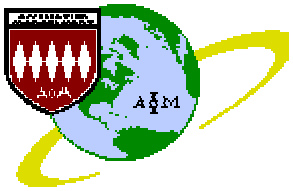

Journal of Information Technology Management

ISSN #1042-1319

A Publication of the Association of Management

REAL-TIME TELECOMMUNICATION SOFTWARE: A FRAMEWORK FOR SELECTION

STEVEN D. SEILHEIMER
NIAGARA UNIVERSITY
seilheimer@niagara.edu

ABSTRACT

Real-time Telecommunication Software (RTS) has had a major beneficial impact on a variety of professional organizations within the business, academic, and government arenas. In addition to the direct benefits of increased profit, higher productivity, and reduced expenses, there are also indirect benefits—such as environmental benefits realized by reducing pollution that results from physical travel (i.e., by car, airplane, etc.), as well as the pollution from maintaining the travel infrastructure (i.e., roads, railways, etc.). From a human-focused benefit perspective, contrary to those who view telecommunication as being a less personal communication method, when compared to face-to-face conversations, literature in the area of communication theory reveals that online interaction is capable of successfully fostering social support in the forms of understanding, reassurance, and advice. The importance of RTS security cannot be overstated; if a system is not secure, it exposes the organization to possible legal prosecution under the numerous current privacy laws, as well as possibly endangering an organization's competitive advantage. The RTS selection framework presented can be employed to select proper RTS for organizations. The framework can be viewed as having three levels: a conceptual level, a strategic level, and an operational level. The framework must have a flexible capacity to accommodate the communication variety among organizations, but it also needs a firm capacity to give the framework the necessary structure. The stated strategic parameters give the framework a firm capacity, yet these can be customized by an individual organization, as well as the operational elements used to gather necessary information, if it is necessary to fit the individual organization's needs. Important considerations are discussed regarding the proper utilization of the RTS selection framework within the business, academic, and government arenas, with the objective of ensuring organizational viability.

Keywords: Real-time telecommunication, interactive systems, software selection.

INTRODUCTION

Real-time Telecommunication Software (RTS) has had a major beneficial impact on a variety of professional organizations within the business, academic, and government arenas. Organizations have significantly increased productivity and cut expenses in a variety of ways through the implementation of such software [1], [3], [6], [21]. In one specific case, an organization saved $114,325 over a 21-week period through the use of video and audio teleconferencing [23]. The usefulness of RTS has led to the creation of unique terminology (e.g., telecommuting, telework, telelearning, telecourses and telemedicine). According to one survey, a number of nations have large teleworkforces, such as the United States (12.2%), Finland (16.8%), Sweden (15.2%) and the Netherlands (14.5%), with an estimated aggregate productivity benefit for the United States of $160,000,000,000 [2]. Telecommuting specifically has experienced considerable growth in the United States due to technological and social changes [14]. RTS can be implemented locally, regionally, or nationally, but the true power of the technology is best realized, in the current environment of globalization, when it is implemented on an international scale [16]. Though some users may be familiar with a particular sub-

set of RTS, there is in fact a very wide variety of systems to choose from, such as collaborative environments for Unix and Linux platforms, teleconferencing systems, and messaging systems [5]. Concerning telelearning (also known as distance learning), business, academic, and government organizations have profited from this virtual-learning approach, with higher education realizing annual revenues of $225,000,000,000 [8].

Although all RTS is useful, there are significant differences in its forms. For example, the video capability of videoconferencing systems communicates important non-verbal information such as facial expressions, gestures, posture, and gaze [25], which are lost in non-video RTS. However, an individual organization may get greater productivity out of RTS with a fewer number of functions. For example, in one Swedish company, audioconferencing is used more frequently than videoconferencing, because of higher accessibility to audioconferencing infrastructure, simpler use, and higher reliability [1].

INDIRECT BENEFITS OF RTS

There are a number of indirect, though very important, benefits of RTS in addition to the direct benefits of increased profit, higher productivity, and reduced expenses. Environmental benefits are realized by reducing pollution that results from physical travel (i.e., by car, airplane, etc.), as well as the pollution from maintaining the travel infrastructure (i.e., roads, railways, etc.). One study calculated that the annual travel savings for a 1-day-per-week United States teleworker translates into approximately 1 metric ton of carbon dioxide and 7 kg. of other air pollutants not being emitted, with the added benefit of reduced congestion for other drivers [2].

From a human-focused benefit perspective, contrary to those who view telecommunication as being a less personal communication method, when compared to face-to-face conversations, literature in the area of communication theory reveals that online interaction is capable of successfully fostering social support in the forms of understanding, reassurance, and advice [4]. Additionally, studies investigating the impact of using mobile communication technologies in learning environments have concluded that accessibility of information, communication, and collaborative learning by students were enhanced [17].

SPECIFIC CONSIDERATIONS REGARDING DIFFERENT PROFESSIONAL ORGANIZATIONS

There are significant differences between private and public organizations; for example, governments can have more legal and formal constraints when compared to other organizations [9]. Conversely, some representatives of the computer, software, and communications industries occasionally raise concerns over the presence of the federal government in the emerging e-commerce market [12]. In academic organizations, virtual seminars have produced benefits such as increasing the number of student contributions [10]. In telemedicine, the utilization of video teleconferencing to communicate with a rural population concerning nutrition counseling increased the number of appointments, decreased no-show and cancellation rates, and increased follow-up appointments [11]. These specific considerations that differ depending on the type of professional organization being examined must be taken into account when selecting RTS for the organization.

RTS SECURITY

The importance of RTS security cannot be overstated; if a system is not secure, it exposes the organization to possible legal prosecution under the numerous current privacy laws, as well as possibly endangering an organization's competitive advantage. In fact, there may be mandated security measures, such as ISO 27001, by a regulatory body, or companies may seek ISO certification to provide evidence to their customers or business partners that their operations are trustworthy [18]. Another method for organizations to provide online trustworthiness is through the use of a third-party World Wide Web assurance service [19].

There is a wide range of additional security methods that must be taken into account. Encryption/decryption and data authentication, for example, are standard teleconferencing security methods that should be utilized [13]. Online network security can be complex, since security levels and approaches in different locations (i.e., nodes) on the network can vary greatly [20]. However, the decentralized nature of widely used Peer-to-Peer (P2P) networks, which can be in various forms, such as the Internet, intranets, or extranets, present special challenges relevant to telecommunication security, when compared to non-P2P systems [15]. Even a standard network implementation for organizations today, such as a Virtual Private Network (VPN), can have different security protocols—e.g., IPsec VPN or SSL VPN—depending on an

individual organization's needs [22]. Security can also take the form of online counterintelligence, such as using "honeypots" to globally log hackers' nefarious activities while at the same time using "honeywalls" to monitor intruders' actions and prevent outbound traffic from doing damage to other systems [24].

In the author's experience, a disturbingly large number of frequent computer users are ignorant of proper security measures. Too many users believe the front-end (i.e., PC) basic security features of passwords, firewalls, and viruscheckers are all that are necessary to secure systems. Passwords are, quite frankly, a weak form of security, because they can be compromised with free, downloadable, password-cracking applications (commonly known as apps)—the simpler the password, the quicker the crack. More secure, but more costly, biological verification systems (e.g., iris or retina scans) can be implemented for high-security access. Because by definition RTS communicates with other nodes on a network, all front-end nodes should have firewall protection, but it does little good if all nodes (i.e., applications, web, etc.) of the network are not firewalled, and therefore can be corrupted. Of course, firewalls should also be used to protect network-to-network telecommunication. Current professional versions of viruscheckers—which in addition to checking for viruses, will auto-scan and quarantine or delete all currently known malware (e.g., trojans, worms, and spyware)—should be installed on all susceptible machines; even infrequent computer users who might think this is unnecessary have at some time, in all probability, been victimized by computer malware, if only by having Internet traffic significantly slowed. The author has found installing a separate spywarechecker enhances computer security, because of the extra layer of safety from having two different malware checkers. Additionally, all security patches for all RTS-relevant software should be downloaded—auto-downloaded if possible—and immediately installed, because unpatched software is a major weak point that invites hacker attacks. Intrusion-detection software for network entry points is also useful to log hacker attacks, protect system assets, and trace hackers for prosecution. An additional security measure is the use of digital client certificates exchanged between two users, which ensures the message has been encrypted and has not been altered.

Another important encryption/decryption protocol between server and client that should be utilized where relevant is Secure Sockets Layer (SSL), which is presently the de facto standard; certificates are passed between server and client to authenticate each. Certificates have a much higher level of security when compared to passwords. The investment in the above security measures by an organization is wise, given the numerous security risks in the present computing environment, when implementing RTS.

RTS TERMINOLOGY: CLARIFICATIONS AND EXPLANATIONS

Terminology in the literature, which is related to RTS, can be confusingly applied. For example, one study differentiates videoconferencing from teleconferencing [3], yet "tele" comes from the Greek and explicitly means "far off" as in distant [7]; hence, any system that communicates over a distance is properly a telecommunication system. This article will specifically focus on electronic-based telecommunication systems, since the author understands that there are other non-electronic telecommunication systems that predate them (e.g., paper mail). An early form of a telecommunication system, the telegraph (which can be viewed as a precursor to email) was a unidirectional, delayed-response system; the delay might have been very brief, but the message still had to be received as an independent entity, read, and then replied to, as with email. Then bidirectional, real-time (i.e., instantaneous-response) telecommunication became available to the general public with the invention of the telephone, which, though probably taken for granted by members of the generation who grew up with it—the author included—was a vastly superior communication system when compared to the earlier delayed-response systems.

Because, as stated above, there can be confusion in how different parties use RTS terminology, in the interest of complete clarity for this article, the below section contains industry-standard definitions, and examples germane to them indicating their usefulness.

As an important point, in this section, the author will present RTS he has personally utilized—however, the systems are meant only to be examples of their category's functionality, not as an endorsement that the systems discussed are superior to other systems within the category.

As a second important point, professional organizations currently are using a variety of useful communication systems internally to increase productivity—e.g., Blogs (Weblogs), Wikis, and multimedia downloads (Podcasts, etc.), but because, as originally conceived and programmed, they are not real-time, they will not be discussed in this article.

Properly speaking, a webcast is unidirectional only, while a webinar (an abbreviation of web-based seminar) is bidirectional and real-time—that is, it supports instantaneous interaction through a high-speed connec-

tion. A webinar can be paid (for the highest-value expert advice) or complimentary (for standard expert advice), but the technological approach is the same; by standard it supports audio and video, with text-only input possibly being used by the host and/or presenter to manage attendee questions, especially with very large audiences that can result in numerous questions being asked. The author has found webinars very useful for learning specific technologies and business processes, of which the author lacks knowledge. A wide variety of webinars are available across a wide range of sites, pertaining to both specific and general topics in many areas of knowledge. An added advantage is an on-demand archive is often available for a replay of a webinar if one cannot attend the originally scheduled event.

One factor that adds to the confusion in exactly defining and categorizing RTS is that, as systems have evolved, cross functionality has been programmed into systems that previously had independent functions. For example, originally Instant Messaging (IM) software was text-based. Yet today it can contain functions that previously were considered as being in the category of teleconferencing systems. As an example, the author's preferred IM application, Paltalk (in the highest-level professional version), supports text, audio, and video, with unlimited and expandable video windows, and with all functions having instantaneous and continuous-feed quality. There is also a high level of user friendliness; the author created and fully customized the configuration of a permanent text-audio-video room in approximately 10 minutes. These capabilities were not available in the first generation of IM software.

Concerning the category of audioconferencing, there are currently a wide variety of options available. In fact, the technological approach is not new in that the author recalls being involved in audioconferences, known at the time as conference calls, approximately 30 years ago. The advantage today is that there are many features available that previously were not. The author has utilized Global Crossing Ready-Access audioconferencing, both as a chairperson and participant, and has found it user-friendly to access and control, with all the modern useful features such as recording, muting, locking, and quick disconnecting/rejoining. Today's audioconferencing is certainly a great improvement over the first generation "conference box" capability.

Videoconferencing could be strictly defined as referring only to real-time streaming visual images—yet in standard, current usage, it can include audio and text.

The term webconferencing, in standard, current usage, includes the full functionality of state-of-the-art groupware—that is, real-time text, audio, and video, with fully integrated collaboration. As an example, the author has utilized Webex webconferencing, which provides all of the above capabilities with a well-organized, multi-window/tab interface. Additionally it has very user-friendly features that have come into later versions of systems in this category, such as fully synchronized content viewers for all participants (which also support slide animation and transition effects), shared web content (Internet or intranet—including multimedia effects), shared annotation of all files (i.e., text documents, slide presentations, whiteboards, etc.) with the options of saving annotated files or printing them. Applications can also be shared, with control being able to be passed between the host and the attendees, though participants should have a high-speed Internet connection if this feature is selected, since it is bandwidth-intensive. Both standard telephone and Voice over Internet Protocol (VoIP) are supported, with VoIP capable of resulting in major savings in long-distance charges if participants are globally dispersed. Attendees can be directly invited via email, IM, or telephone, or meetings can be listed on the Meeting Center website calendar. Standard view features, such as zooming, thumbnail and full-screen, and resizing and positioning are also available. Although there was a significant learning curve involved to properly utilize all features of this system, the author found it to be a worthwhile investment of time. All standard demands of virtual teams can be met through the utilization of webconferencing.

It is important to note from a cost standpoint that, in the first generation of videoconferencing technology, a high-quality videoconferencing infrastructure with a significant number of seats could easily exceed a cost of $100,000. Today webconferencing, with inexpensive webcams, PCs, headsets, software cost, and telecommunication via the World Wide Web, can provide more functionality at a fraction of the cost per seat.

THE RTS SELECTION FRAMEWORK

As stated above, there are numerous factors that have to be taken into consideration, if an organization is going to select the proper RTS to fit its needs. Additionally, the RTS selection framework must be able to accommodate all organizations, because organizations, even within one academic, business, or government segment, can vary greatly in their communication processes—that is, there is no "right or wrong" approach to organizational communication, as long as all required deliverables are produced on time within budget.

The RTS selection framework can be viewed as having three levels: a conceptual level, a strategic level, and an operational level. As stated above, the framework must have a flexible capacity to accommodate the communication variety among organizations, but it also needs a firm capacity to give the framework the necessary structure. The stated strategic parameters give the framework a firm capacity, yet these can be customized by an individual organization, as well as the operational elements used to gather necessary information, if it is required to fit the individual organization's needs. The framework is illustrated diagrammatically in Figure 1 and also shown in Table 1.

There are certain core strategic parameters and operational elements that are relevant, to some degree, to all professional organizations; these have been included in the RTS selection framework. Strategic parameters and operational elements can, however, vary in their importance, within an individual organization; therefore the author recommends a weighted approach, from +1 to +10 for an advantage (i.e., positive effect in some form) and from -1 to -10 for a disadvantage (i.e., negative effect in some form), to indicate the overall impact an RTS standard category will have on an organization. The selection framework is a meta-level when compared to traditional project management methodology. It allows for the selection of the category of RTS which will be most productive for the organization. Once this is accomplished, then traditional project management methodology (i.e., gathering specific system requirements, generating a feasibility study for system selection, etc.) can be utilized. The framework is intentionally stated in general terms to allow an individual organization to customize it to its individual needs.

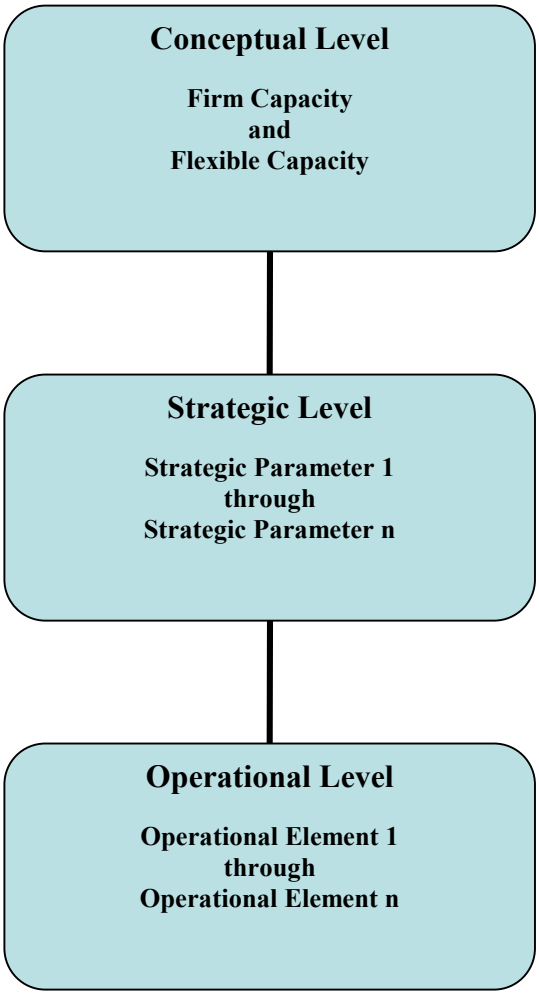

Figure 1: RTS Selection Framework

Table 1: RTS Selection Framework

Strategic Parameters	Operational Elements (Benefits And Costs In Some Form)	RTS Standard Categories (Weights: Advantage, +1 To +10; Disadvantage, -1 To -10)				
		Webinars	IM	Audio Conferencing	Video Conferencing	Web Conferencing
Internal Use (Communication Between Employees)	Benefit Of Features Available In An RTS Category Benefit Of Portability Of An RTS Category Internal Infrastructure Support Cost Per Year (Projected) External Infrastructure Support Cost Per Year (Projected) [Through Organizational Element n (As Required By An Individual Organization)]					
External Use (Communication With Stakeholders: Customers, Suppliers, Etc.)						
Immediate Importance To The Organization (Current Use)						
Importance of Feature Scalability (Future Use)						
[Through Strategic Parameter n (As Required By An Individual Organization)]						

The total of the weights for each RTS category reveals its usefulness to the organization. If the total is 0 or negative it is not useful, while positive totals indicate usefulness to the organization.

CONCLUSIONS

The RTS selection framework is in fact a formalization of a process the author has used to successfully select software for a variety of organizations. One might think that it is not necessary to be so concerned about having a formal framework for software selection, but there are important reasons for this.

First, in the current, very competitive environment of global competition, organizations that wish to remain viable cannot afford to waste resources on software that does not have all the necessary features to meet their needs.

Second, a formal framework also reveals which features are not necessary to carry out the organizational mission, which saves resources and can actually increase productivity. As an example, the author previously worked in an organization with four official communication systems: internal paper mail, telephone/voicemail, server-based email, and client-based email. This was before modern RTS existed, and the concept was to provide state-of-the-art communication (which it was at the time) to all organizational members. However, the result was that important information frequently was not obtained in time by organizational members to properly act on it, be-

cause organizational members did not have time to continually check four communication systems while still accomplishing other necessary tasks—thus too many communication options caused a significant decrease in productivity, with a consequential negative impact on the viability of the organization. This is not to say that organizations should not choose multiple RTS systems if the framework indicates they would be productive, but there should be an organizational policy to establish a priority communication thread—or instead an RTS system should be chosen that encompasses all required communication features, with an interface that provides the capability of simultaneous feature utilization.

In a related point, even if RTS is properly selected through the selection framework for an organization, there can be a danger of underutilization, which also threatens the viability of the organization. As an example, the author has a business colleague whose organization invested significant resources in state-of-the-art videoconferencing and webconferencing systems, in an effort to increase the productivity of frequent, necessary collaboration among the organizational members on documents, in the forms of real-time communication and real-time document enhancements. However, due to a combination of technological phobia and the "this is the way we've always done it" syndrome that influences most users within the organization, much of the investment has been wasted.

RTS, in the current and future academic, business and government arenas, can provide significant organizational benefits—but only if it is properly selected and utilized.

REFERENCES

[1] Arnfalk, P. and Kogg, B. "Service transformation—managing a shift from business travel to virtual meetings," *Journal of Cleaner Production*, Volume 11, Number 8, 2003, pp. 859-872.

[2] Ayres, R.U. and Williams, E. "The digital economy: Where do we stand?," *Technological Forecasting and Social Change*, Volume 71, Number 4, 2003, pp. 315-339.

[3] Bolyard, E., Scott, R.D., Banerjee, S., Pearson, M. and Team, H.P. "Blue Ribbon Abstract Award: Assessment of Education and Communication Resources for Public Health Emergencies in U.S. Hospitals," *American Journal of Infection Control*, Volume 32, Number 3, 2004, p. E13.

[4] Caplan, S.E. and Turner, J.S. "Bringing theory to research on computer-mediated comforting communication," *Computers in Human Behavior*, Volume 23, Number 2, 2007, pp. 985-998.

[5] Doyle, E., Collaborating to get the message across. *Computer Weekly*, 2006, pp. 58-60.

[6] Gibbons, H.R. "Wax and Wan: Groundwork in place at some operations to utilize teleconferencing systems," *Nation's Restaurant News*, Volume 40, Number 45, 2006, pp. special section 4-6.

[7] Guralnik, D.B. (Ed.), *Webster's New World Dictionary: Second College Edition*, Simon & Schuster, New York, New York, 1984, p. 1461.

[8] Harper, K.C., Chen, K. and Yen, D.C. "Distance learning, virtual classrooms, and teaching pedagogy in the Internet environment," *Technology in Society*, Volume 26, Number 4, 2004, pp. 585-598.

[9] Hung, S.-Y., Chang, C.-M. and Yu, T.-J. "Determinants of user acceptance of the e-Government services: The case of online tax filing and payment system," *Government Information Quarterly*, Volume 23, Number 1, 2006, pp. 97-122.

[10] Jelfs, A. and Colbourn, C. "Virtual seminars and their impact on the rôle of the teaching staff," *Computers & Education*, Volume 38, Number 1, 2002, pp. 127-136.

[11] Johnson, A., Rader, J., Coulehan, N. and Baker, F. "The Use of Interactive Videoconferencing to Provide Nutrition Counseling to A Rural Population," *Journal of the American Dietetic Association*, Volume 97, Number 9, 2003, p. A37.

[12] Joseph A. Salem, J. "Public and private sector interests in e-government: a look at the DOE's PubSCIENCE," *Government Information Quarterly*, Volume 20, Number 1, 2003, pp. 13-27.

[13] Mukherjee, R. and Atwood, J.W. "Scalable solutions for secure group communications," *Computer Networks*, Volume 51, Number 12, 2007, pp. 3525-3548.

[14] Mundorf, N. and Bryant, J. "Realizing the social and commercial potential of interactive technologies," *Journal of Business Research*, Volume 55, Number 8, 2002, pp. 665-670.

[15] Palomar, E., Tapiador, J.M.E., Hernandez-Castro, J.C. and Ribagorda, A. "Secure content access and replication in pure P2P networks," *Computer Communications*, Volume 31, Number 2, 2008, pp. 266-279.

[16] Raaij, E.M.v. and Schepers, J.J.L. "The acceptance and use of a virtual learning environment in

China," *Computers & Education*, Volume Online ScienceDirect available 27 October, Number N/A, 2006, p. N/A.

[17] Rau, P.-L.P., Gao, Q. and Wu, L.-M. "Using mobile communication technology in high school education: Motivation, pressure, and learning performance," *Computers & Education*, Volume 50, Number 1, 2008, pp. 1-22.

[18] Rowlingson, R. and Winsborrow, R. "A comparison of the Payment Card Industry data security standard with ISO17799," *Computer Fraud & Security*, Volume 2006, Number 16-19, 2006, pp. 3-11.

[19] Runyan, B., Smith, K.T. and Smith, L.M. "Implications of Web assurance services on e-commerce," *Accounting Forum*, Volume Online ScienceDirect, Number N/A, 2007, p. N/A.

[20] Schmidt, V. and How, J. "Remote participation technical infrastructure for the JET facilities under EFDA," *Fusion Engineering and Design*, Volume 56-57, Number October, 2001, pp. 1039-1044.

[21] Schubert, A. "Teleconferencing, distance learning, and telementoring: new technology harnessed for perioperative education," *Journal of Clinical Anesthesia*, Volume 12, Number 3, 2000, pp. 250-251.

[22] Stanton, R. "Securing VPNs: comparing SSL and IPsec," *Computer Fraud & Security*, Volume 2005, Number 9, 2005, pp. 17-19.

[23] Watson, A.R., Lee, K., Billiar, T. and Luketich, J. "Interactive multi-site video teleconferencing as a means to increase surgical resident and staff participation at core teaching conferences," *Journal of the American College of Surgeons*, Volume 205, Number 3, Supplement 1, 2007, p. S85.

[24] Watson, D. "Honeynets: a tool for counterintelligence in online security," *Network Security*, Volume 2007, Number 1, 2007, pp. 4-8.

[25] Werkhoven, P.J., Schraagen, J.M. and Punte, P.A.J. " Seeing is believing: communication performance under isotropic teleconferencing conditions," *Displays*, Volume 22, Number 4, 2001, pp. 137-149.

ACKNOWLEDGEMENTS

The author wishes to thank Bank Officer Pamela A. Seilheimer, who is a Senior Process and Systems Analyst with M&T Bank, for her valuable contributions to this article, especially in the forms of suggested additional content based upon her professional experiences, and suggested clarifications relating to existing content; Pamela manages virtual-team projects, leveraging telemeeting technology, to maximize productivity within an environment that integrates internal teams and external vendors.

AUTHOR BIOGRAPHY

Steven D. Seilheimer is a tenured faculty member in the Computer and Information Sciences department at Niagara University, New York, USA, and president of Data Systems and Concepts, a computer consulting firm based in Williamsville, New York, USA. During his twenty-six-year academic career, he has published a number of articles on topics in the information management area. His thirty-two-year computer consulting career has included the completion of a variety of projects in both the public and private commercial sectors.