

Running head: LAN END USER SATISFACTION

Local Area Network
End User Satisfaction Study
at the
Department of Veterans Affairs
Veterans Health Administration's
VA Puget Sound Health Care System

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Abstract

This non-experimental, longitudinal study examines Local Area Network (LAN) end user satisfaction (EUS) among 47 healthcare executives at the VA Puget Sound Health Care System (VA PSHCS). The executives included in this study were using the LAN before October 1, 1997, and after the implementation (February 18, 1998) of the LAN infrastructure enhancements. This study uses satisfaction as one measure to support the LAN enhancements, and as an indicator of LAN success or effectiveness using the short form instrument developed by Blake Ives, Margrethe Olsen and Jack Baroudi in 1983, and refined by Jack Baroudi and Wanda Orlikowski in 1988. While the VA PSHCS improves their information technologies (IT), the organization must balance quality, access, and cost of providing healthcare services to eligible veterans. Additionally, the organization must scan the horizon for opportunities to remain solvent in an era of limited resources and alternative healthcare delivery models. Therefore, with limited resources, healthcare organizations that improve their IT must somehow demonstrate the added value of IT expenditures and establish system success. This paper presents three hypotheses that were tested using the short form instrument to measure LAN EUS. The alternate hypotheses include: 1) the short form instrument used at the VA PSHCS is a reliable and valid measure of LAN EUS; 2) healthcare executive LAN EUS at the VA PSHCS is expected to increase over time; and 3) healthcare executive LAN EUS at the VA PSHCS is independent of grouped differences (i.e., gender, age, position held in the organization, duration of LAN usage, percent of time using LAN, and LAN training). In each case, the null hypothesis was rejected.

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Introduction

The VA Puget Sound Health Care System (VA PSHCS) provides tertiary care services to the veteran population in the Pacific Northwest United States. The organization is one of 173 healthcare facilities and systems (VA Fact Sheet, January 1998) within the Department of Veterans Affairs' (VA), Veterans Health Administration (VHA). The VHA has 22 Veterans Integrated Service Networks (VISN; Kizer, December 9, 1997a; VA Fact Sheet, January 1998) operating in the United States including the District of Columbia, and Puerto Rico, Guam, the Philippines, and the U.S. Virgin Islands (Kizer, 1997b).

The VHA has four missions:

1. "... to provide healthcare to eligible veterans (Kizer, 1997b, p. 286)."
2. "... to conduct education and training programs that enhance the quality of care provided to veterans (Kizer, 1997b, p. 287)."
3. "... to conduct research that will enhance VA's provision of healthcare to veterans (Kizer, 1997b, p. 287)."
4. "... to serve as the primary contingency back-up to the Department of Defense medical care system and to assist the PHS [Public Health Service] and the National Disaster Medical System [by providing] emergency medical care to victims of natural and other disasters (Kizer, 1997b, p. 288)."

These missions lay the foundation for each facility within the VHA to develop a congruent, yet geographically distinct strategic direction. The VA PSHCS's mission, vision, and values are:

MISSION - We proudly serve the Veterans of the Northwest, by delivering the highest quality health care and services supported by our education and research programs.

VISION - Together, we can exceed customer expectations by continually developing better ways to provide the highest quality health care and services to our veterans within an environment that empowers and inspires excellence.

VALUES - Quality, Courtesy, Respect, Caring, Integrity, Commitment, Teamwork (VA PSHCS VISTA, October 28, 1997).

These living statements and qualities are the foundation that supports the rich tapestry of a healthcare organization. At the VA PSHCS, the staff provides healthcare and support services at two divisions approximately 45 miles apart. In fiscal year 1997, the organization's bed services included 367 acute care, 146 extended care, 54 psychiatric residential rehabilitation treatment, and 50 domiciliary beds with a complement of 2,574 full-time employee equivalents and a \$225 million medical care budget (VA PSHCS Executive Summary, 1997). The organization also realized a budget of over \$20 million (VA and non-VA funding) for biomedical, health services, geriatric, VA/DOD collaborative, and rehabilitation research activities. Additionally, the organization supported educational efforts through the medical school affiliation with the University of Washington and other accredited higher learning institutions.

To support the VA PSHCS's mission, the organization is migrating from a mainframe system to a client/server system operating on a Local Area Network (LAN) platform to better meet the needs of the facility's end users (Acting Chief IRMS, personal communication, October 16, 1997). A mainframe system is "a very large and expensive computer capable of supporting hundreds, or even thousands, of users simultaneously (pcwebopedia, November 8, 1997). Conversely, a LAN is a system of electronics (e.g., printers, computers, and data storage devices) connected together by cable (e.g., Cat 5 and fiber optic) in a small geographical area, which allow users to optimize communication channels, such as sharing data and information (Ball, et al, 1995; Nath, 1990; Tan, 1995).

Within the organization, the Information Resources Management Service (IRMS) provides the LAN infrastructure, software and educational support to the organization's LAN end users (VA PSHCS Memorandum IM-01, 1995; VA PSHCS Memorandum IM-22, 1995). The facility has a LAN operating at each Division (Seattle and American Lake; Acting Chief IRMS, personal

communication, October 16, 1997). The two LANs are connected via two T-1 lines that transmit data between the two divisions. The LAN infrastructure at the Seattle Division used a hub environment and the American Lake Division's LAN used an TUT-box environment before the enhancements. During November 1997 through mid-February 1998, the IRMS staff enhanced the LAN infrastructure in several critical ways: 1) replacing the hubs and TUT-boxes with switches; 2) installing Category 5 cable and a fiber optic backbone; and 3) providing enhancements at the desktop such as installing 64MB (Acting Chief IRMS, personal communication, October 16, 1997 and April 10, 1998).

While the VA PSHCS improves their information technologies (IT), the organization must balance quality, access, and cost of providing healthcare services to eligible veterans within the local community and the VISN. Additionally, the organization must scan the horizon for opportunities to remain solvent in an era of limited resources, restriction of growth, and alternative financing and healthcare delivery methods (Williams & Torrens, 1993). Therefore, with limited resources, healthcare organizations that improve their IT must somehow demonstrate added value of IT expenditures at least in terms of opportunity cost (e.g., forgoing additional clinical staff) and establish system success (e.g., effectiveness); this paper examines the latter in terms of end user satisfaction (EUS).

Problem Statement

According to Blake Ives, Margrethe Olsen and Jack Baroudi (1983), EUS is a perceived measure that substitutes for objective criteria of information system effectiveness where few objective measures are available. The authors state that the net value of an information system equals the actual benefits (e.g., improved effectiveness) minus the development and operational costs. However, measuring the actual benefits are challenging at best.

According to many authors, EUS with a system such as a LAN, is the critical factor that defines success for the system (Bailey & Pearson, 1983; Baroudi & Orlikowski, 1988; Gatian, 1994; Guimaraes & Igbaria, 1997; Ives, Olsen & Baroudi, 1983; Melone, 1990; Nath, 1990; Ryker, Nath & Henson, 1997). On the basis of prior research, EUS was used in this study as a measure to support the enhancements to the LAN and as an indicator of LAN success or effectiveness as the VA PSHCS does not have LAN satisfaction information from healthcare executives within the organization.

Literature Review

James Bailey and Sammy Pearson (1983) published their efforts to measure computer user satisfaction (CUS). The authors developed and analyzed an instrument to measure CUS using the semantic differential technique. As developed by Charles Osgood, G. Suci and P. Tannenbaum, semantic differential is a scaling method for measuring "psychological meanings of an object to an individual (Bailey & Pearson, 1983; Cooper & Emory, 1995)." According to Donald Cooper and C. William Emery (1995), this technique is widely used for business studies (e.g., organizational, political, and marketing).

The CUS instrument included 39 scales (questions) with six bipolar adjective pair items on a seven point interval scale (e.g., extremely dissatisfied to extremely satisfied) to measure CUS (Bailey & Pearson, 1983). The authors measured content, construct, and predictive validity. The first four items were used to measure CUS. The fifth item was used to establish internal validity with the first four items. The sixth item was used to determine the importance (weight) of the scale. Reliability was demonstrated using an analysis of variance among the first four items of the 39 scales.

Blake Ives, Margrethe Olsen and Jack Baroudi (1983) developed an instrument to measure "user information satisfaction (UIS; p. 785)." Essentially, the authors used Bailey & Pearson's (1983) instrument to develop a new 13 scale instrument, known as the "short form (p. 530)." Through a series of reliability (Cronbach's alpha) and validity procedures (content, predictive, and construct), Ives, Olsen and Baroudi (1983) developed and validated the short form. The authors used the process below to develop the short form instrument.

The authors first removed those scales with "undesirable psychometric characteristics" (p. 791) from the original 39 scales. Second, of the remaining scales, the authors removed those scales with factor loading below .50. After the second step, three factors (information product, electronic data processing staff and services, and knowledge and involvement with five, five, and three scales, respectfully) remained to comprise the 13 scale short form instrument. Third, the 13 scales were given two bipolar adjective pair items. Fourth, to validate that the short form instrument measured UIS as in Bailey and Pearson's 39 scales, the authors removed the 13 scales on the short form instrument from the 39 scales. The short form instrument total satisfaction was then correlated with the remaining scales ($r = .90$, $p = .001$). The correlation between the short form instrument total satisfaction score and the first four items of Bailey and Pearson's (1983) 39 scales resulted in a correlation of .54, $p = .001$. According to Ives, Olsen and Baroudi (1983), these correlations "provide substantial evidence that the short form questionnaire is a sound general measure of Pearson's original UIS concept (p. 791)."

Jack Baroudi and Wanda Orlikowski (1988) used the short form instrument that was developed by Ives, Olsen and Baroudi in 1983 to measure UIS. In Baroudi and Orlikowski's (1988) article, they analyzed the short form instrument and provided recommendations for future use of the instrument. The authors used the short form instrument to measure UIS among 26

New York City organizations, none of which were healthcare facilities or systems. Three-hundred-and-fifty-eight employees responded to the survey. The respondents were asked to remain anonymous however most were clerical or support personnel. Their total user satisfaction score was determined by summing the scores from the short form instrument's 13 scales. In addition, the satisfaction scores for the three factors (information product, electronic data processing staff and services, and knowledge and involvement) were calculated by averaging the respective scale scores. The averaging process was used to measure across the three factors. Thus, the total satisfaction score can range from -39 to 39 and the scores for the three factors can range from -3 to 3.

According to Baroudi and Orlikowski (1988), the short form construct and convergent validity measures were met. Additionally, the authors concluded that previous evaluations of the short form provided "extensive evidence" (p. 47) of content validity.

Construct validity was demonstrated using the correlation between each of the 13 scales and the total UIS score (correlations ranged from .35 to .69 with 11 scales over .50, $p < .001$). This is the weaker method when compared to factor analysis, according to the authors. The authors then used the method of factor analysis with "varimax rotation" (p. 48) and an "eigen value of 1 (p. 48)." After five iterations, the factor analysis (information product, electronic data processing staff and services, and knowledge and involvement) solution accounted for "68% of total variation (p. 48)." With this outcome, the authors suggest that the three factors are "stable and provide strong evidence for construct validity (p. 48)."

Convergent validity was determined through an interview process among users in five organizations. The users in two organizations were "generally" (p. 48) satisfied with their

information systems, and users in the remaining three organizations were "very dissatisfied" (p. 48) with their information systems. The users in the five organizations were asked to complete the short form instrument and then the mean scores were computed for each group ($n = 26$, satisfied mean = 14.5; $n = 44$, dissatisfied mean = -5.1). The authors then computed a t-test between the two groups (significant at $p < .001$).

The authors used Cronbach's alpha to demonstrate the reliability of the short form instrument. To reduce the tendency of users to mark straight down the form, Baroudi and Orlikowski (1988) reverse ordered some of the scales (e.g. positive on right and negative on left; and positive on left and negative on right). Cronbach's alpha for the 13 scales' two item bipolar adjective pairs was above .80 for all item pairs; total satisfaction and the 13 scales was at .89; EDP staff and services was at .83; information product was at .89; and knowledge and involvement was at .72. Baroudi and Orlikowski (1988) then concluded that the short form is "internally consistent and thus reasonably free of measurement error (p. 50)." On the basis of Baroudi and Orlikowski's (1988) findings, the short form instrument was selected to measure LAN EUS at the VA PSHCS.

Purpose Statement

The purpose of this study is to examine LAN EUS among the healthcare executives at the VA PSHCS who were using the LAN before October 1, 1997, and after the implementation (February 18, 1998) of the LAN enhancements. A presentation follows with the identification of the three LAN EUS hypotheses that were tested during this study.

Hypothesis Formulation

Reliability and Validity of the Short Form Instrument

Previous researchers as noted in the literature review established reliability and validity of the satisfaction instrument. Therefore, the author will also measure the reliability and validity of the short form instrument used in this study.

Hypothesis 1: The short form instrument used at the VA PSHCS is a reliable and valid measure of LAN EUS.

End User Satisfaction

This section of hypothesis development includes total LAN EUS and the three factors that comprise 68% of EUS variation (Baroudi and Orlikowski, 1988). These satisfaction levels are expected to increase as the LAN is enhanced to indicate system success or effectiveness. The total EUS score is the overall satisfaction with the LAN. The three factors are defined below.

1. The LAN information product "factor is the respondent's self-reported assessment of the quality of output delivered by the [LAN] information system (Baroudi and Orlikowski, 1988, p.48)."
2. The IRMS staff and services "factor is the respondent's self-reported assessment of the attitude and responsiveness of the EDP [IRMS] staff as well as the quality of their relationship with the EDP [IRMS] staff (Baroudi and Orlikowski, 1988, p. 48)."
3. The LAN knowledge and involvement "factor is the respondent's self-reported assessment of the quality of [LAN] training provided, their understanding of the [LAN] system, and their participation in its [the LANs] development (Baroudi and Orlikowski, 1988, p. 48)."

Hypothesis 2: Healthcare executive LAN EUS at the VA PSHCS is expected to increase over time.

EUS and Grouped Differences

The following section presents EUS and grouped differences (i.e., gender, age, position held in the organization, duration of LAN usage, percent of time using the LAN, and LAN training) as variables for the third hypothesis.

EUS and Age

In addition to the 13 scales provided in the short form instrument, certain demographic information was used in this study such as the position held in the organization, the age and the gender of the respondents (Bowman, et al, 1993; Guimaraes & Igarria, 1997; Nath 1990). This information should provide further insight to the cohort even with the small sample size (if all 47 people respond to the survey and there is parity between gender, the small sample size of 23 and 24 would be below the minimum sample size for significance, $n = 30$). This example is true for the variable position held in the organization as well. However, the age variable has the potential to reach a sample size equal to or greater than 30.

EUS and Duration of LAN Usage

Other elements of end user characteristics (LAN usage in monthly duration, intensity by percent of LAN time usage, and LAN training) were used during previous information system user satisfaction studies (Baroudi, Olsen and Ives, 1986; Guimaraes & Igarria, 1997; Nath, 1989; Nath 1990; Smith, 1993). According to Harold Smith (1993) in his article entitled, "Local Area Network User Satisfaction: An Analysis of Relevant Factors (p. 15)," the length of time the LAN is used (duration in months) influences EUS.

EUS and Percent of Time Using the LAN

According to Ravinder Nath (1989) in his article entitled, "Are Frequent Users More Satisfied (p. 557)," the percentage of time spent using a system is a significant determinant of user satisfaction. Other studies have shown a correlation between user satisfaction and system usage (Baroudi, Olsen & Ives, 1986; Guimaraes & Igbaria, 1997).

EUS and LAN Training

User training has also shown to have a positive relationship (correlation) with user satisfaction of a system (Guimaraes & Igbaria, 1997; Nath, 1990). According to Tor Guimaraes and Magid Igbaria (1997), user training is a key component in user satisfaction as well as in promoting system usage. Additionally, Nath (1990) found similar results from his study entitled, "The Impact of Local Area Networks on Users and Their Work: A Field Study (p. 15)." He found that there is a "positive association between user-training and their satisfaction with the network (p. 22)."

Hypothesis 3: Healthcare executive LAN EUS at the VA PSHCS is independent of grouped differences.

Methods and Procedures

Based on the evidence from Baroudi and Orlikowski (1988), the short form instrument was used to measure healthcare executive LAN EUS at the VA PSHCS. The following six modifications were made to the original short form instrument to better relate to the organization's healthcare executives:

1. The phrase electronic data processing (EDP) was replaced with Information Resources Management Service (IRMS).
2. The acronym LAN was added to the information product factor scales.

3. The definition of LAN output (Smith, 1993) is provided on the survey tool in place of the original computer support definition.
4. Certain demographic questions were added to the survey instrument, such as the position held in the organization, age and gender.
5. A section was added at the end of the survey tool for respondent anonymity (Galletta & Lederer, 1989).
6. The name, the intra-organizational address for returning the completed instrument and the telephone extension of the author was provided on the survey instrument.

This graduate management project was a non-experimental, longitudinal study of 47 healthcare executives' satisfaction (11 Administrative Officers [AO], 24 Service Chief/Assistant/Section Chiefs [SASC], and 12 Senior Management/Staff [SMS]) with the organization's LAN. These executives were using the LAN as of October 1, 1997, and were asked to respond to a LAN EUS instrument that was distributed twice--November 6, 1997, and February 26, 1998. A standardized memorandum accompanied the instrument, which informed the cohort that the study was voluntary and anonymous. The executives were identified through the following two step procedure: 1) the services and programs connected to the LAN as of October 1, 1997, were identified from the IRMS leadership; and 2) the healthcare executives working in those services and programs were identified from the electronic telephone directory in the VA PSHCS's VISTA computer system.

To date, only one identified research study using repeated measures was available for comparison using the short form instrument. Dennis Galletta and Albert Lederer (1989) advised in their repeated measure study to use caution with parametric statistical procedures for ordinal scales. Conversely, Donald Cooper and C. William Emory (1995) state that the use of parametric statistical analysis for ordinal scales is commonly used in research efforts as the

ordinal scales approach interval scales. Moreover, the short form instrument uses the semantic differential technique, which uses interval scales. Therefore, parametric tests were used in this study.

Reliability

Reliability is the "accuracy or precision of a measuring instrument (Kerlinger, 1986, p. 405)." More importantly, reliability is "a contributor to validity and is a necessary but not sufficient condition for validity (Cooper & Emory, 1995, p. 153)." The instrument's reliability was demonstrated using Cronbach's alpha for the two bipolar adjective pair items for each of the 13 scales, for the total satisfaction score and the 13 scales, and for each of the three factors and their respective scales. This was accomplished for both cross-sectional surveys.

Validity

According to Fred Kerlinger (1986), validity can best be defined by asking the question, "are we measuring what we think we are measuring (p. 417)?" As previously stated, three types of validity were used to validate the short form instrument (content, construct and convergent validity). Content validity for the instrument has been demonstrated by previous researchers and will be assumed for the purpose of this study. Construct validity was determined by Pearson's correlation coefficient (r) between the total EUS and each of the 13 scales. Construct validity was further demonstrated in previous research (Baroudi & Orlikowski, 1988) using factor analysis with varimax rotation and was not repeated in this study. A paired-samples t-test was used to measure convergent validity between the two surveys' total satisfaction scores.

To determine whether to reject or accept the null hypotheses one through three, the following statistical methods were conducted for the appropriate hypothesis. In addition to the methodologies below, descriptive statistics were calculated for organizational added value.

Ha₁: Use Cronbach's alpha for reliability; Pearson's correlation coefficient (r) for construct validity; and a paired-samples t-test for convergent validity as described in the reliability and validity paragraphs in the methodology section above.

Ha₂: Use the EUS scores (total and three factors) from surveys 1 and 2.

Ha₃: Use Pearson's correlation coefficient (r) to identify significant grouped differences with the satisfaction scores.

Ethics

The views and/or opinions expressed in this paper, unless otherwise stated, are those of the author and do not reflect the official policy of the Department of Veterans Affairs, the Veterans Health Administration, the VA PSHCS, and/or the U.S Army-Baylor University Program in Health Care Administration. The data that was gathered for this study was necessary to achieve four objectives:

1. To measure LAN EUS.
2. To identify opportunities for LAN end user training.
3. To measure the IRMS staff relations with LAN end users.
4. To meet the U.S. Army-Baylor University Graduate Program in Health Care Administration's graduate management project requirement.

Copyright Permission

Once a survey instrument is published in a journal, the author usually relinquishes the copyright to the publisher (K. Finstuen, personal communication, October 27, 1997). Even though Baroudi and Orlikowski (1988) included the survey tool in their paper, every effort was

made to obtain permission from the authors to use the short form instrument for this study. An electronic-mail (e-mail) message was sent to Jack Baroudi, Ph.D., seeking permission to use the short form instrument for this study. On October 29, 1997, Dr. Baroudi responded via an e-mail message granting permission to use the short form instrument (J. Baroudi, personal communication, October 29, 1997).

In addition, a request to use the short form instrument from Baroudi and Orlikowski's 1988 article was sent to the publisher (M.E. Sharpe, Incorporated) on October 28, 1997. The publisher replied via a facsimile on October 29, 1997, granting permission to use the short form instrument for this study; the copyright permission follows below:

Jack J. Baroudi and Wanda J. Orlikowski, A Short-Form Measure of User Information Satisfaction: A Psychometric Evaluation and Notes on Use, *Journal of Management Information Systems*, Vol. 4, No. 4, Spring 1988, pp. 44-59, including Survey. Please note that this permission is for a one-time use only and that you must reapply for future uses and/or semester classes (G. Chandoha, personal communication, October 29, 1997).

Results

This study was a non-experimental, longitudinal study of 47 healthcare executives' LAN EUS at the VA PSHCS. The instrument was distributed on November 6, 1998, to measure EUS prior to the LAN enhancements. The same survey was distributed on February 26, 1998, to obtain post-LAN enhancement EUS data. Of the 47 surveys distributed to the cohort, 31 (survey 1) and 30 (survey 2) executives completed the short form as shown in Table 1. The respondents' demographic information is shown in Table 2.

Table 1
Response Rates

Overall Response Rates				Response Rates by Management Level					
Survey	Number in Sample	Number Returned	Percent Response	Administrative Officer (#/n) (%)		Service/Asst./Section Chief (#/n) (%)		Senior Mgt/Staff (#/n) (%)	
1	47	31*	66%	11/11	100%	14/24	58%	6/12	50%
2	47	30**	64%	9/11	82%	15/24	63%	6/12	50%

Note. * = 37 total responses minus 6 incomplete responses; ** = 35 total responses minus 5 incomplete responses.

(#/n) = number of responses by management level / number of total surveys distributed by management level.

(%) = response rate by management level.

The EUS score was determined by summing the scores from the short form instrument's 13 scales. In addition, the three factors' (LAN information product, IRMS staff and services, and user's LAN knowledge and involvement) satisfaction scores were determined by summing and averaging the respective scales. The averaging process was used to measure across the three factors. Thus, the total satisfaction score can range from -39 to 39 and the satisfaction scores for the three factors can range from -3 to 3 as shown in Table 3.

Reliability

The reliability of the short form instrument was demonstrated using Cronbach's alpha for the two bipolar adjective pair items for each of the 13 scales as shown in Table 4; for the total satisfaction score and the 13 scales (survey 1, .77; survey 2, .77); and the three factors. The IRMS staff and services factor had a reliability index of .89 for survey 1 and .91 for survey 2.

The LAN information product factor had a reliability index of .87 for survey 1 and .92 for survey 2. The user's LAN knowledge and involvement factor had a reliability index of .91 for survey 1 and .93 for survey 2.

Table 2
Respondents' Demographic and Other Mean LAN Values

Item	Total Survey Values*		Management Demographic Values					
			Administrative Officer**		Service/Asst./Section Chief**		Senior Mgt/Staff**	
	(S1)	(S2)	(S1)	(S2)	(S1)	(S2)	(S1)	(S2)
Male	61%	63%	55%	56%	71%	73%	50%	50%
Female	39%	37%	45%	44%	29%	27%	50%	50%
Age	46	46	45	47	46	45	48	50
Months using LAN	13	11	12	10	13	11	16	14
Percent of time using LAN	38%	47%	41%	43%	36%	49%	36%	48%
LAN training received	68%	70%	100%	89%	57%	67%	33%	50%
Number of days trained before (-) or after (+) LAN connection	+12	+10	-4	+9	+11	+7	+12	+25

Note. Values represent the item mean (arithmetic average).

S1 = Survey 1; S2 = Survey 2

* = Sample size for each survey (S1, n = 31; S2, n = 30)

** = Sample size for Administrative Officer (S1, n = 11; S2, n = 9), Service/Assistant/Section Chief (S1, n = 14; S2, n = 15), Senior Management/Staff (S1, n = 6; S2, n = 6).

Validity

Three types of validity were considered for this study (content, construct and convergent validity). Content validity for the instrument was demonstrated by previous researchers and was assumed for the purpose of this analysis. Construct validity was demonstrated using Pearson's

Table 3
Satisfaction Scores

Survey/Management Level	Total* Satisfaction	Factors		
		IRMS Staff** and Services	LAN Information** Product	User Knowledge** and Involvement
Survey 1	13.01	1.04	1.20	.52
Survey 2	16.19	1.30	1.55	.63
Administrative Officer				
Survey 1	16.27	1.25	1.47	.89
Survey 2	19.78	1.51	1.70	1.17
Service/Assistant/Section Chief				
Survey 1	13.46	1.13	1.09	.80
Survey 2	16.89	1.28	1.67	.73
Senior Management/Staff				
Survey 1	5.98	.43	.95	- .81
Survey 2	9.08	1.02	1.05	- .42

Note. The values represent the survey and management level means (arithmetic average) for the total satisfaction and the three factors (IRMS staff and services, LAN information product, and the user's LAN knowledge and involvement).

* = The total satisfaction score can range from -39 to 39.

** = The three factors' scores can range from -3 to 3.

correlation coefficient (r) between the total EUS and each of the 13 scales (see Table 5). A paired samples t -test was used to demonstrate convergent validity between the two survey total satisfaction scores (see Table 6).

Table 4
Reliability Scores

Scales One Through 13	Cronbach's alpha	
	Survey 1	Survey 2
1. Relationship with the IRMS Staff	.93	.98
2. Processing of requests for changes to existing LAN systems	.91	.97
3. Degree of LAN training provided to users	.92	.99
4. User's understanding of LAN systems	.93	.98
5. User's feeling of participation	.91	.97
6. Attitude of the IRMS Staff	.98	.90
7. Reliability of LAN output	.96	.92
8. Relevancy of LAN output	.92	.89
9. Accuracy of LAN output	.97	.98
10. Precision of LAN output	.83	.67*
11. Communication with the IRMS staff	.94	.97
12. Time required for new LAN development	.94	.96
13. Completeness of the LAN output	.97	.97

Note. The 13 scales have two items. Each of the items by scale was analyzed using Cronbach's alpha to obtain a reliability score. A score of .70 or above is desired for most research studies, and often time and costs are wasted to increase the index beyond .80 (Nunnally, 1978).

* = A reliability score of .67 was achieved with a (-3, 3) outlier included. However, a reliability score of .96 can be achieved by removing one outlier (-3, 3) from Survey 2, scale 10.

Table 5
Scale Correlations with Total Score

Scales One Through 13	Pearson's (r)	
	Survey 1	Survey 2
1. Relationship with the IRMS Staff	.87	.96
2. Processing of requests for changes to existing LAN systems	.83	.93
3. Degree of LAN training provided to users	.86	.98
4. User's understanding of LAN systems	.86	.96
5. User's feeling of participation	.83	.95
6. Attitude of the IRMS Staff	.96	.82
7. Reliability of LAN output	.92	.86
8. Relevancy of LAN output	.86	.82
9. Accuracy of LAN output	.95	.97
10. Precision of LAN output	.71	.52*
11. Communication with the IRMS staff	.90	.94
12. Time required for new LAN development	.89	.93
13. Completeness of the LAN output	.94	.95

Note. Pearson's correlation coefficient (r) was used to measure the correlation between the total satisfaction and each of the 13 scale scores. The closer the correlation is to ± 1.0 , the greater the correlation; the closer the correlation is to 0, the poorer the relationship between the variables. The correlations for each survey are presented in this table.

* $r \geq .456$ is significant $p < .001$ (survey 2). Note: sample size for survey 1, $n = 31$ (29 df) and survey 2, $n = 30$ (28 df).

*= Correlation of .52 was achieved with one outlier (-3, 3) included in survey 2, scale 10. Without the outlier, the correlation score improves to .92.

Table 6
Paired Samples Test

Satisfaction	Survey 1 November 6, 1997		Survey 2 February 26, 1998		t	p
	Mean	S.D.	Mean	S.D.		
IRMS Staff and Services	1.04	1.04	1.30	.96	1.276	.212
LAN Information Product	1.20	.96	1.55	.88	2.233	.033*
User's LAN Information and Knowledge	.52	1.44	.63	1.47	.440	.663
Total Satisfaction	13.01	12.34	16.19	12.20	1.584	.124

Note. * = LAN Information Product is significant $n = 31$ (30 df).

Discussion and Conclusions

Hypothesis 1

The findings from this study provide further evidence to support the reliability and validity of the short form instrument. These statistical methods are the essential foundation of this study. Without establishing the short form instrument's reliability (does the short form instrument consistently and accurately measure satisfaction?) and validity (does the short form instrument measure satisfaction?), information derived from the data might be erroneous.

The reliability index for all scales (survey 1 and 2) were above .80 with one exception. In survey 2, scale 10, (see Table 4) one subject responded at the extreme interval ends of the two items (-3, 3). With this outlier, the reliability index is .67. However, with the outlier removed from the sample, the index improved to .96. According to Jum Nunnally (1978), a score of

.70 or above is desired for most research studies, and often money and time are wasted to increase the index beyond .80. *Therefore, with all but one of the indexes above .80, the short form instrument is considered to be reasonably free of measurement error.*

The validity methods for the short form instrument included content, construct, and convergent validity. Content validity has been established in previous studies and was assumed for this study. Construct validity was demonstrated using Pearson's correlation coefficient (r) where all correlations were significant as shown in Table 5. Twelve of the 13 scale correlations (r) were greater than .82, with scale 10, survey 1 at .72 ($n = 31$, 29 df) and survey 2 at .52 ($r \geq .456$ is significant, $p < .001$, $n = 30$ (28 df; Edwards, 1984). Convergent validity was measured using a paired samples t-test for the total satisfaction scores from each survey (see Table 6).

Refinements to the short form instrument in subsequent research included repeated measures (test-retest) in only one study (Galletta & Lederer, 1989). Test-retest was provided in Baroudi and Orlikowski's (1988) article as a suggestion for further research and in Galletta and Lederer's (1989) study as a suggestion for continued future research. The correlation of the two total satisfaction scores was significant ($n = 31$, $r = .58$, $p < .001$, 30 df). *With all of the correlations for construct and convergent validity being significant and the prior research outcomes for content validity, the author concludes that the short form instrument measures LAN EUS.*

On the bases of the reliability and validity information above, the null hypothesis is rejected in that the short form instrument used at the VA PSHCS to measure LAN EUS is reliable and valid. Stated another way, the short form instrument consistently and accurately measures LAN EUS.

Hypothesis 2 and Demographics

With the reliability and validity of the instrument established, the level of satisfaction (total and three factors) will also be reliable and valid. However, before this discussion pursues, the demographic data may help to better define the healthcare executive LAN EUS within the organization. The demographic information is shown in Table 2. Overall, the respondents' demographic means were approximately 60% male and 40% female (the cohort was 62%/38% by gender); were 46 years old; have been using the LAN 11 to 13 months; use the LAN 38% to 47% of the workday; approximately 70% of the end users were provided with LAN training by the organization; and the end users that received training by the organization received the training 10 to 12 days after being connected to the LAN. The demographics by management level (AO, SASC, and SMS) are also shown in Table 2. There were notable differences between the overall demographics and management level:

- a) Senior Management and Staff were using the LAN one to three months longer than SASCs, and two to four months longer than AOs;
- b) Approximately 90 to 100% of AOs received LAN training from the organization, whereas approximately 60% to 70% for SASCs and 30% to 50% for SMS;
- c) Administrative Officers received training between four days before and nine days after the LAN connection; SASCs received LAN training between seven and 11 days after the LAN connection; and SMS received LAN training 12 to 25 days after the LAN connection.

The demographic information above is provided to assist the reader in developing a conceptual model including the shape and texture of the cohort and respondents. These demographic variables will be discussed later in the third hypothesis section.

With the establishment of the short form instrument's reliability and validity, and a better understanding of the respondents including the number of healthcare executives that received LAN training, we can now discuss the LAN EUS data obtained from this study. The total and

factor satisfaction scores by survey and by management level are shown in Tables 3 (satisfaction scores) and 6 (paired samples test). The total satisfaction change from survey one (slightly satisfied 13.01) to survey 2 (slightly satisfied 16.19) was not significant. *However, there is an increasing trend of higher LAN satisfaction among the healthcare executives at the VA PSHCS.*

The IRMS staff and services satisfaction difference between survey 1 (slightly satisfied 1.04) and survey 2 (slightly satisfied 1.30) was not significant. The user's LAN knowledge and involvement satisfaction difference between survey 1 (neither dissatisfied nor satisfied .52) and survey 2 (neither dissatisfied nor satisfied .63) was not significant. *However, as the total satisfaction level increases over time, so does the IRMS staff and services, and the users' LAN knowledge and involvement satisfaction levels.* The only significant difference between the surveys is the change of the information product factor satisfaction level (survey 1, slightly satisfied 1.20; survey 2, slightly satisfied 1.55, S.D. = .88, $t = 2.233$, $n = 31$, 30 df). *This suggests that the healthcare executives are becoming more satisfied with the LAN (reliability, relevancy, accuracy, precision, and completeness; see appendix 1 for instrument scales and definitions). Moreover, this information might be an indicator for LAN success and effectiveness and thereby supports the implementation of the LAN infrastructure and desktop enhancements. On the basis of the information provided above, the null hypothesis is rejected in that there is an increasing trend of healthcare executive LAN satisfaction over time.*

The total and three factor satisfaction scores by management level are shown in Table 3. All but one of the satisfaction scores is increasing where most of the respondents by management level remain in the same satisfaction interval. However, there are a few noteworthy changes by interval:

- a) The AOs increased their LAN knowledge and involvement satisfaction interval from neither dissatisfied nor satisfied to slightly satisfied;

- b) The SMS increased their IRMS staff and service, and LAN information product satisfaction intervals from neither dissatisfied nor satisfied to slightly satisfied;
- c) The SASCs' LAN knowledge and involvement satisfaction decreased to .73 from .83 (neither dissatisfied nor satisfied), but remained in the same interval.

Hypothesis 3

There are several published LAN satisfaction studies that include grouped differences (i.e., gender, age, position held in the organization, duration of LAN usage, percent of time using the LAN, and LAN training) in part, but not all. As with the somewhat new test-retest methodology being applied to the short form instrument, the grouped differences are also a somewhat new approach beyond the previous research studies in relation to the 13 short form instrument scales. *In this study, the author found no significant findings between the satisfaction scores and the grouped differences. Therefore, the null hypothesis is rejected in that healthcare executive LAN EUS at the VA PSHCS is independent of grouped differences in this study. Stated another way, the data suggest that gender, age, position held in the organization, duration of LAN usage, percent of time using the LAN, and LAN training, is inconclusive regarding the affect these variables have on LAN satisfaction.* This outcome might have been limited due to the small sample size. In other studies, the sample sizes were much larger as in Nath's (1990) study where the sample size was 107; as in Brent et al's (1993) study where the sample size was 215; and as in Smith's (1993) study where the sample size was 253. Moreover, there are many other challenges other than the sample size that might influence the subjects' responses between surveys 1 and 2. According to Alan J.B. Anderson (1989), they include, but are not limited to:

1. History—any number of unknown external events might occur and influence the attitude, and behavior of the respondent.
2. Maturation—changes within the respondent, such as growing older.

3. Mortality—subjects who die or are lost to the study.
4. Observation—subjects may change their behavior, responses, etc. if they know that their activities are being observed; this is also known as the Hawthorne Effect.
5. Interaction between survey 1 and the LAN—subjects might have completed survey 1 and taken a training course, read about the LAN, etc., and then took survey 2. This problem is diminished with a standardized instrument like the short form instrument.

Summary of Conclusions

The conclusion summary is provided below by hypothesis.

Hypothesis 1: The short form instrument used at the VA PSHCS is a reliable and valid measure of LAN EUS.

The LAN EUS data gathered during this study suggests:

- a) The short form instrument is considered to be reasonably free of measurement error--instrument reliability.
- b) The short form instrument measures LAN EUS--validity of the instrument.

On the basis of the reliability and validity statements above, the author rejected the null hypothesis. The short form instrument consistently and accurately measured LAN EUS at the VA PSHCS.

Hypothesis 2: Healthcare executive LAN EUS at the VA PSHCS is expected to increase over time.

The LAN EUS data gathered during this study suggests:

- a) The VA PSHCS is experiencing an increasing trend of LAN satisfaction among healthcare executives.

This suggests that the healthcare executives are becoming more satisfied with the LAN (reliability, relevancy, accuracy, precision, and completeness). Moreover, this outcome provides strong evidence as an indicator for LAN success and effectiveness, and thereby supports the

implementation of the LAN infrastructure and desktop enhancements. On the basis of the information provided above, the null hypothesis is rejected and the healthcare executives' LAN satisfaction at the VA PSHCS is increasing over time.

Hypothesis 3: Healthcare executive LAN EUS is independent of grouped differences (i.e., gender, age, position held in the organization, duration of LAN usage, percent of time using the LAN, and LAN training).

The LAN EUS data gathered during this study suggests:

- a) There are no significant findings between the satisfaction scores and the grouped differences.

Therefore, the null hypothesis is rejected and this suggests that the healthcare executive LAN EUS at the VA PSHCS is independent of grouped differences. Stated another way, the data suggest that gender, age, position held in the organization, duration of LAN usage, percent of time using the LAN, and LAN training, is inconclusive regarding the affect these variables have on LAN satisfaction.

Recommendations

Essentially, there are several key recommendations gleamed from this study in support of the project's objectives: to measure LAN EUS; to identify opportunities for LAN end user training; and to measure the IRMS staff relations with LAN end users. Congruent with the objective to measure LAN EUS, the first recommendation is to refine the short form instrument or develop another satisfaction instrument to measure LAN and other computer systems' EUS for system success and for other accrediting body standards such as from the Joint Commission on Accreditation of Healthcare Organizations. There are five modified questions taken from the

short form instrument that are essential to understanding the success and effectiveness of a computer system that should be answered to better meet the needs of the VA PSHCS's internal customers:

1. How does the organization know if the computer system or product is dependable and consistent?
2. How does the organization know if the computer system can deliver what it is suppose to deliver?
3. How does the organization know if the computer system services and products are what the end users need to function in their present position?
4. How does the organization know if the computer system and products are correct for the end user?
5. How does the organization know if the computer system and products meet the needs of the end user?

The second recommendation, which is congruent with the objective to identify opportunities for LAN end user training, is to continue to measure LAN EUS among all staff at the VA PSHCS and identify computer end user training needs. This study was limited to healthcare executives, which is only a small portion of the organization's staff and should be expanded to include all of the organization's computer systems end users. Additionally, LAN training provided to the respondents ranged from four days prior to the LAN connection and 25 days after the connection. Furthermore, there appears to be some disparity by management level regarding the LAN training provided to the end users. Finally, the pattern of disparity by management level also appears to follow the implementation of LAN connections. Stated another way, the higher the respondent's position by management level, the sooner she was

connected to the LAN and the least likely to receive LAN training. This observation is not presented to state a fact, but to suggest further inquiry into the LAN training practices at the VA PSHCS.

The third recommendation, which is congruent with the final objective of this study, is to continue to measure IRMS staff relations with LAN end users. Overall, the healthcare executives in this study were slightly satisfied with the IRMS staff and services. This outcome suggests that there is an opportunity for improvement that is congruent with the continuous quality improvement cycle. One recommendation is to use the average IRMS staff and services factor score as a starting point, and have the IRMS staff answer the modified five questions below that were taken from the short form instrument:

1. How does the IRMS employees and ostensible agents interact, conduct, and associate with end users?
2. How (manner and methods) does the IRMS employees and ostensible agents exchange information with end users?
3. How does the IRMS employees and ostensible agents respond to the requests for changes to the existing computer systems or services?
4. How does the IRMS employees and ostensible agents respond to user's request for new applications and design, development, and implementation of computer systems? How long does it take to respond to a user's request?
5. How does the IRMS employees and ostensible agents respond to conflicting external, professional goals and the goals and tasks of the organization?

Future Research with the Short Form Instrument

As mentioned in previous studies by Galletta and Lederer (1989), and by Baroudi and Orlikowski (1988), future test-retest short form instrument research is necessary. To date, no other study has been able to advance beyond replication of Baroudi and Orlikowski's (1988)

study. Galletta and Lederer (1989) used test-retest spanning a one-day college class period.

Therefore, further longitudinal research is necessary with a longer period of time using the short form instrument as in this study of LAN EUS.

Another opportunity for future research is in the area of grouped differences. To date, no other study, except this project of LAN EUS, has analyzed the correlation of grouped differences (i.e., age, gender, position held in the organization, duration of LAN usage, percent of time using the LAN, and LAN training) and total satisfaction with a computer system using the short form instrument. This could potentially further the application of the short form instrument from cross-sectional to longitudinal analysis to provide organizations with trending capabilities.

Appendix

VA PUGET SOUND HEALTH CARE SYSTEM

LOCAL AREA NETWORK

END USER SATISFACTION QUESTIONNAIRE

The purpose of this study is to measure how you feel about certain aspects of the VA Puget Sound Health Care System's Local Area Network (LAN) Services that are provided to you in your present position.

On the following pages you will find different factors, each related to some aspect of your LAN support. You are to rate each factor on the descriptive scales that follow it, based on your evaluation of the factor. **Your responses are important and will remain anonymous. If you have any questions, please contact Warren Hill at extension 6089 at American Lake Division.**

The scale positions are defined as follows:

Adjective X : _____ : Adjective Y
(1) (2) (3) (4) (5) (6) (7)

- (1) Extremely X (5) Slightly Y
- (2) Quite X (6) Quite Y
- (3) Slightly X (7) Extremely Y
- (4) Neither X or Y; equally X or Y; does not apply

The following example illustrates the scale positions and their meanings:

My vacation in the Bahamas was:

Restful : _____ : _____ : _____ : _____ : _____ : X : Hectic
 (1) (2) (3) (4) (5) (6) (7)

Healthy : : X : : : : : Unhealthy
(1) (2) (3) (4) (5) (6) (7)

According to the responses, the person's vacation was extremely hectic and quite healthy.

INSTRUCTIONS

1. Check each scale in the position that describes your evaluation of the factor being judged.
2. Check every scale; do not omit any.
3. Check only one position for each scale.
4. Check in the space, not between spaces. THIS, NOT THIS
: X : X :
5. Work rapidly. Rely on your first impressions.

Thank you for your cooperation.

ANSWER BASED ON YOUR OWN FEELINGS

1. Relationship with the IRMS* Staff is:
(the manner and methods of interaction, conduct, and association between the user and the IRMS staff)

 dissonant : ____ : ____ : ____ : ____ : ____ : ____ : ____ : harmonious
 bad : ____ : ____ : ____ : ____ : ____ : ____ : ____ : good
2. Processing of requests for changes to existing LAN systems is:
(the manner, method, and required time with which the IRMS staff responds to user requests for changes in existing LAN system or services)

 fast : ____ : ____ : ____ : ____ : ____ : ____ : ____ : slow
 untimely : ____ : ____ : ____ : ____ : ____ : ____ : ____ : timely
3. Degree of LAN training provided to users is:
(the amount of specialized instruction and practice that is afforded to the user to increase the user's proficiency in utilizing the LAN capability)

 complete : ____ : ____ : ____ : ____ : ____ : ____ : ____ : incomplete
 low : ____ : ____ : ____ : ____ : ____ : ____ : ____ : high
4. User's understanding of LAN systems is:
(the degree of comprehension that a user possesses about the LAN systems or services that are provided)

 insufficient : ____ : ____ : ____ : ____ : ____ : ____ : ____ : sufficient
 complete : ____ : ____ : ____ : ____ : ____ : ____ : ____ : incomplete
5. User's feeling of participation is:
(the degree of involvement and commitment which the user shares with the IRMS staff and others toward the functioning of the LAN systems and services)

 positive : ____ : ____ : ____ : ____ : ____ : ____ : ____ : negative
 insufficient : ____ : ____ : ____ : ____ : ____ : ____ : ____ : sufficient

*IRMS = Information Resources Management Service

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6. Attitude of the IRMS Staff is:
(the willingness and commitment if the IRMS staff to subjugate external, professional goals in favor of organizationally directed goals and tasks)

cooperative : _ : _ : _ : _ : _ : _ : belligerent
negative : _ : _ : _ : _ : _ : _ : positive

7. Reliability of LAN output* is:
(the consistency and dependability of the LAN output information)

high : _ : _ : _ : _ : _ : _ : low
superior : _ : _ : _ : _ : _ : _ : inferior

8. Relevancy of LAN output* is:
(the degree of congruence between what the user wants or requires and what is provided by the LAN products or services)

useful : _ : _ : _ : _ : _ : _ : useless
relevant : _ : _ : _ : _ : _ : _ : irrelevant

9. Accuracy of LAN output* is:
(the correctness of the LAN products or services)

inaccurate : _ : _ : _ : _ : _ : _ : accurate
low : _ : _ : _ : _ : _ : _ : high

10. Precision of LAN output* is:
(the variability of the LAN products or services from that which it purports to provide)

low : _ : _ : _ : _ : _ : _ : high
definite : _ : _ : _ : _ : _ : _ : uncertain

11. Communication with the IRMS staff is:
(the manner and methods of information exchange between the user and the IRMS staff)

dissonant : _ : _ : _ : _ : _ : _ : harmonious
destructive : _ : _ : _ : _ : _ : _ : productive

12. Time required for new LAN development is:
(the elapsed time between the user's request for new applications and design, development, and/or implementation of the application systems by the IRMS staff)

unreasonable : _ : _ : _ : _ : _ : _ : reasonable
acceptable : _ : _ : _ : _ : _ : _ : inadequate

***LAN output may include network speed and performance (e.g., log-in time, opening software programs); the number and length of LAN major and minor malfunctions that interrupt work; sharing peripherals (e.g. printers); and sharing information (e.g., computer files).**

13. Completeness of the **LAN output*** is:
(the comprehensiveness of the LAN products or services content)

sufficient : ____ : ____ : ____ : ____ : ____ : ____ : ____ : insufficient

adequate : ____ : ____ : ____ : ____ : ____ : ____ : ____ : inadequate

***LAN output may include network speed and performance (e.g., log-in time, opening software programs); the number and length of LAN major and minor malfunctions that interrupt work; sharing peripherals (e.g. printers); and sharing information (e.g., computer files).**

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What is your present position?

- ____ Administrative Officer
____ Service Chief/Program Director/Section Chief
____ Senior Management and Staff

Gender: Male ____ Female ____

Age ____

How many months have you been using the LAN? ____

Percent of time spent using the LAN? ____ %

Have you received LAN training? Yes ____ No ____

If yes, how many days before or after you were connected to the LAN? Days before ____ Days after ____

If no, who taught you how to use the LAN? _____

Please provide any brief comments/additional information you wish to include:

Your responses will remain anonymous. However, to correlate your responses to other potential surveys, please provide the following information:

What is the last digit in the year that you graduated from high school? ____
(e.g. "1992" would equal "2")

What is the first letter in the name of the high school you graduated from? ____
(e.g., "Billings Senior High School" would equal "B")

What is the last letter in your mother's maiden name? ____
(e.g., "Golden" would equal "N")

Thank you for completing this questionnaire. Your responses are important. **Please return (ONLY) the questionnaire in the self-addressed governmental envelope to Warren Hill (00H) by November 21, 1997.** If you have any questions, please contact Warren Hill at extension 6089 at the American Lake Division.

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