

VoIP Adoption: Issues & Concerns

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ABSTRACT

VoIP is a relatively new technology. Current research suggests that firms are using VoIP technology to cut costs, to improve productivity, and the firm's strategic position. The literature is rich with "how to" articles and a discussion of possible benefits, costs, and implementation barriers. But, very few academic studies exist. The purpose of this study is to identify and present the issues related to VoIP adoption and implementation.

INTRODUCTION

The business environment has changed dramatically within the last decade. Globalization and market liberalization has altered the way a firm competes within this environment and how the firm interacts both with its customers and suppliers. For example:

- Both customers and competition have become global. To cut cost and to ensure easy access to customers, production and sourcing have shifted overseas.
- Technology has become complex and sophisticated.
- The use of communication networks is widely available at many parts of the world.
- More firms than ever are using technology for a variety of tasks and several options exist for technology procurement.
- Through the use of the Internet, customers have access to a wealth of information about products, markets, and a firm's competition.
- Customers have become more demanding in terms of price, features, product quality, delivery, level of service, and responsiveness.
- To manage customer expectations and needs firms have begun to form alliances and partnerships to manage their supply chain.

To compete in this new economy firms are looking at many strategic options. Recent events noted below suggest that firms, in particular large ones, are exploring the use of Voice over Internet Protocol (VoIP) as a means to cut costs, to improve productivity, and the firm's strategic position¹:

- Bank of America is deploying more than 180,000 Cisco VoIP phones across its branches
- Boeing has announced plans to equip its 150,000 workers with VoIP
- Ford has a deal with SBC to deploy 50,000 VoIP phones
- Vonage has nearly 600,000 customers and new subscribers at the rate of 15,000 per week
- BT, the major telecommunications player in UK has announced that it plans to convert its infrastructure to VoIP by 2009.

VoIP is a relatively new technology. As with any new technology, some firms quickly adopt technology while other firms either wait or ignore it. Moore (1991) developed a model for categorizing new technology adopters. According to Moore, based on the time of adoption, firms may be placed in one of five categories: innovators, early adopters, early majority, late majority, and laggards. It could be argued that firms may not be ready for another substantial investment especially if they made a recent investment in mobile and cellular services. But, published information within USA lend to the notion that the investment in VoIP is accelerating. For example, telecommunications giants such as Avaya (<http://www.avaya.com>) and Cisco (<http://www.cisco.com>) report successful implementations in hundreds of diverse firms. This could imply that VoIP adoption is in the early majority phase (Walker and Hicks 2004). But, in other countries, the situation may be different if these countries do

not practice free market policies. In market economies such as USA, the individual firms make the determination on the decision to adopt VoIP technology. But in many third world countries, state enterprises often operate the telecommunication services and these enterprises may not be quick to adopt VoIP technology if such technology is seen to have a negative impact on their profitability.

The literature is rich with “how to” articles and possible benefits, costs, and implementation barriers. VoIP has not shown to have a clear economic advantage of the traditional phone systems. Some practitioners suggest that VOIP is all hype and may not be the right choice for some organizations if: a) voice quality and reliability are of paramount importance to the organization, b) power or high speed Internet connections are unreliable, c) the VoIP does not have the needed features, d) high speed Internet is not available, e) high speed Internet usage is near capacity, and f) capital costs (Britt, 2005).

The purpose of this study is to identify and present issues related to VoIP adoption and implementation. This study attempts to fill a gap in the existing literature as there is a dearth of studies focusing on VoIP adoption (Bakes et al., 2005) and prior research on VoIP has primarily dealt with either technology or regulatory issues with the target audience of practitioners. The article is organized in terms of four (4) sections. After this introduction, we next provide a brief description to the VoIP technology. We then proceed to examine the issues involved in VoIP adoption. We conclude by providing summary remarks and suggestions for future research.

TECHNOLOGY OVERVIEW

VoIP refers to the movement of voice traffic over Internet Protocol (IP) based network. To permit the traffic over the computer networks, the analog signals are turned into digital packets. The digital packets have a destination address but they follow no fixed path. To enable VoIP, broadband access, computer, and software. Additional hardware such as servers, switches, routers, and others may be required depending on the volume and nature of traffic. Readers are urged to consult VarShney, Snow, McGivern, & Howard (2002) for an excellent review of the VoIP history and technology.

VoIP permits the integration of data, voice, and video into one communication channel. The term digital convergence refers to this phenomenon of multiple media delivered over a single network. Some of the applications and services include PC based distance learning solutions, video conferencing, live webcasting, video streaming, collaboration and team management software, security surveillance, contact center applications, remote multimedia solutions and unified messaging ((Tobin & Bidoli, 2006).

VoIP ADOPTION & IMPLEMENTATION ISSUES

VoIP Adoption Influence Factors

Technology adoption and implementation remains a core IS research area. In one of the very early studies on the adoption of telecommunication technologies within US firms, Grover and Goslar (1993) develop model for telecommunications technology adoption and test their model by surveying senior IS personnel from 154 organizations. Their research model consists of three factors related to the environment, organizational, and IS. Their primary hypothesis is that these factors influence initiation, adoption, and implementation. The environmental factors capture uncertainty present in the environment. Organizational factors refer to size, decision making centralization, and formalization defined as the degree of reliance on rules and procedures. The IS factor present refers to IS maturity and it incorporates top management’s knowledge of IT, top management involvement in IS planning, the extent of infusion and diffusion of IT, and IS performance criteria. The 15 telecommunication technologies included in their study are FAX, Voice/data PBX, Access to commercial databases, Email, Interorganizational links, LAN, Network management software, Voice oriented systems, WAN, Intelligent/mobile phones, Owned communication lines, ISDN, VAN, Video conferencing, and Video text. They find that environmental uncertainty and decentralization of decision making show significant relationship with technology usage.

Perhaps the most surprising element of their finding is that organizational size does not have a bearing on initiation, adoption, and implementation of telecommunication technologies. Larger firms, i.e. those with sales of over \$100 million dominated the sample and perhaps this along with the “newness” of the technology accounted for the study findings. But, other research show that firms size plays a key role in the adoption process. Welsh and White note

that small businesses can be differentiated from larger businesses in terms of availability of capital, lack of technical expertise, and as a result of operating in a highly competitive environment susceptible to external forces. Small businesses also face additional pressures as their knowledge base is restricted when compared to larger businesses. They face complications in raising capital and thus may choose projects based on lowest cost and tend to underestimate the amount of resources required for completion (Yap, 1989). Larger businesses with more “clout” and credibility and with greater access to capital markets may be able to easily overcome their financial limitations.

Small businesses with restricted technical expertise may require the use of external expertise in the form of consultants and / or vendor support. But hiring suitably qualified personnel or motivating them to work within a small business may be difficult. Larger businesses can easily overcome their technical expertise limitations by hiring additional staff, using consultants, or using third party vendors. Lack of access to education and training within small business may affect their willingness to adopt new technology (Fariselli et al., 1999). The need to take a strategic view and the changing web dynamics may be ignored by small business (Tetteh and Burn, 2001). Small business managers are also likely to take a short term view of IS implementation (Thong, Yap, Raman, 1996) and may not be too actively involved in IS implementation. Further, they are susceptible to greater risk in IS implementation failure than their larger counterparts (Ein-Dor and Segev 1978; West 1975; Whistler 1970) and if IS implementation is not successful, they face severe repercussions as they may not have the necessary organizational slack to act as a buffer (Carter, 1990; Gerwin 1988, Thong, 2001). Thus, small business managers have a high stake in ensuring that IS implementation occurs and that such implementation is a success.

Bakes, Gwebu, and Zhu (2005) extend Grover and Goslar’s research model by incorporating additional factors shown in Table 1. The authors then use the case study approach to examine the VoIP adoption within three organizations. Two of these organizations are Fortune 500 firms and the other is an academic institution. Their key findings are as follows: a) VoIP remains a niche technology and the possible integration with wireless technology may enable it to become mainstream, b) the Fortune 500 firms tend to pilot test and use emerging technologies to cut costs and enhance competitive position, and c) cost savings through the use of VoIP are insignificant and the technology needs to mature before firms can realize significant savings. Tobin and Bidoli (2006) use both structured and semi structured interviews to identify the factors that influence VoIP adoption in South Africa (see Table 1 for the list of adoption factors). Their findings indicate that high bandwidth costs/high service costs and quality of service is the major barrier to adoption.

There is a need to develop a deeper understanding of the factors involved in the adoption of VoIP. It is not clear whether the research model of Grover and Goslar (1993) is relevant or whether changes to their model are required. Both theoretical work in model development and empirical testing of such models are of need.

Rationale for VoIP Implementation, Benefits, Challenges, and Barriers

A key decision area prior to the adoption and implementation of VoIP is the expected benefits and the extent to which benefits will materialize. In summer 2005, INS (<http://www.ins.com>), a provider of IT consulting and software solutions conducted a web based survey to assess the VoIP market and its growth potential. The key findings are as follows:

1. The rationale for implementing VoIP networks include: increasing network flexibility (61%), simplifying the network infrastructure (55%), enabling new feature rich and integrated applications (52%), and lowering voice toll costs outside the enterprise (52%),
2. The major obstacles for replacing the current system with VoIP are: demonstrating ROI (29%), identifying the business opportunities requiring converged applications (22%), lower voice quality/availability (19%), getting telecom and IT departments to work together (14%), security (10%), and lack a full telephony feature set (6%),
3. The significant barriers to VoIP implementation are: integration issues (43%), cost of upgrading the network to provide the required quality of service (40%), lack of experienced staff (37%), high cost of products and tools (37%), and justifying the costs and benefits to upper management (35%),

Researchers	Adoption Influence Factors		
Bakes, Gwebu, and	a. Environment (predictability,	b. Organization (size,	c. IS (IS maturity,

Zhu (2005)	stability)	formalization, centralization)	Relative advantage, Cost, Complexity, Technical compatibility)
Tobin and Bidoli (2006)	a. High bandwidth costs and high service costs	b. Security	c. Need for upgrade to VoIP
	d. Complexity of deployment and implementation costs	e. QoS	f. Lack of clarity in regulations
	g. Market confusion with large number of suppliers	h. Poor quality of voice comm.	i. Internal company policies
	j. ROI and time to recap investment	k. Privacy	l. Satisfaction with the current system
	m. Possible disruption in business	n. Use of cutting edge technology	o. Lack of skills
VarShney, Snow, McGivern, & Howard (2002)	a. Cost factor	b. Quality	c. Equipment availability
	d. Regulations	e. Global connectivity	f. Network management
	g. Internetworking with diverse networks	h. Future pricing and revenue sharing	i. Possible effect on traffic volume in IP networks
	j. Security and hacking threats	k. Reliability and failure measures	l. User equipment requirements
	m. Service integration		
Zeadally, Siddiqui, & Kubher (2004)	a. Cost savings	b. Improved network utilization	c. Opportunities for value added services
	d. Integrated infrastructure	e. Progressive deployment	

Table 1: Adoption Influence Factors

4. The three most important criteria when selecting VoIP solution include: network reliability (91%), voice quality (84%), and security (75%).

The two factors that may hinder the widespread adoption of VoIP are Quality of Service (QoS) and security. Lower VoIP QoS may be due to delays (propagation, network, accumulation, and processing), jitter, dropped packets, echo, and talker overlap (McPhillips, 1999). Chen et al. (2003) suggest that IP networks lack stringent QoS controls and present a survey of QoS management mechanisms of VoIP. Sass (2006) suggests that VoIP security is the key barrier to VoIP adoption. Radware (2005) categorizes the security threats as attacks on VoIP network operating system devices, configuration weaknesses, IP infrastructure attacks, VoIP protocol implementation vulnerabilities, and VoIP application level attacks. Progress needs to be done in these two areas before VoIP technology gains mainstream acceptance.

Another area of concern is the provision of acceptable level of emergency services. This concern has been echoed by researcher researchers and practitioners. For example, Sicker and Lookabaugh (2004) state:

Most VoIP services, atleast as they exist today, do not deliver the same quality ES service, leading some state regulators to consider legacy regulation on this service to require it to do just that (along with other requirements), regardless of the dramatic technical and business differences in nascent VoIP services. pp. 2-3

To address this issue, Sicker and Lookabaugh (2004) develop a model for VoIP emergency service compliance through industry certification and labeling. Future research needs to be directed at examining the applicability of their model in a range of situations as well as in developing alternate models.

Researcher(s)	Potential benefits, challenges, and barriers
Arunagiri, K. (2005).	a. Potential benefits: cost savings, features and functionalities, new

	applications, global customer support, productivity improvements, and mobility.
	b. Major challenges: QoS, cost, reliability, 911 emergency, interoperability, and regulation.
Sacker, Santaiti, & Spence (2006)	a. Potential benefits: measurable user productivity, greater voice messaging accessibility and efficiency, lower total cost of ownership, immediate and long term hard savings, reduced telecommunication costs, simplified management of servers, systems, endpoints, and network, and greater flexibility in component selection
Walker & Hicks (2004)	a. Major benefits are cost savings (equipment and maintenance, network administration, and network carrier related costs), capital and expense savings (long distance service, single network infrastructure savings, productivity savings) b. Major obstacles are cost & capital investment and business risk.

Table 2: Rationale for Implementation, Benefits, Challenges, and Barriers

There exists a wealth of information on potential benefits, challenges, and barriers as shown in Table 2. Many articles are from practitioner sources and little scientific verification exists of their claim exists. In one of the few studies to measure potential benefits, Sacker, Santaiti, & Spence (2006) report the results of a 50 user six month pilot study using Intel tools and technologies. In routine office phone related tasks, the authors find that productivity gain per user would be 2.7 days per year, with the productivity gain per user being \$480. Barnes (2005) examines whether VoIP is more economical for large businesses with large call centers. Using data from service providers, Barnes finds that a firm could save 76.2% of their outbound calling expenses if VoIP is used.

SUMMARY REMARKS

VoIP is a new technology that promises to provide competitive advantage to a firm. The Telecom Insider newsletter identifies the following seven VoIP trends for 2006 that will have a bearing on its adoption. These include a possible retaliation by Internet access providers who may block VoIP calls, consolidation and partnerships, growth in broadband penetration, growth in wireless use, Session Initiation Protocol (SIP) to become the standard for delivering VoIP calls, regulatory threats, and availability of sophisticated multimedia applications.

While growth prospects look rosy, several barriers and implementation challenges remain. These include the need to justify investment in VoIP technology, QoS, and security. While great deal of “how to” and practitioner related articles exist in the literature, there is a need for academic oriented articles on theory development and empirical testing of these theories. In particular, there is a need to assess the applicability and relevance of the contribution of Grover and Goslar (1993). There is also a need for case studies that will focus on VoIP initiation, adoption, and implementation over a longer period of time.

End Notes

¹ http://www.ezilon.com/information/article_15586.shtml. Accessed May 6, 2006.

REFERENCES

Arunagiri, K. (2005). Voice over Internet Protocol – A Strategic Technology for the Enterprise. *Archstone Consulting Report*. Available at <http://www.archstoneconsulting.com/>. Accessed May 8 2006.

Bakes, C.M., Gwebu, K.L., & Zhu, D.X. (2005). The State of VoIP Adoption in Contemporary Organizations. *Proceedings of the 16th IRMA International Conference*. San Diego, CA, May 15 – 18.

Barnes, Z.A. Is Implementation of Voice over Internet Protocol (VoIP) More Economical for Businesses with Large Call Centers? *Graduate Research Report*. Bowie State University. Available at <http://faculty.ed.umuc.edu/~meinkej/inss690/barnes.pdf>. Accessed May 8, 2006.

Britt, P. Six Reasons to Avoid VoIP. Available at <http://www.networkingpipeline.com/173500263>. Accessed May 7th 2006.

- Carter, N.M. (1990). Small firm adaptation: responses of physicians' organizations to regulatory and competitive uncertainty. *Academy of Management Journal*, 33 (2), 307-330.
- Chen, X., Wang, C., Xuan, D., Li, Z., Min, Y., and Zhao, W. (2003). Survey on QoS Management of VoIP. *Proceedings of the 2003 International Conference on Computer Networks and Mobile Computing (ICCNMC '03)*. IEEE Computer Society.
- Fariselli, P., Oughton, C., Picory, C., Sugden, R. (1999). Electronic Commerce and the Future for SMEs in a Global Market-Place: Networking and Public Policies. *Small Business Economics*, 12, 261-275.
- Gerwin, D. (1988). A theory of innovation processes for computer-aided manufacturing technology. *IEEE Transactions of Engineering Management*, 35(2), 90 -100.
- Grover, V., & Goslar, M.D. (1993). The Initiation, Adoption, and Implementation of Telecommunications Technologies in U.S. Organizations. *Journal of Management Information Systems*, 10(1), 141-163.
- McPhillips, E. (1999). The Factors Affecting the Growth of VoIP. *Hewlett Packard Research Report*. Available at www.hpl.hp.com/techreports/1999/HPL-IRI-1999-003.pdf. Accessed May 8, 2006.
- Moore, G.A. (1991). *Crossing the Chasm*. New York: Harper Business.
- Radware (2005, August). VoIP: Security Threats and Solutions. <http://www.radware.com/content/document.asp?v=about&document=6142>. Accessed November 3 2005 (Cited in Sass 2006).
- Sacker, S.M., Santaiti, M., & Spence, C. (2006). The Business Case for Enterprise VoIP. Available at Intel Research Report. <http://www.intel.com/netcomms/technologies/voice/311289.pdf>. Accessed May 8th, 2006.
- Sass, D. (2006). Voice over IP Security Planning, Threats and Recommendations. Available at http://www.infosecwriters.com/text_resources/pdf/VOIP_DSass.pdf. Accessed May 8, 2006.
- Sicker, D. & Lookabaugh, T. (2004). A Model for Emergency Service of VoIP Through Certification and Labeling. *NET Institute Working Paper No. 04-19*. Available at SSRN: <http://ssrn.com/abstract=621724>
- Tetteh, E. and Burn, J. (2001). Global Strategies for SME-business: applying the SMALL framework. *Logistics Information Management*, 14(1), 171-180.
- Thong, J.Y.L. (2001). Resource constraints and information systems implementation in Singaporean small businesses. *Omega: The International Journal of Management Science*, 29, 143-156.
- Thong, J.Y.L., Yap, C.C., and Raman, K.S. (1996). Top management support, external expertise, and information system implementation in small business. *Information Systems Research*, 7(2), 248-267.
- Tobin, P.K.J. & Bidoli, M. (2006). Factors affecting the adoption of Voice over Internet Protocol (VoIP) and other converged IP services in South Africa. *South African Journal of Business Management*, 37(1), 31 – 40.
- VarShney, U., Snow, A., McGivern, M., & Howard, C. (2002). Voice Over IP. *Communications of the ACM*,. 45 (1), 89 – 95.
- Walker, J.Q. & Hicks, J.T. (2004). *Taking Charge of your VOIP Project*. Indianapolis: Cisco Press.
- Welsh, J.A. and White, J.F. (1981). A Small Business is Not a Little Big Business. *Harvard Business Review*, 59(4), 18-32.
- Yap, C.S. (1989). Computerization Problems Facing Small and Medium Enterprises: The Experience of Singapore. *Proceedings of the Twentieth Annual Meeting of the Midwest Decision Science Institute*, Miami University, OH, April 19-21, 128-134.