation approach to be followed, i.e. brand new "green fields", replacement of current conventional operation with all-VOIP, or upgrade to "hybrid" that supports current world and VOIP**
   No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

6. **Scope of Contact Centre Applications (i.e. existence of, or plans for IVR, routing, CTI and other applications)**
   No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

7. **Execution of multi-media servicing (e.g. e-mail, web, telephone by same agent)**
   No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

8. **Ease of scaling up or down**
   No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

9. **Existence or plans for advanced Contact Routing**
   No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

10. **Savings on Toll Costs (domestic or international)**
    No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

11. **Size of Operation (number of seats and branches)**
    No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

12. **Network Management Strategy (e.g. use of quality-of-service tools, ownership of bandwidth, combined or separate teams for data and voice, etc.)**
    No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

13. **Ratio of voice to be carried on the WAN vs. LAN**
    No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

14. **IP Telephones (new features, power supply, etc.)**
    No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

15. **Ability to carry-over ACD functions to VOIP systems**
    No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

16. **Easily support peak loads and 24x7 service**
    No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

17. **Disaster Recovery requirements currently or planned**
    No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

18. **Number of Skills and Queues across geographically spread centres**
    No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

19. **Quality of Service (QoS)**
    No influence ☐ Low ☐ Medium ☐ High ☐ Crucial ☐

20. Additional factors not mentioned above (please comment in space provided):

Appendix B

FEASIBILITY ASSESSMENT QUESTIONS

An "Overall Weight" out of ten is assigned to each factor in relation to the rest of the factors:

- Maximum influence = 10
- High influence = 7.5
- Medium influence = 5
- Low influence = 2.5

Some questions require as an answer a selection from more than two items. Depending on the selection, the answer to these questions also carries a weight on the following scale to determine its influence on the ultimate feasibility rating:

- Maximum positive influence = 10
- High positive influence = 7.5
- Medium positive influence = 5
- Low positive influence = 2.5
- No influence = 0

Questions are offered in the following sets:

Set One - information about the size and functionality of the Contact Centre operation
Set Two - information about the network
Set Three - general questions and the type of implementation being planning
Set Four - questions based on the specific type of implementation being planning

Set One: Characteristics and extent of Contact Centre Operation

Factor: Intentions to implement multiple sites (overall weight: 10)			
Questions	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
1.1 Will multiple sites exist nationally? (0=no 1=yes)	0 10	0: no influence 1: maximum influence	Having or planning multiple sites is one of the key motivators to consider VOIP. VOIP can facilitate extending telephony functionality to a campus environment or to remote users. On a larger scale, connecting branches increases the potential of running a single virtual contact centre and thereby leveraging routing, reporting and workforce optimization – with VOIP all of this can be achieved over a data network. Branch offices that are otherwise remote from the main contact center can act as logical extension of the contact center. An enterprise can also benefit from the efficiencies of centralizing enterprise-wide communication application servers (e.g., voice mail, IVR, etc.), administration access, and technology support. In a conventional operation each site typically has a separate voice system, supported by a separate service contract. Enterprises thus may have as many service and support contracts as sites to manage, which is a highly inefficient scenario that could be avoided with VOIP.
1.2 Will multiple sites exist internationally? (0=no 1=yes)	0 10	0: no influence 1: maximum influence	

Factor: Size of Operation (overall weight: 5)			
Question	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
1.3 What will be the size of the operation? (0=1/2 sites and less than 101 seats 1=1/2 sites and more than 100 seats 2=3 or more sites and less than 101 3=3 or more sites and more than 100 4=more than 5 sites and more than 250 seats)	0 2.5 5 7.5 10	0: no influence 1: low influence 2: medium influence 3: high influence 4: maximum influence	More seats increase leverage from having all skills pooled and from optimizing workload across workforce – with VOIP all of this can be achieved over a data network.

Factor: Use of home-based agents and back-office experts (overall weight: 7.5)			
Questions	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
1.4 How many agents (will) work from home? 0=none 1=few 2=moderate number 3=large number	0 5 7.5 10	0: no influence 1: medium influence 2: high influence 3: maximum influence	Any worker who has a sufficient data connection to the corporate data network can potentially be leveraged within the contact center. VOIP can be used to extend the 'reach' of applications to agents who work from home. Potentially immediate savings can be had on call charges by implementing VOIP over a single basic rate data channel instead of the previous typical approach of reserving one channel for voice and another for data communication. More home agents will also increase savings on cost of office space, equipment, etc. Some cost could be attached to "soft" factors, e.g. convenience, different environment, eliminated traveling, etc. Home agents could result in lower recruitment costs and can augment language skill groups more easily.
1.5 Do you apply (or are you considering) the concept of knowledge workers outside of the contact centre, but capable of handling specialized customer interactions or referrals? (0=no, 1=considering, 2=already applied 3=already applied and plans to increase)	0 5 7.5 10	0: no influence 1: medium influence 2: high influence 3: maximum influence	Knowledge workers are individuals with specialized knowledge or skills who don't necessarily work in the contact centre. These individuals may take customer calls at their desks in the "back office". VOIP technology enables applications to be delivered to each and every desktop in an enterprise to support all knowledge worker applications.
Factor: Savings on Toll Costs (overall weight: 5)			
Questions	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
1.6 What volumes of domestic calls are/will be made outside the organisation? (0=none 1=low volume 2=moderate volume 3=high volume)	0 1.5 2.5 5	0: no influence 1: lower influence 2: low influence 3: medium influence	Toll charges are potentially reduced for site-to-site transfers and routing because voice over IP can be delivered over the private network instead of the PSTN. Potential cost savings for domestic calls outside the organisation are lower compared to within the organisation or compared to international calls.
1.7 What volumes of domestic calls are/will	0 5	0: no influence 1: medium influence	More calls increase potential voice carrier cost savings. Savings are typically limited to large operations that have high volumes. Potential cost savings are higher compared to domestic calls

be made between national sites (within the organisation)? (0=none 1=low volume 2=moderate volume 3=high volume)	7.5 10	2: high influence 3: maximum influence	outside the organisation or compared to international calls.
1.8 What volumes of international calls are/will be made? (0=none 1=low volume 2=moderate volume 3=high volume)	0 2.5 5 7.5	0: no influence 1: low influence 2: medium 3: high influence	More calls increase potential voice carrier cost savings. Potential cost savings are higher compared to domestic calls outside the organisation but lower compared to domestic calls within the organisation.

Factor: IP Telephones (new features, power supply, etc.) (overall weight: 2.5)

Questions	Weight	Selections	Information displayed with "Tell me more" button
1.9 Will IP phones deliver new functionality? (0=no 1=yes)	0 10	0: no influence 1: maximum influence	The functionality offered by IP phones is relevant when new functionality is needed on the telephone or the softphone that the conventional PBX does not provide.
1.10 How will power be delivered to IP telephone? (over LAN = 1, separate power = 0)	0 10	0: no influence 1: maximum influence	Most IP telephones can be powered via an AC adapter or in-line via the Ethernet cable. Deploying in-line power in conjunction with Ethernet switches that have redundant power (either via UPS or other solutions) ensures that a phone system will work in the event of a power outage. Powered switches can be beneficial for phones in common locations such as conference rooms and reception areas where there may not be enough power outlets available.

Factor: Ease of scaling up or down (overall weight: 7.5)

Questions	Weight	Selections	Information displayed with "Tell me more" button
1.11 On average how many seats will be created, moved, changed and eliminated annually? (0=none 1=low number 2=moderate number	0 2.5 5 7.5 10	0: no influence 1: low influence 2: medium influence 3: high influence 4: maximum influence	With VOIP, agents can log onto a Web portal that supports point-and-click moves, adds and changes (MACs), to add features such as conferencing or voice recognition, with no intervention required by the service provider. With VOIP, a telephone is simply another network device. More MACs will increase savings on costs associated with these moves on a conventional network.

3=high 4=high and will increase in future)			
1.12 Do you currently (or intend to) in-source contact centre servicing? (0=no, 1=considering, 2=yes)	0 7.5 10	0: no influence 1: high influence 2: maximum influence	In sourcing refers to providing contact centre services to other organisations, thereby servicing their customers' contacts within your contact centre operation. In sourcing requires an organisation to be able to rapidly scale up or down according to in-source clients' needs.
1.13 How will seats be managed into the future? 0: future growth not considered yet 1: new seats added to conventional voice network 2: new seats balanced between conventional and IP endpoints 3: new seats added as IP endpoints 4: new seats added as IP endpoints and conventional seats actively managed out by conversion to IP or by closing them down 5: all seats will be IP only from the start	0 0 2.5 5 7.5 10	0: no influence 1: no influence 2: low influence 3: medium influence 4: high influence 5: maximum influence	Growth in IP seats will leverage benefits of VOIP and will avoid increased maintenance and support costs of growing seats on a conventional, separate voice network.

Factor: Easily support peak loads and 24x7 service (overall weight: 2.5)			
Questions	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
1.14 Does your operation experience peak loads? (0=no 1=daily 2=weekly 3=monthly 4=seasonal)	0 2.5 5 7.5 10	0: no influence 1: low influence 2: medium influence 3: high influence 4: maximum influence	Peaks require the number of agents to be increased or decreased in order to maintain a constantly optimized workforce. By dynamically distributing calls among agents in many locations and time zones, contact center managers can support dramatic shifts in demand at far less expense. Maintaining an optimized workforce is more challenging for seasonal than daily peaks.
1.15 Current/intended hours of contact centre operation (0=8x5 1=10x5 2=12x5 3=10x7 4=24x7)	0 2.5 5 7.5 10	0: no influence 1: low influence 2: medium influence 3: high influence 4: maximum influence	By dynamically distributing calls among agents in different time zones, extended business hours can be supported at less expense.

Factor: Execution of multi-media servicing (overall weight: 7.5)			
Questions	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
1.16 How many of the following media are/will be used: Web (self and/or co-browsing) or Video (0=none 1=one 2=two 3=all of these)	0 5 7.5 10	0: no influence 1: medium influence 2: high influence 3: maximum influence	Each additional medium further leverages the benefits of IP multimedia servicing. The same XML (legacy and new) applications can be used in all 3 media. When combined with VOIP on the desktop, videoconferencing could become a useful tool for agents. Rather than sending them to a centralized location to access video-based training or meetings, Voice and Video over IP allow face-to-face interactions from their workstations over a converged network. Customers could soon expect to view agents or interactive product demos as part of the interaction.
1.17 Do you (or intend to) have agents multi-skilled across media? (0=no, 1=2 media, 2=3 or more media)	0 7.5 10	0: no influence 1: high influence 2: maximum influence	Multi-skilling refers to an agent's capability to provide customer service for multiple products, or to provide service using multiple media (e.g. voice, web, e-mail). VOIP will enhance efficiency of agents servicing in more than 1 medium. Agents that are multi-skilled in media usage contribute to a more efficient, cost-effective operation.

Factor: Number of Skills and Queues (overall weight: 2.5)			
Questions	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
1.18 How many call	0	0: no influence	More queues increase the benefits of leveraging IP for queue-specific Auto Attendants, contact

queues to be serviced? (0=one 1=up to 5 2=up to 10 3=more than 10 and plans to increase)	5 7.5 10	1: medium influence 2: high influence 3: maximum influence	routing, and data lookups. In a conventional operation, each different queue typically requires vendor/specialist involvement to develop or change AA, routing and CTI functions.
1.19 How many skills are/will have to be provided? (0=one 1=up to 5 2=up to 10 3=more than 10 and plans to increase)	0 5 7.5 10	0: no influence 1: medium influence 2: high influence 3: maximum influence	Skills refer to, for example, the number of products for which an agent can provide service, the number of media that an agent can use to service customers and the number of languages within which an agent can provide service. Multiple skills increase the benefits of leveraging IP Routing. Additional skills add to the complexity of routing contacts correctly – typically requiring vendor/specialist involvement in a conventional operation.

Factor: Disaster Recovery requirements currently or planned (overall weight: 5)

Question	Weight	Selections	Information displayed with "Tell me more" button
1.20 What is the status in terms of Disaster Recovery? (0=current level to be maintained 1=currently basic but high required 2=currently none but basic required 3=currently none but high required)	0 5 7.5 10	0: no influence 1: medium influence 2: high positive 3: maximum influence	Disaster Recovery refers to the ability to continue customer servicing in situations where a number of contact centre seats or sites are unable to function. In the absence of disaster recovery ability, VOIP could be an enabler to establish this with less effort. If DR is currently of a high level, converting it to VOIP does not necessarily increase benefits, but rather poses a challenge, as current level of DRF will have to be matched in the face of data network stability issues that might exist.

Factor: Scope of Contact Centre Applications (overall weight: 7.5)			
Questions	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
1.21 How many new contact centre voice applications will be developed? (0=none 1=one or two 2=moderate number 3=high number 4=high number and plans to increase in future)	0 2.5 5 7.5 10	0: no influence 1: low influence 2: medium 3: high influence 4: maximum influence	VOIP provides the foundation for all types of new voice applications and services (e.g. auto-attendants, voicemail, routing, data lookups), which will improve communications and increase employee productivity. With VOIP the deployment of these will be more rapid than on traditional platforms (e.g. there is potentially no need for a 3rd party ACD switch or an external CTI link for attaching data to a call).
1.22 How many Web applications (for self-service) exist or are planned? (0=none 1=one or two 2=moderate number 3=high number 4=high number and plans to increase in future)	0 2.5 5 7.5 10	0: no influence 1: low influence 2: medium 3: high influence 4: maximum influence	VXML facilitates the bridge between web-based applications and the presentation and manipulation of data in a voice environment. The existence of or plans for web self-service applications increase the benefits of potentially re-using XML code for voice self-service applications.
1.23 How many "data lookup" applications exist / will exist? (0=none 1=one or two 2=moderate number 3=high number 4=high number and plans to increase in future)	0 2.5 5 7.5 10	0: no influence 1: low influence 2: medium 3: high influence 4: maximum influence	With VOIP the results of data lookups can seamlessly be included with a call and forwarded to any worker in the organisation and referenced during a customer interaction.

1.24 Do you (or will you) deploy basic telephony and other applications at branches too? (0: no, 1: considering, 2: yes)	0 7.5 10	0: no influence 1: high influence 2: maximum influence	The 'reach' of contact centre applications can be extended to agents at branches. Most applications now support common web-based protocols (XML), so the foundation is laid to integrate these into a single servicing portal, including remote agents' desktops. VOIP promotes the concept of a "virtual" contact centre regardless of location of workers and branches or contact media.
1.25 Is/will call recording, silent monitoring and/or barge-in capabilities be deployed? (0=none, 1=one, 2=two, 3=all three, 4=all three and plans to increase)	0 2.5 5 7.5 10	0=no influence 1: low influence 2: medium 3: high influence 4: maximum influence	With VOIP more rapid implementation is possible (no cables to wire, but only network configuration). Scaling up should only require additional licenses. Flexibility includes centralized recording for multiple sites (depending configuration of these) and switch independence. The eventual convergence of voice and data application architectures offers saving and efficiency opportunities that cannot easily be obtained with conventional proprietary solutions.
1.26 Is or will Voicemail be implemented for customer calls? (0=no 1=yes)	0 10	0: no influence 1: maximum influence	Stand-alone voice applications, such as voice mail, can be integrated into the VOIP system and more easily managed.

Factor: Existence or plans for advanced Contact Routing (overall weight: 5)

Question	Weight	Selections	Information displayed with "Tell me more" button
1.27 Do you, or will you implement Universal Queue and/or Intelligent Routing? (0=no, 1=considering, 2=yes)	0 7.5 10	0: no influence 1: high influence 2: maximum influence	Universal Queue refers to the ability to route all contacts using the same rules, regardless of contact channel. Planning or applying multi-channel contacts is one of the key motivations for considering VOIP. VOIP will facilitate routing of all media on the same network and will support the concept of a "virtual" contact centre regardless of location of workers and branches or contact media.

Set 2: Network Characteristics

Factor: Ratio of voice to be carried on WAN vs. LAN (overall weight: 2.5)			
Question	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
2.1 Will voice be carried on the WAN? (0:Yes 1: No)	0 10	0: no influence 1: maximum influence	LAN (Local Area Network) bandwidth is typically abundant, while WAN (Wide Area Network) bandwidth is typically a relatively small fraction of the LAN. The challenge of obtaining adequate quality of service is exacerbated when a data packet must traverse the WAN.
Factor: Readiness and characteristics of the existing data network (overall weight: 7.5)			
Questions	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
2.2 What is the strategy for network testing or evaluation to determine the existing network's VOIP readiness? (0=no tests done or planned 1=yes, details to be formulated 2=use of a MOS value and basic delay and loss measurements 3="lifecycle" testing technology to be adopted in addition to tests before VOIP deployment)	0 5 7.5 10	0: no influence 1: medium influence 2: high influence 3: maximum influence	Network testing isn't just important at the start of a VOIP project, but is an ongoing requirement of any successful long-term VOIP implementation. The addition of new applications, the extension of the network to new locations, and increases in network utilization can all potentially impact VOIP quality. Mean Opinion Score (MOS) is a standardized way of assessing a network's ability to support VoIP on a scale of 1 to 5. This scale provides a useful language for the industry as a whole to talk about VoIP deployments and gauge the severity of networking issues as they relate to voice services.
2.3 Will voice be carried on an Ethernet or Tokenring network? (1: Token, 2: Ethernet)	*0* *10*	0: no influence 1: maximum influence	*Ethernet is a networking technology for putting information on a LAN; Ethernet is currently the most popular; it is widespread and extremely cost-effective. Since VOIP builds on it, an Ethernet network is more suitable for VOIP than other technologies such as Tokenring.*
2.4 What routing protocols are used? (0=older types like RIP, 1=comparable to OSPF, 2=OSPF)	0 7.5 10	0: no influence 1: high influence 2: maximum influence	Routing protocols (rules by which data is routed on a network), affect a network's performance. OSPF (Open Shortest Path First) is a router protocol used within larger autonomous system networks in preference to the Routing Information Protocol (RIP), an older routing protocol that is installed in many corporate networks. Older protocols like RIP will reconfigure the network, but cannot deliver the fast recovery times of OSPF.
2.5 Is the network a switched one? (yes=1, no=0)	0 10	0: no influence 1: maximum influence	The time-sensitive nature of VOIP applications requires Ethernet collisions – a major contributor to delay and jitter – to be eliminated by having a switched as opposed to a shared (hubs or bussed) network.

2.6 Is VPN (virtual private network) used? (0=yes 1=no)	0 10	0: no influence 1: maximum influence	VPNs (Virtual Private Networks) is a method for using a public network (like the Internet) for an organisation's private business. To address security, information is encrypted and decrypted between sending and receiving sites. Large delays are typically inherent in some VPN products, mainly due to the encryption and decryption required. If VPN is run on the internet, voice quality could be at risk due to these potential delays.
Factor: Network Management Strategy (overall weight: 5)			
Questions	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
2.7 Will network-optimization tools be used to manage the bandwidth and prioritize traffic? (0=no 1= yes)	0 10	0: no influence 1: maximum influence	Organisations need to be aware of the network management issues involved in moving from a conventional voice environment to a packet environment. This requires organisations to prepare for ongoing management, monitoring and documentation of the network to assure quality is maintained.
2.8 Does/will "customer" own network bandwidth? (0=no 1= yes)	0 10	0: no influence 1: maximum influence	The customer (e.g. contact centre or customer service management) should preferably be in charge of bandwidth. Quantifying the reach of the contact center is important in understanding bandwidth requirements.
2.9 Does/will the customer determine voice priority over data? (0=no 1= yes)	0 10	0: no influence 1: maximum influence	In order to ensure quality is maintained, voice traffic should enjoy a higher priority over data on a network. The customer (e.g. contact centre or customer service management) should preferably be in charge of the priority of voice over data.
Factor: Quality of Service (QoS) (overall weight: 5)			
Question	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
2.10 Will VOIP quality monitoring tools be deployed for voice traffic? (0=no 1= yes)	0 10	0: no influence 1: maximum influence	VOIP quality requires constant monitoring. Tools and an operational plan should be implemented to proactively react to changing network conditions that could affect VOIP quality.

Set 3: General Questions

Factor: Voice equipment is at end-of-life or end-of-lease (overall weight: 7.5)			
Question	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
3.1 Is your current voice equipment nearing end-of-life or lease? (0=no 1=yes)	0 10	0: no influence 1: maximum influence	This is one of the key motivations for changing to VOIP. It is most relevant to consider IP when building a new contact center or when older conventional infrastructure has reached its end-of-life
Factor: Implementation approach to be followed (overall weight: 7.5)			
Question	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
3.2 What type of implementation are you planning for VOIP in your contact centre(s)? 0: Upgrade existing switch(es) for "hybrid" (traditional and IP) capability 1: Replace existing switch(es) with IP ("forklift" implementation) 2: Convert from current traditional to IP-only (phased implementation during which "hybrid" will be in place for a period of time, but ending with IP only) 3: "Green Fields" implementation (no existing contact centre operation)	2.5 5 7.5 10	0: low influence 1: medium influence 2: high influence 3: maximum influence	Potential benefits from VOIP are highest in "pure IP" scenarios. **Hybrid** scenarios deliver VOIP benefits initially on a smaller scale and over time. When VOIP solutions are based on legacy voice or data platforms, rolling one out at a new site could require involvement of specialists from the vendor and local reseller, which implies possible unwanted dependencies. "Hybrid" implementations reduce potential for cost savings, as two networks still have to be maintained. Hybrids typically rely on legacy architecture and may suffer from constrained scalability. However, hybrid IP solutions cause minimal disruption, and make use of existing equipment such as standard telephones, instead of forcing an investment in IP phones. In "hybrid" scenarios there are no major architectural changes. **Replace** scenarios carry highest risk, but deliver full benefits of VOIP. **Conversion** is a "slow" version of replacement where hybrid solutions can provide a migration path to an all-IP solution at low, per user monthly rates. Low risk with ultimate full benefits of VOIP. For **Greenfield** deployments, there is only one network to install, manage and maintain. Also, holistic network management can be better achieved with a design from the ground up. A native VOIP architecture has built-in autonomy and survivability.

Set 4: Questions specific to a "Hybrid" Implementation scenario

Factor: Ability to carry-over traditional (ACD etc.) functions to VOIP systems (overall weight: 5)			
Questions	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
4.1 If speakerphones are deployed, which of the following applies? (3=all new best type; 2=all new average, 1=some new, 0=all reuse)	0 5 7.5 10	0: no influence 1: medium influence 2: high influence 3: maximum influence	Speakerphones have built-in loudspeakers, allowing agents to listen without a headset. Acoustic echo associated with speakerphones can be exacerbated when speakerphones are applied with converged systems.
4.2 If headsets to be re-used, which applies? (Traditional re-used = 0; Re-use of sets associated with both conventional and IP terminals = 1; Re-use of existing IP headsets = 2; Brand new IP headsets = 3)	0 5 7.5 10	0: no influence 1: medium influence 2: high influence 3: maximum influence	Headset adapters that were designed for conventional voice networks may not have the necessary acoustical (or electrical) isolation needed to mitigate echo returns when used with converged networks. In converged systems headsets associated with both traditional analog and digital terminals as well as IP terminals can degrade echo performance.
4.3 Capacity of current ACD to support "hybrid" functionality (3=excellent, 2=good, 1=uncertain, 0=insufficient)	0 0 7.5 10	0: no influence 1: no influence 3: high influence 4: maximum influence	The contact centre switch (ACD) must have the capacity to support both the conventional and IP telephony required in a Hybrid scenario. Insufficient capacity impacts the ease of scaling up towards IP in the future.
Factor: Network Management Strategy (overall weight: 5)			
Question	**Weight**	**Selections**	**Information displayed with "Tell me more" button**
4.4 What is the team strategy for management of the two networks? (0=current teams retained; 1=teams retained but bridged in some way; 2=teams merged into one)	0 7.5 10	0: no influence 1: high influence 2: maximum influence	Continuing with separate teams for data and voice will be high risk. Ideally 2 teams should be merged into one "Enterprise Communications Team".

Set 4: Questions specific to a Conversion Implementation scenario

Factor: Ability to carry-over traditional (ACD etc.) functions to VOIP systems (overall weight: 5)			
Questions	**Weight**	**Selections**	**Rationale applied to assess influence on VOIP feasibility**
4.1 If speakerphones are deployed, which of the following applies? (3=all new best type; 2=all new average, 1=some new, 0=all reuse)	0 5 7.5 10	0: no influence 1: medium influence 2: high influence 3: maximum influence	Speakerphones have built-in loudspeakers, allowing agents to listen without a headset. Acoustic echo associated with speakerphones can be exacerbated when speakerphones are applied with converged systems.
4.2 If headsets to be re-used, which applies? (Traditional re-used = 0; Re-use of sets associated with both conventional and IP terminals = 1; Re-use of existing IP headsets = 2; Brand new IP headsets = 3)	0 5 7.5 10	0: no influence 1: medium influence 2: high influence 3: maximum influence	Headset adapters that were designed for conventional voice networks may not have the necessary acoustical (or electrical) isolation needed to mitigate echo returns when used with converged networks. In converged systems headsets associated with both traditional analog and digital terminals as well as IP terminals can degrade echo performance.
4.3 Will circuit-switched features be carried over to IP? (0=no 1=only some 2=most 3=all)	0 0 7.5 10	0: no influence 1: no influence 2: high influence 3: maximum influence	The average PBX comes standard with more than 400 features, covering a broad and flexible spectrum of voice options. Conversion could allow legacy features to be carried over, which means a functionally richer IP system.

Appendix C

Survey Questions: Evaluation of Assessment Tool

Participants:

Sixteen individuals were invited to test the assessment tool. The four responses received represented Avaya, Gartner and Old Mutual.

Instructions:

For each question indicate how much you agree with the statement. Select one option with an X. If you do not have an opinion, please leave the answer blank.

Questions:

1. **The assessment is user-friendly and easy to use**
   Strongly disagree ( ) Disagree ( ) Agree ( ) Strongly agree ( )

2. **The assessment can be executed by anyone with basic contact centre, VOIP and network knowledge**
   Strongly disagree ( ) Disagree ( ) Agree ( ) Strongly agree ( )

3. **The assessment contains all the relevant questions for the assessment of VOIP**
   Strongly disagree ( ) Disagree ( ) Agree ( ) Strongly agree ( )

4. **The assessment questions will remain relevant for the near future (e.g. next 2 years)**
   Strongly disagree ( ) Disagree ( ) Agree ( ) Strongly agree ( )

5. **The end result is an accurate assessment of VOIP feasibility for a contact centre**
   Strongly disagree ( ) Disagree ( ) Agree ( ) Strongly agree ( )

6. **I can confidently recommend the use of this assessment**
   Strongly disagree ( ) Disagree ( ) Agree ( ) Strongly agree ( )

7. **Additional comments about this assessment tool (please comment in space provided):**

References

1. Gartner (2001) *VOIP: Is it Right for You?*, Gartner Resource ID: 328715
2. Gartner (2001) *Moving from a PBX to IP Telephony? Your Time will Come!,* Gartner Resource ID: 328726
3. BearingPoint (2004) *IP Telephony puts the Service back into Financial Services* [online]. Available from http://www.bearingpoint.com/ipt/pdfs/C2852_IP_Telephony_WP.pdf [Accessed 3 May 2004].
4. Gartner (2004) *Management Update: Create a Companywide Plan for Automated Speech Recognition,* Article no. IGG-03242004-03, 24 March 2004.
5. Verizon (2002) *Telecommunications Infrastructure – Networks and Calls* [online]. Available from http://www22.verizon.com/about/community/learningcenter/articles/displayarticle1/0,4065,1136z1,00.html [Accessed 22 September 2004].
6. Avaya (2002) *Avaya MultiVantage Software: Adapting Proven Call Processing for the Transition to Converged IP Networks,* [online]. Available from http://www1.avaya.com/enterprise/resourcelibrary/whitepapers/ [Accessed 22 September 2004].
7. Verizon (2002) *Weighing the Pros and Cons of Integrated Voice and Data* [online]. Available from http://www.verizon.com/smallbiz/integrate-138 [Accessed on 2 June 2003].
8. Avaya Inc (2003) *The Benefits of IP Telephony Enabled Self-Service* [online]. Available from http://www1.avaya.com/enterprise/resourcelibrary/whitepapers/ [Accessed 22 September 2004].
9. Shoretel (2004) *Next-Generation Contact Centers: The "Killer App" for VOIP* [online]. Available from http://www.shoretel.com/STCorp/products/documents/Contactcenterwhitepaper.final.pdf [Accessed 9 September 2004].
10. Avaya (2003) *IP Telephony and the Contact Centre,* [online]. Available from http://www1.avaya.com/enterprise/resourcelibrary/whitepapers/ [Accessed 22 September 2004].
11. Liebmann,L *VOIP Psychology* [online]. Available from http://www.networkmagazine.com/article/NMG20010517S0002 [Accessed 6 October 2004].
12. Nemertes Research (2003) *How to Plan for VOIP (It's tougher than you think)* [online]. Available from http://www.nemertes.com/node/view/363 [Accessed 6 October 2004].
13. Gartner Symposium ITXPO 4-6 August 2003 *Implementing IP Telephony Today* [online]. Available from http://www3.gartner.com/Events?pageName=calendar&previous=true [Accessed 3 May 2004].
14. Nortel Networks (2003) *Seven Myths and Misconceptions about IP contact centres* [online]. Available from http://www.webtorials.com/main/resource/papers/nortel/paper12/7myths.pdf [Accessed 13 September 2004].
15. Nuasis (2004) *A Guide to Migrating Your Call Centre to an IP Contact Centre* [online]. Available from http://www.nuasis.com/private/wp_migration.pdf [Accessed 6October 2004].
16. Nuasis (2004) *Whitepaper: Total Cost of Ownership with a Pure IP Contact Center* [online]. Available from http://www.nuasis.com/private/Nuasis_TOC.pdf [Accessed 6 October 2004].
17. Nemertes (2003) *Users still leery of switch to voice-over-IP Systems* [online]. Available from http://www.computerworld.com/managementtopics/roi/story/0,10801,86979,00.html?f=x257 [Accessed 2 October 2004].
18. Metzler,J (2002) *Survey: VOIP Moves Beyond Cost-Cutting* [online]. Available from: http://www.webtorials.com/main/resource/papers/BCR/paper38/200207metzler.pdf [Accessed 13 September 2004].
19. AMC Technology (2004) *Multiple Channels...Multiple Vendors* [online]. Available from http://www.amctechnology.com/products/connectors.asp [Accessed 23 September 2004].
20. Whatis.com [online]. Available from http://searchnetworking.techtarget.com/sDefinition/ [Accessed 23 September 2004].
21. CRMXchange (2003) *The Realities of a Successful IP Implementation* [online]. Available from http://www.crmxchange.com/sessions/debates/dec03-transcript.asp [Accessed 6 October 2004].
22. Nortel Networks (2003) *Why Voice over IP?* [online]. Available from: http:/www.nortelnetworks.com/corporate/technology/voip/enhancements.html [Accessed 5 January 2004].

23. Hettick,L (2004) *Creating Business Value with IP Telephony* [online]. Available from http://www.vertical.com [Accessed 28 April 2004].
24. Gartner (2001) *Betting the Business on IP Telephony – a Case Study,* Gartner Resource ID: 327780
25. Nemertes Research (2003) *VOIP by the Numbers* [online]. Available from http://www.nemertes.com/node/view/66 [Accessed 6 October 2004].
26. Avaya (2000) *Enterprise Class IP Solutions (ECLIPS),* [online]. Available from http://www1.avaya.com/enterprise/resourcelibrary/whitepapers/eclips.html [Accessed 22 September 2004].
27. Datamonitor (2004) *Pure-IP vs. Hybrid-IP in the Contact Centre* [online]. Available from http://www.nuasis.com/private/Datamonitor_7_04_final.pdf [Accessed 6 October 2004].
28. Kulathumani,V (1999) *Voice over IP: Products, Services and Issues* [online]. Available from http://www.cse.ohio-state.edu/~jain/cis788-99/ftp/voip_products/index.html#intro [Accessed 6 October 2004].
29. Gartner (2002) *VOIP in Public Services: Facts, Fiction and Myth,* Gartner reference: AV-18-6958
30. DataMonitor (2004) *Understanding IP Telephony in the Contact Centre –When Should You Invest?* [online]. Available from http://www.genesyslab.com/g7/2004/download/datamonitor_IP_report.pdf [Accessed 7 May 2004].
31. Wainhouse Research (2003) *Network Readiness Assessment for Voice and Video over IP* [online]. Available from http://www.webtorials.com/main/resource/papers/packeteer/paper7/Network-Readiness-VOIP.pdf [Accessed on 5 October 2004].
32. Bocklund,L., Bengtson,D. (2003) *Call Center Technology Demystified.* Maryland: Call Center Press
33. Gartner (2001) *Preparing your LAN for IP Telephony,* Gartner Resource ID: 327781
34. Nuasis (2003) *Compelling Reasons for VOIP in the Contact Center.* [online]. Available from http://www.crmxchange.com/whitepapers/pdf/nuasis-compell_VOIP.pdf [Accessed 14 October 2003].
35. Kuter U, Yilmaz, C (2001) *Survey Methods: Questionnaires and Interviews*
36. Kirakowski, J *Questionnaires in Usability Engineering – A List of Frequently Asked Questions (3rd Ed.)* [Online], Available from http://www.ucc.ie/hfrg/resources/qfaq1.html [Accessed 7 July 2004].
37. Nielsen (1994) [online]. Available from: http://www.useit.com/alertbox/20040412.html [Accessed 6 July 2004].
38. Webopedia [online]. Available from http://www.webopedia.com/TERM/R/Rapid_Application_Development.html [Accessed 31 October 2004].
39. Gantthead.com [online]. Available from http://www.gantthead.com/process/processMain.cfm?ID=2-19516-2 [Accessed on 31 October 2004].
40. POLICY Announcement by the Minister of Communications, Dr Ivy Matsepe-Casaburri, 2 September 2004. Available from: http://www.doc.gov.za.