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A Study of the Relationships Between End-User Information Systems Problems and Helpdesk Critical Success Factors in Higher Education

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by

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy

Graduate School of Computer and Information Sciences
Nova Southeastern University

2005

We hereby certify that this dissertation, submitted by Richard Dale Parrott, conforms to acceptable standards and is fully adequate in scope and quality to fulfill the dissertation requirements for the degree of Doctor of Philosophy.

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Graduate School of Computer and Information Sciences
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An Abstract of a Dissertation Report Submitted to Nova Southeastern University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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Richard Dale Parrott

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In the last fifteen years, information technology (IT) customer support has increased in importance within higher education. The pervasiveness of computers and technology on the campus has allowed students, staff, and faculty to perform a multitude of tasks by controlling their own environments and setting their own priorities. Qualified professional system and user support services have lagged demand. The problem investigated in this study was end-users' satisfaction levels of the higher education helpdesk and how end-users' satisfaction levels affected a helpdesk manager's critical success factors performance and goals. In this study, the first goal was to identify the critical success factors (CSF) for the higher education academic helpdesk manager. The second goal was to assess the relationships of CSFs to problems associated with end-user satisfaction levels within a higher education environment. The population of interest included all accredited higher education institutions (as of the publishing date of the 2003 Higher Education Directory). The researcher used a random sample of 1,765 from the list of 4,282 profiles in the 2003 Higher Education Directory (http://www.hepinc.com). The survey instrument was an online questionnaire implemented as an HTML form. Eight research questions and eight hypotheses were developed. Specifically, the researcher conducted the following statistical analyses: (a) descriptive statistics for the variables of interest, (b) a Chi-square test between the respondents and non-respondents to check for non-response bias, (c) a factor analysis to identify CSF constructs and helpdesk problems, (d) multiple regression to determine the relationship between CSFs and helpdesk problems using the helpdesk problem constructs identified from the factor analysis as dependent variables and the helpdesk CSFs as independent variables (e) MANOVA to determine the relationship between CSFs and the stage of growth of the helpdesk, and (f) seven ratios to serve as CSF performance indicators.

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Chapter 1

Introduction

Basis for Study

In the last fifteen years, information technology (IT) customer support has increased in importance within higher education. The pervasiveness of computers and technology on the campus has allowed students, staff, and faculty to perform a multitude of tasks by controlling their own environments and setting their own priorities. Qualified professional system and user support services have lagged demand (Paulson, 2001; Rice, Collins-Jarvis, & Zydney-Walker, 1999; Yohe, 1999).

Helpdesk is a generic term used to describe a support center for end users who request help for hardware installation and software problems (Verghis, 2003). *Help* is the operative word. Prescott, Kilty, Franklin, Cleary, Lovgren, and Mai (2001) observed that the diverse nature of end users and technology required that the helpdesk know and understand what services are necessary. Rainer and Carr (1998) called the first helpdesks information centers (IC) where large monoliths with simple dumb terminals were situated in large computer rooms for the end user. Support was provided locally and most times quickly. However, with the advent of the PC more end users went back to their offices and classrooms to work. End users were distributed all over the organization and helpdesk analysts with limited tools now had to support many more users (Cahoon, Dunn, McCarron, & Munroe, 1997). Rhodes, Goveia, and Sierkowski (2000) suggested

that end users would seek the technical expertise of the helpdesk looking for a solution to a difficult problem. End users want a solution, usually quickly, because they themselves might be busy teaching a class or completing a project. There is a certain amount of time called the "window of opportunity" within which the analyst must provide a satisfactory answer to the end user (Delic & Hoellmer, 2000; Wooten, 2001). The least amount of time the end user is willing to wait is based on the credibility of the helpdesk analyst, while the maximum amount of time is based on the seriousness of the end-user's problem. Workplace conditions may also affect the helpdesk analysts' attitudes and can cause hostility towards the end user (Niederman & Sumner, 2001). Customer service in higher education is defined as the effectiveness of the IT helpdesk to provide the end user with a timely and correct solution (Stewart, Voss, & Workman, 2001).

The helpdesk does not run itself. It requires helpdesk analysts with the tools, knowledge, skills, and abilities to answer difficult questions (Rhodes, Goveia, & Sierkowski, 2000). A helpdesk also requires management to provide leadership and direction for the helpdesk team. In light of declining budgets for IT (Young, 2001), management must control direct costs for the test equipment and computers, as well as the salaries for knowledgeable staff, and even heating and air conditioning for the office space used by the helpdesk team. Webster's New Collegiate Dictionary (Woolf, Artin, Crawford, Gilman, Kay, Pease, Jr., et al., 1981) defined effectiveness, in terms of manpower, as producing a decided, decisive or desired result. Efficiency is defined as a comparison of production with cost. Peebles, Stewart, Voss, and Workman (2001) used effectiveness and efficiency synonymously with quality and cost, respectively. In this

study, effectiveness will be used synonymously with quality, and efficiency will be used to describe direct and indirect costs associated with providing support services.

Problem Statement

The problem investigated in this study was end-users' satisfaction levels of the higher education helpdesk and how end-users' satisfaction levels related to a helpdesk manager's critical success factor performance and goals. Bullen and Rockart (1981) defined problems as "…specific tasks rising to importance as a result of unsatisfactory performance or environmental changes. Problems can affect the achievement of goals or performance in a CSF area" (p. 8). Managers must identify those critical success factors (CSF) where satisfactory results are necessary in order for the helpdesk to meet its goals. Rapid improvements in technology have fueled average users' expectations for infallible computer systems and immediate support response from omnipotent helpdesk staff. Information technology usage at universities has exceeded the helpdesk staff's capability (Yohe, 1999).

University helpdesks have been stretched beyond their limits in their efforts to support a technology-steeped campus. This condition has led to higher IT support costs and lower customer satisfaction (Adler, Bright, & Scott, 2001; Leach & Smallen, 1998; McClure, Smith, & Sitko, 1997). The National Center for Educational Statistics has indicated that 82% of undergraduate and 73% of graduate students use computers for school assignments (Snyder & Hoffman, 2002). Also, 58% of undergraduate and 66% of graduate students use the Internet. Increasing numbers of students, staff, and faculty have access to computers on the campus as well as at home. Computing resource support

services have had to grow quickly to support the myriad applications and products campus-wide. The failure of higher education helpdesk managers to identify the needs of end users can create problems reflected as IT staff turnover, student worker attrition, high costs, loss of knowledge, and customer dissatisfaction (Niederman & Sumner, 2001).

As the end-users' needs change, so too should the helpdesk organizational structure. Rhodes, Goveia, and Sierkowski (2000) stated that the majority of higher education helpdesk organizations did not have a well-defined mission statement and did not have a clear understanding of the customers' needs. Foley (1999) reported that the Lehigh University organizational structure of IT support managed six distinct service groups that were overlapping in services provided to customers, thereby resulting in confusion and frustration. Higher education organization helpdesks must have scalability and escalation processes in place so that more difficult problems can be quickly solved as organizations grow. One such escalation process combines four universities' helpdesks into one multi-continent helpdesk and serves students from multiple countries 24-hours a day 7-days a week (Sykes, 2002). Middleton and Marcella (1997) noted that higher education organizations with greater than 60 support functions needed to reengineer their organizations by bringing knowledge, skills, and abilities of helpdesk personnel together as a single knowledge base. Reengineering departments and services take time and the commitment of the affected organizations in order to innovate and improve customer support (Hammer & Champy, 2001).

The structure within the helpdesk organization can also be the source of problems. Cook (1996) claimed that decentralization implied autonomy and independence that gave rise to redundancy of effort and loss of control. Whiting and Eshbaugh (2000) defined a

centralized helpdesk as a tightly woven relationship between the helpdesk and the academic institution where each has confidence in the other. Whiting and Eshbaugh also described Princeton University's reengineering of the centralized helpdesk from legacy to client/server systems as a transformational change of internal business processes and technology. The University of Wyoming customer support center started out as centralized support agency for legacy systems, but soon became decentralized when personal computers showed up on campus. The customer support center was overwhelmed with calls, had no call tracking capability, and lacked organization (Reasoner, 2000). Virginia Tech had supported mainframe computing using simple terminal access in a central IC since 1969, but transitioned to a client/server infrastructure because their customer base had changed from only faculty, staff and graduate students, to all university affiliates including distance learners and alumni (Adler, Bright, & Scott, 2001).

Information technology (IT) has revolutionized higher education. Wireless networking, high-speed networking, and palm-top computing are just a few of the new technologies available today. Oberlin (1996) stated that legacy-based fiscal thinking also led to misunderstanding of both new client/server technologies and financial strategies. Technological advancement generates an increased demand in higher education institutions that financial officers are finding difficult to accommodate in their budget. The true value of IT in higher education is difficult if not impossible to measure (Peebles & Antolovic, 1999). Even as computer capabilities double every 18 to 24-months and the purchase prices continue to decrease, the costs of managing and maintaining IT continues

to rise (Leach & Smallen, 1998; Oberlin, 1996; Universities Connecting With The Future…, 1999).

Goal

In this study the researcher had two goals. The first goal was to identify the critical success factors (CSF) for the higher education academic helpdesk manager. The second goal was to assess the relationships of CSFs to problems associated with end-user satisfaction levels within higher education environments. The relationships between helpdesk CSFs and problems can provide information that higher education helpdesk managers can use to monitor and improve performance and provide measures to achieve overall goals and objectives. In this study the researcher conducted an analysis of current IT helpdesks within higher education. Published cases, literature searches, personal experience, and interviews with academic helpdesk managers were used to determine the CSFs and problems in higher education helpdesk areas.

Critical success factors can be developed and used at all levels throughout the organization and are the key areas of performance in which positive results are necessary for a particular manager to obtain a particular goal (Bullen & Rockart, 1981). Magal, Carr, and Watson (1988) suggested that CSFs in an information center (IC) provided a focal point for managers, but that CSFs were more descriptive rather than prescriptive. Results of a study by Guimaraes, Gupta, and Rainer (1999) suggested that the relationship between IC CSFs and end-user problems were important to IC effectiveness.

Problems can arise in organizations that are indications of performance or environmental changes (Bullen & Rockart, 1981). This may be due to managers not

explicitly understanding and prioritizing CSFs, simply monitoring the wrong factors, or not monitoring at all (Bullen & Rockart, 1981). These problems can affect the achievement of a particular manager's goals (Guimaraes, Gupta, & Rainer 1999; Middleton & Marcella, 1997). Helpdesk managers must have the necessary information in order to focus their limited resources on those things that really make a difference between success and failure (Bullen & Rockart, 1981). Proper CSF selection will aid in the planning process, improve communications, and aid information systems development (Bullen & Rockart, 1981).

Critical success factors can be defined at various levels within an organization's hierarchy (Bullen & Rockart, 1981). An initial literature review provided little evidence of the use of the CSF method at the helpdesk management level within academic institutions. Some literature specifically addressed helpdesk efficiency and effectiveness implementations within higher education in terms of the problems identified such as a centralized knowledge base, call tracking, and service level agreements (SLA) (Chipman & Long, 2000; Cunningham & Lubbers, 1998; Marcella & Middleton, 1996; Tucker & Barraza, 2000; Twitchell, 1997; Verghis, 1993; Whiting & Everett, 2001). There was no evidence of linkages between problems and CSFs in any of the literature. This lack of explicit CSFs and their relation to helpdesk problems was the motivation for the research in conducting this study. While there was no single solution for all academic helpdesks in this research the author provided a comprehensive choice of CSFs that academic helpdesk managers and others will be able to use as a model or guideline to achieve their own goals and objectives.

Research Questions

Based on the stated goals of the author in this study and the hypotheses that follow, the research questions raised were:

1. What are the critical success factors for an academic helpdesk?

Within research question 1, two important sub-questions arise:

1a. What CSFs relate to higher education IT helpdesk efficiency?

1b. What CSFs relate to higher education IT helpdesk effectiveness?

Sub-question 1a addresses helpdesk CSFs that may have an impact on costs. Efficiency issues identify the factors that relate to current helpdesk costs such as analysts' salaries, equipment, tools, and office space. This investigation encompassed qualitative measures, such as information gathering through open-ended questions. Also included were quantitative measures involved in CSFs elicited through the use of an online questionnaire.

Sub-question 1b addresses customer satisfaction, worker productivity, staff turnover, and staff training issues that have an impact on a helpdesk. Effectiveness issues identify factors that impact overall customer satisfaction such as correct solutions, timely response and follow-up, and the use of software and hardware tools. This investigation encompassed qualitative measures, such as information gathering through open-ended questions, as well as quantitative measures elicited through the use of an online questionnaire.

2. What are the problems associated with higher education helpdesks?

Within research question 2, two important sub-questions arise:

2a. What problems relate to higher education IT helpdesk efficiency?

2b. What problems relate to higher education IT helpdesk effectiveness?

Sub-question 2a addresses helpdesk problems that may have an impact on costs. Efficiency issues identify the problems that relate to current helpdesk costs such as analysts' salaries, equipment, tools, and office space. This investigation encompassed qualitative measures, such as information gathering through open-ended questions. Also included were quantitative measures involved in helpdesk problems elicited through the use of an online questionnaire.

Sub-question 2b addresses problems that may have an impact on customer satisfaction, worker productivity, staff turnover, and staff training. Effectiveness issues identify problems that impact overall customer satisfaction such as correct solutions, timely response and follow-up, and the use of software and hardware tools. This investigation encompassed qualitative measures, such as information gathering through open-ended questions, as well as quantitative measures elicited through the use of an online questionnaire.

3. What are the relationships of the helpdesk CSFs to problems associated with helpdesks within higher education environments?

Helpdesk managers must give constant and careful attention to areas of activity where performance is critical to the success of the organization (Rockart, 1979). The relationships between helpdesk CSFs and problems can provide information that higher education helpdesk managers can use to monitor and improve performance and provide measures to achieve overall goals and objectives. This investigation encompassed qualitative measures, such as information gathering through open-ended questions. Also

included were quantitative measures involved in CSFs elicited through the use of an online questionnaire.

4. What are the relationships of CSFs to stage of growth of the helpdesk?

Magal, Carr, and Watson (1988) showed that information centers and their helpdesks evolve through four stages of growth: (a) stage 1, initiation; b) stage 2, expansion; c) stage 3, formalization; and d) stage 4, maturity. As the helpdesk evolves and technology becomes more pervasive within the organization, the helpdesk activities and objectives may change and helpdesk managers must adopt new strategies to handle the evolution (Guimaraes, Gupta, & Rainer, 1999). The characteristics of effective helpdesk growth may be a hybrid of progressive, non-continuous, and self-managed development models (Gordon, 1996, chap. 5).

5. What are the relationships of helpdesk problems to the overall helpdesk's structure?

This research question addresses both the physical and logical structure of a helpdesk. Cook (1996) differentiated between centralized and decentralized computing as a matter of independence and autonomy. However, end users blamed centralization for their dissatisfaction (Cook, 1996). According to Cook, what end users really wanted was central support from the organization, while maintaining decision-making at the local level. The term *distributed* describes strong guidance from the center by setting clear, meaningful objectives throughout the organization within a physically distributed computing infrastructure (Cook, 1996; Drucker, 1986). The way the helpdesk is structured, such as a single tier or multi-tiered, walk-in, or web-based, may influence helpdesk effectiveness. This research question also addressed the measures helpdesk

managers could use to meet a particular goal on their CSF list by understanding the difference between helpdesk structures and how these relate to the helpdesk problems.

6. What are the relationships of helpdesk problems to overall helpdesk organizational acceptance?

This research question addresses how commitment from higher education management, faculty, and staff relates to the overall helpdesk concept. Factors such as promoting and marketing the helpdesk, communicating and collaborating with other higher education departments, helpdesk staff job satisfaction, and upper management support are considered important to the success of the helpdesk (Guimaraes, Gupta, & Rainer, 1999). Overall acceptance of a helpdesk in higher education is related to its position within the institution's hierarchy and requires support from all departments that utilize the helpdesk's services (Cook, 1996; Middleton & Marcella, 1997). Continuous process improvement (CPI), surveying end-user needs, quality and end-user satisfaction are central to promoting the value of the helpdesk and demonstrating achievements to senior management (Peebles, Stewart, Voss, & Workman, 2001; Wooten, 2001).

7. What are the relationships of helpdesk problems to end-user training?

End-user training may consist of helpdesk staff educating the customers on the location and use of frequently asked questions (FAQs), knowledge bases, off-site resources, and formal training for application software. This research question addresses how training end users affect the number and complexity of helpdesk problems. Online FAQs, knowledge bases, and other off-site materials are often overlooked as valuable training sources for end users (Perez & Moore, 2000). End users may be able to fix their own problems thus reducing the number of live contacts to the helpdesk (Yohe, 1996).

End users can fix the simplest, repetitive problems (tier-0) allowing helpdesk staff to address more difficult problems (tier-1 through tier-4). Delic and Hoellmer (2000) posited that the cost of escalating a problem from tier-1 to tier-2 rises by a factor of four and that an online knowledge base could reduce the solution time by 10.76%. As an example, the knowledge base at Indiana University receives over 75,000 hits per week and provides answers to the most common questions (Peebles, Stewart, Voss, & Workman, 2001).

8. What are the relationships of helpdesk problems to helpdesk staff training?

Helpdesk managers must determine the amount of training the analyst receives prior to working the helpdesk. Training for helpdesk analysts may include hands-on experience with ticket tracking software, phone systems, or specific applications. This research question addresses how training for helpdesk staff affects the number and complexity of helpdesk problems. The University of Wyoming and Virginia Tech have cited helpdesk staff training as a problem (Adler, Bright, & Scott, 2001; Reasoner, 2000).

The importance of identifying CSFs is key for managers to focus their limited resources, such as time and money, on those issues that can determine success or failure (Bullen & Rockart, 1981). What may be perceived as a crisis for the helpdesk function could be an opportunity for the entire institution. Drucker (1986) posited that efficiency consists of doing things right, and effectiveness consists of doing the right things. For higher education helpdesks this translates into planning, organizing, and improving processes (Yohe, 1996). Instead of a vertical, monolithic helpdesk system, a cross-departmental helpdesk system would allow for integration and coordination across the higher education institution (Cook, 1996).

The survey questionnaire (see Appendix A) identified CSFs, helpdesk problems, and variables of interest that addressed effectiveness, efficiency, and stage of growth. Both CSF and helpdesk problem responses were factor analyzed in order to determine composite CSFs and helpdesk problems. The eight research questions were viewed through eight hypotheses.

Hypotheses

The following null hypotheses are posited and the related research questions stated previously are discussed (see Table 1 for a matrix that presents the hypotheses in relation to the research questions, questionnaire items, and the statistical tests to be used).

Table 1. Matrix of Hypotheses, Research Questions, Questionnaire Items and Statistical Tests

Hypothesis	Related Research Questions	Questionnaire Item #	Statistical Test
		1, 13-24	Descriptive statistics
		1-24	Chi-Square (Non-response bias)
H1, H2	1, 1a, 1b, 3	8-12	IV Factor Analysis (CSFs)
H1, H3	2, 2a, 2b, 3	2-7	DV Factor Analysis (Helpdesk Problems)
H1, H5, H6, H7, H8	1, 1a, 1b, 2, 2a, 2b, 3, 4, 5, 6, 7, 8	composites[a]	Multiple Regression

Table 1 *(continued)*. Matrix of Hypotheses, Research Questions, Questionnaire Items and Statistical Tests

Hypothesis	Related Research Questions	Questionnaire Item #	Statistical Test
H4	4	13-16 composite[a] CSFs	MANOVA

[a]Factor analyze questionnaire items for CSFs and helpdesk problems.

Hypothesis H1: There are no statistically significant relationships between helpdesk CSFs and helpdesk problems. Research question 1 seeks to identify and prioritize academic helpdesk managers' CSFs. Research question 2 seeks to identify and prioritize academic helpdesk problems. Research question 3 seeks to identify the relationships of the academic helpdesk managers' CSFs to helpdesk problems. In order to determine if there are any statistically significant relationships between helpdesk managers' CSFs and helpdesk problems, the researcher will first identify aggregate helpdesk CSFs and problems.

Hypothesis H2: There are no statistically significant differences between the means of the importance of helpdesk CSFs. Research question 1 seeks to identify and prioritize academic helpdesk managers' CSFs. Overall, certain CSFs may be more important than others in an academic helpdesk. Also, within each Carnegie classification certain CSFs may be more important than others. For example, the helpdesk structure may be more important than training within Baccalaureate colleges. Conversely, Master's colleges and universities may place more importance on training because the helpdesk structure is mature.

Hypothesis H3: There are no statistically significant differences between the means of the importance of helpdesk problems. Research question 2 seeks to identify and prioritize academic helpdesk problems. Overall, certain helpdesk problems may be more important than others in an academic helpdesk. Also, within each Carnegie classification certain helpdesk problems may be more important than others. For example, Tribal colleges may be more concerned with Internet access than end-user training.

Hypothesis H4: There are no statistically significant relationships between the stages of growth and composite CSFs. Research question 4 seeks to identify the relationships of academic CSFs to the stage of growth of the helpdesk. Four stages of growth proposed by Magal, Carr, and Watson (1988) will be used as a basis for establishing the relationship to the composite CSFs. Stage 1, initiation, is characterized as having little of no helpdesk staff and varying hardware configurations. Stage 2, expansion, is characterized by steep increases in IT use and growing helpdesk responsibilities. Stage 3, formalization, is characterized by formal management controls and higher levels of helpdesk staff expertise. Stage 4, maturity, is characterized as a more distributed throughout the organization and highly specialized. Identifying the current stage of growth for a particular academic helpdesk may help a helpdesk manager meet the goals of a particular CSF.

Hypothesis H5: There are no statistically significant relationships between composite helpdesk problems and the structure of the helpdesk. Research question 5 seeks to identify the relationships of composite helpdesk problems to the overall helpdesks structure. Cook (1996) differentiated between centralized and decentralized computing as matter of independence and autonomy. Identifying and implementing the

optimum academic helpdesk structure may eliminate the problems on the helpdesk and improve end-user satisfaction. For example, the way the helpdesk is structured, such as a single tier or multi-tiered, walk-in, or web-based, may influence helpdesk effectiveness.

Hypothesis H6: There are no statistically significant relationships between composite helpdesk problems and the acceptance of the helpdesk. Research question 6 seeks to identify the relationships of composite helpdesk problems to overall helpdesk organizational acceptance. Overall acceptance of a helpdesk in higher education is related to its position within the institution's hierarchy and requires support from all departments that utilize the helpdesk's services (Cook, 1996; Middleton & Marcella, 1997). The implementation of the logical and physical structure of the helpdesk may be significant in the overall acceptance of the helpdesk. For example, surveying end user needs and implementing end-user suggestions may promote a positive attitude towards the helpdesk.

Hypothesis H7: There are no statistically significant relationships between composite helpdesk problems and end-user training. Research question 7 seeks to identify the relationships of composite helpdesk problems to end-user training. End users may not know where to get their answers or who to call and even if they did, the helpdesk staff may be ill prepared to solve their problem. Online FAQs, knowledge bases, and other off-site materials are often overlooked as valuable training sources for end users (Perez & Moore, 2000). Relationships between helpdesk problems and end-user training could indicate ways to eliminate the problems and improve end-user satisfaction. Differences in end-user training levels and helpdesk problems may vary with the Carnegie classification.

For example, training on using campus network resources for new students may not be offered at Research-I universities because of the lack of helpdesk resources.

Hypothesis H8: There are no statistically significant relationships between composite helpdesk problems and helpdesk staff training. Research question 8 seeks to identify the relationships of composite helpdesk problems to helpdesk staff training. The helpdesk staff may be ill prepared to solve end-users' problems. Tennessee Technological University has overcome the disadvantages of student helpdesk analysts and is reaping the benefits of cost and quality by requiring the novice helpdesk analysts to receive hands-on training prior to the beginning of the semester (Littrell, 1993). Relationships between helpdesk problems and training could indicate ways to eliminate the problems and improve end-user satisfaction. Differences in helpdesk staff training levels and helpdesk problems may vary with the Carnegie classification. For example, a Tribal college may not have a budget for training helpdesk staff.

Relevance and Significance

Based on preliminary research, there was literature available specifically on helpdesk efficiency and effectiveness implementations within higher education that addressed training, call tracking software, knowledge bases, customer satisfaction, costs, and SLAs (Chipman & Long, 2000; Cunningham & Lubbers, 1998; Marcella & Middleton, 1996; Tucker & Barraza, 2000; Twitchell, 1997; Verghis, 1993; Whiting & Everett, 2001). However, efficiency and effectiveness were treated separately and addressed within a single higher education institution at a specific stage of growth (Magal, Simha, Carr, & Watson, 1988). The literature available included applied research

and only involved a specific university's IT helpdesk services for two or three factors such as staffing, cost, and training.

In the past, many educational institutions responded to increasing demands for computer support services by instituting a helpdesk so that faculty, staff, and students could be productive in their own work, rather than them wasting time trying to fix computer problems (Cunningham & Lubbers, 1998). The need for a helpdesk became evident as each academic department tackled issues of poor support, lack of training, and loss of knowledge because of growth (Cunningham & Lubbers, 1998; Twitchell, 1997; Verghis, 1993; Whiting & Everett, 2001). The plans, processes, and implementations differed, but the unifying forces were customer support and cost.

However, some higher education institutions that have grown their own helpdesks have met with failure because the reactive support paradigms they relied on could not evolve quickly enough (Cunningham & Lubbers, 1998; Middleton & Marcella, 1997; Twitchell, 1997). This could have been compounded by the fact that each department may have had its own specialized application and network or a legacy computer system that was too expensive to replace that required helpdesk analysts with unique skill sets. Currently, there is a push to move toward a more integrated, logically centralized environment for services and support (Chipman & Long, 2000; Cook, 1996; Reasoner, 2000; Tucker & Barraza, 2000; Whiting & Eshbaugh, 2000). Some higher education institutions have used other academic institutions' models and made changes to suit their needs (Chipman & Long, 2000). For most higher education institutions, however, the helpdesk must be adaptable and responsive to meet the increasingly complex needs of the

end users (Middleton & Marcella, 1997; Peebles, Stewart, Voss, & Workman, 2001; Twitchell, 1997; Whiting & Everett, 2001).

The goal of most higher education institutions has been to implement IT support services and helpdesks across their campuses in order to meet the needs of their customers and keep the costs under control (Middleton & Marcella, 1997). Good helpdesk analysts are difficult to find and costly to train. However, the hidden costs, such as training and retaining helpdesk staff, are often overlooked (Perez & Moore, 2000; Phipps & Wellman, 2001). Higher education institutions have tried hiring students as analysts for their helpdesks, but they have met with difficulties such as lack of experience, lack of motivation, high turnover, low job commitment, and difficulty in supervising (Reasoner, 2000). A few academic IT helpdesks such as those at the University of Maryland, Baltimore County and Tennessee Technological University have made their helpdesks successful by developing a career path for the analyst, instilling a positive work ethic, and developing a continuous improvement plan to reduce cost and increase quality (Littrell, 1993; Perez & Moore, 2000). Declining budgets and increasing expectations within higher education institutions have made it important for higher education helpdesk managers to be more efficient and effective in establishing measures to reach their goals (Young, 2001).

Higher education IT helpdesks must be able to change quickly in order to meet the demands of its consumers. Students, staff, and faculty have unique needs and requirements that they place on IT helpdesks. Distance education also puts increasing demands on faculty and staff to provide ever-changing services (Middleton & Marcella, 1997). Distance education must deal with content delivery, forums, chats, and other web-

based applications in order to serve the students and faculty. Adler, Bright, and Scott (2001) at Virginia Tech discovered that support must extend to all customers, including distance learners and alumni. The issue of "after normal hours support" is most important for institutions that serve students from multiple countries (Middleton & Marcella, 1997). A possible solution called "Follow The Sun" (Sykes, 2002) in which four universities provide 24-hour support 7-days a week by combining their university helpdesks that spanned three continents has met with mixed results. The IT support infrastructure of higher education institutions must be flexible in order to change with such demands.

Higher education students also expect colleges and universities to be the source of knowledge and experience and to answer their questions about technology (Foley, 1999; Govindarajulu & Reithel, 1998). Faculty and staff must remain in the forefront of technology in order to make the learning experience a positive and profitable one (National Association of State Universities and Land-Grant Colleges, 1999). In the current research, the author examined the call management system software, automatic call routing (ACD) telephone hardware, and helpdesk organizational processes that increase effectiveness and efficiency in order to determine factors that are critical to successful implementation and operation of IT helpdesks within higher education. Peebles, Stewart, Voss, and Workman (2001) recognized these two crucial elements when they began focusing on support services at Indiana University:

> Measurement of *cost and quality* [italics added] seems inherently valuable. The leadership of any organization will claim, in at least some abstract sense, a desire to deliver high-quality services at favorable costs. Turning such a desire into tangible and effective actions is, however, a critical challenge. (Peebles, Stewart, Voss, and Workman, 2001, p. 3)

The true value of identifying CSFs is to make those things explicit instead of simply thinking of them as implied abstract ideas. CSFs are not prescribed measures of performance nor are they limited to aggregate data accounting; so too are cost and quality. Simply identifying the critical factors of efficiency and effectiveness is the first step in meeting the challenge.

In addition, higher education financial officers will benefit because of savings realized by efficient operation of the helpdesk. The overall IT infrastructure will also benefit from improved customer satisfaction. There was no evidence in the literature of linkages between problems and CSFs in any of the literature. This lack of explicit CSFs and their relationships to helpdesk problems was part of the motivation of the researcher for conducting this study. Factors uncovered in this research provided a model for further research within higher education IT infrastructures.

Helpdesk managers would benefit from the knowledge of the stage of growth their helpdesk was in. Magal, Carr, and Watson (1988) showed that information centers and helpdesks went through four stages of growth: (a) initiation, (b) expansion, (c) formalization, and (d) maturity. Bullen and Rockart (1981) reported that a manager's CSFs are temporal. The helpdesk manager could consider the stage of growth as a CSF and how it relates to helpdesk problems and the measures necessary to achieve their goals. Once that helpdesk manager has met a goal, it is crossed off their list.

Barriers and Issues

Consumer demand has been the impetus behind changes made to higher education computing resources over the years. Upgrades to existing infrastructures and technologies

will continue to present new problems. The CSFs that are identified in this research may have limited scope as newer tools become available, and certainly as new problems are solved. Changes in IT helpdesk processes and methodologies are inevitable, and it is difficult to predict the exact directions that IT support services will take.

Temporal, stage of growth, and managerial position factors present barriers to identifying and classifying CSFs. The age and experience of the helpdesk and staff will also affect the CSFs and related problems. Different managers may have different CSFs, and these particular CSFs will change based on roles and temporal factors (Bullen & Rockart, 1981). Different higher education institutions are at different stages of growth in their helpdesks (Magal, Carr, & Watson, 1988).

Issues of process reengineering and change management within an organization can complicate CSF selection (Cook, 1996). IT brings about change to end-users' behavior and job tasks. An academic department may have its own local support expert and so may not like the direction towards a more integrated, logically centralized environment for services and support (Chipman & Long, 2000; Reasoner, 2000; Tucker & Barraza, 2000; Whiting & Eshbaugh, 2000). In contrast, higher education administration may be unwilling to accept a distributed helpdesk solution that takes control from a centralized support model. Das, Soh and Lee (1999) posited that cost becomes secondary, and quality and client satisfaction become primary when outsourcing services. However, outsourcing could have the harmful effect of taking control away from the administration of higher education institutions, which may lower costs and customer satisfaction (McCord, 2002).

The heterogeneity of the operating systems and networks used throughout the institution could pose more complex problems for the helpdesk. Wireless networking, high-speed networking, and palm-top computing are just a few of the technologies available to campus end users. More customers using newer technologies create a new breed of end user interested only in using technology to produce results, and may be more dependent on the support structure and require quick service (McClure, Smith, & Sitko, 1997). The heterogeneity of computer applications may further confound efforts of IT helpdesk staff. While many higher education institutions are trying to standardize hardware and software, the end users have been prone to personalize their computer systems according to evolving technology (McCord, 2002). Saini (1990) reported that attempts to force standard hardware or software solutions on the departments at the University of Saskatchewan failed because individual departments had different requirements and required their own support technicians. The need for subject-matter experts (SME) for each specialization within an academic organization would decentralize the helpdesk support function, increase training requirements, and increase budgets (Leach & Smallen, 1998). Not only may the structure of IT helpdesks be to blame, but also the funding models may be at fault (McClure, Smith, & Sitko, 1997).

From the organizational perspective, many issues may complicate the classification and identification of CSFs. The lack of any formal helpdesk mission statement is one such issue (Nelson & Davenport, 1996). Helpdesk managers may not have a clear understanding of what a helpdesk is or does (Magal, Carr, & Watson, 1988). Bullen and Rockart (1981) stated that in order to determine CSFs, the interviewer must understand the interviewee's organizational mission, role, goals, and objectives. It is

vitally important that the helpdesk manager answering the questionnaire for this study understand the helpdesk's mission and role. In order to ensure that the helpdesk manager is prepared, the researcher has followed these steps: (a) conducted a thorough literature review of academic helpdesks, (b) studied the CSF interview method as outlined by Bullen and Rockart (1981), (c) written a pre-notice email emphasizing the purpose and importance understanding CSFs, and (d) chosen questionnaire items that address the unique problems and CSFs faced by academic helpdesks.

Another critical issue is the timing of the survey. Dillman (2000) reported that many web surveys suffer from high non-response errors because of poor design, lack of convenience, and a long time to complete. Many higher education helpdesks have only full-time staff during the summer and spring breaks, because the student employees are not available. The survey response rate is likely to be higher for the current study during traditional breaks because there are fewer requests for helpdesk support from faculty, staff and students. However, the beginning of each semester is typically a very busy time, and participants may delay responding, or not respond at all.

Limitations

As with many surveys, the development of survey procedures must produce respondent trust and perceived benefit (Dillman, 2000). The overall success of this study will revolve around the willingness of the higher education institutions' helpdesk managers to respond honestly to the survey. It will be vitally important that this survey is respondent-friendly and assures anonymity in order to reduce survey error. The limitations for this study are as follows:

1. The timing and administration of the survey may affect the response rate. Dillman (2000) reported that many web surveys suffer from high non-response errors because of poor design, lack of convenience, and length of time to complete them. Many higher education helpdesks have only full-time staff during the summer and spring breaks, because the student employees are not available. The survey response rate is likely to be higher for this study during traditional breaks because there are fewer requests for helpdesk support from faculty, staff and students. However, the beginning of each semester is typically a very busy time and participants may delay responding, or not respond at all.
2. Random selection of the population of interest is another limiting factor. The population of interest includes all accredited higher education institutions. The researcher will use a random sample of 1,765 from the list of 4,282 profiles in the 2003 Higher Education Directory (http://www.hepinc.com). Some higher education institutions may not have an IT helpdesk, any network infrastructure, or email. In these cases the randomly selected participant will be considered a non-response.
3. The target population includes only accredited institutions in the United States listed in the Higher Education Directory; therefore, the survey results may not be generalizable to higher education institutions outside of the United States.

Delimitations

The problem statement and goals established the scope of this research. Interesting information may become available that is outside the boundary of this

research and not relevant to the central focus of the problem statement (Leedy, 1997). The delimitations for this study are as follows:

1. To narrow the focus of this research, only managers of higher education IT helpdesks were surveyed. This constrained the scope of this study and made it more manageable.
2. The survey questionnaire was designed specifically for this study. Since there was no prior empirical research identifying CSFs in academic helpdesks and their relation to end-user problems, there was no meaningful way to estimate population variance to determine a sample size (Charles, 1998; DeVillis, 1991). The researcher expects a response rate of 20% and the sample size will be 1,765.

Resources

The researcher served as a Senior Information System Analyst for an IT services and support company working on the United States Postal Service Central Management Facility (CMF). The CMF is a multitiered helpdesk for all USPS facilities. It is expected that this experience will help the researcher organize the information gathering from interviews with managers and helpdesk analysts.

Primary literature resources have come from the Association for Computing Machinery (ACM) digital library, the Institute of Electrical and Electronic Engineers (IEEE) publications, EDUCAUSE.COM, the National Center for Educational Statistics (NCES), as well as other articles and proceedings available from the Nova Southeastern University (NSU) electronic library website. Since the researcher is located in Raleigh, North Carolina, resources through North Carolina State University and the University

North Carolina Chapel Hill library have also been used. The Higher Education Directory from Higher Education Publications, Incorporated was the source of respondents in the sample. The researcher obtained 1,812 samples of higher education institutions (including those for the expert panel and the pilot study). The data was provided in a Microsoft Excel spreadsheet.

In this study the researcher focused on higher education institutions' IT helpdesks. The researcher interviewed the managers electronically about their methodologies and costs at helpdesk facilities. Therefore the study incurred nominal web hosting charges for the questionnaires, printing and mailing costs, and a nominal charge for the sample data. The researcher paid all costs.

Definition of Terms

Centralized Helpdesk – Defined as a tightly woven relationship between the helpdesk and the academic institution where each has confidence in the other and provides support or information on demand from a single point of contact (Marcella & Middleton, 1996; Whiting & Eshbaugh, 2000).

Continuous Process Improvement – Defined as the continuous monitoring of helpdesk work, procedures, and rules to effect incremental and measurable improvements to effectiveness and efficiency (Peebles, Stewart, Voss, & Workman, 2001; Wooten, 2001).

Critical Success Factor – Defined as the few key areas of activity in which favorable results are absolutely necessary for managers to reach their goals (Bullen & Rockart, 1981).

Customer Service - The useful labor performed by an individual to produce a non-tangible commodity that is used by another individual having some specified distinction (Woolf, et al. 1981).

Decentralized Helpdesk – Defined as a number of completely autonomous and independent support centers, or staff, providing small portions of the organization's overall information technology needs (Cook, 1996).

Distributed Helpdesk – Defined as a number of physically separate support centers, or staff, logically centralized with strong guidance and high objectives from a single point of contact (Cook, 1996; Drucker, 1986).

Educational Core Services Ratio - This ratio analyzes whether core services are using a growing or dwindling share of institutional resources. The numerator includes instruction, research, public service, and indirect costs such as IT support. The denominator is composed of total unrestricted revenues and other additions from the statement of activities, including net assets released from restrictions for the fiscal year (Salluzzo, Tahey, Prager, & Cowen, 1999).

Educational Support Ratio – This ratio analyzes whether educational support services are using a growing or dwindling share of institutional resources. Support services are defined as the functional categories of expense that are ancillary, but directly related, to the mission of the institution. The numerator is the total of academic support and student services from the statement of activities. The denominator is composed of total unrestricted revenues and other additions from the statement of activities, including net assets released from restrictions for the fiscal year (Salluzzo, Tahey, Prager, & Cowen, 1999).

Efficiency - Defined as a comparison of production with cost (Woolf, et al. 1981).

Effectiveness - Defined in terms of manpower as producing a decided, decisive or desired result (Woolf, et al. 1981).

General Support Ratio - This ratio analyzes whether general support expenses are using a growing or dwindling share of institutional resources. The numerator is composed of institutional support expenses. The denominator is composed of total unrestricted revenues and other additions from the statement of activities, including net assets released from restrictions for the fiscal year (Salluzzo, Tahey, Prager, & Cowen, 1999).

Helpdesk - A generic name associated with the end-user support center, both internal and external, that is seen as an integral part of the support function responsible for multiple resources to solve technical issues to the end-user's satisfaction (Verghis, 2003).

Natural Classification Ratios – An alternative presentation of non-program costs, such as depreciation, interest, salaries, benefits, depreciation, helpdesks, and operations and maintenance of facilities, into the categories that consume these costs (Salluzzo, Tahey, Prager, & Cowen, 1999).

Number of Full-time Helpdesk Staff / Carnegie Classification - This ratio is the number of full-time helpdesk staff collected from this study's questionnaire for each of the Carnegie classifications.

Number of Students / Full-time Helpdesk Staff – This ratio is the number of full-time equivalent (FTE) students indicated in the Higher Education Publications (2003) data divided by the number of full-time helpdesk staff collected from this study's questionnaire.

Number of Students / Student Helpdesk Staff - This ratio is the number of full-time equivalent (FTE) students indicated in the Higher Education Publications (2003) data divided by the number of student helpdesk staff collected from this study's questionnaire.

Number of Trouble Calls a Day / All Helpdesk Staff - This ratio is the number of trouble calls received in one day divided by the number of all helpdesk staff collected from this study's questionnaire.

Number of Trouble Calls a Day / Carnegie Classification - This ratio is the number of trouble calls received in one day collected from this study's questionnaire for each of the Carnegie classifications.

Ratio Analysis - Ratio analysis quantifies the status, sources, and uses of financial resources and the institution's relative ability to repay current and future debt. Ratios can focus planning activities on those steps necessary to improve the institution's financial profile in relation to its vision and mission (Salluzzo, Tahey, Prager, & Cowen, 1999).

Service Level Agreement – A formal agreement between the helpdesk and a customer to provide a certain level of service. The document defines in quantitative and qualitative terms the service being offered, the performance objectives, and measures used to obtain the goals (Wooten, 2001).

Window of Opportunity - A generic phrase used to describe a short period of time during which an opportunity must be acted on or missed. Within a helpdesk environment it is the period of time that the helpdesk analyst must provide a satisfactory answer or resolve a problem for an end user (Delic & Hoellmer, 2000; Wooten, 2001).

Summary

Chapter 1 introduced and established the purpose and processes of this research. The problem investigated in this study was stated and supported with references from literature and case studies. The researcher's goals of identifying higher education academic helpdesk CSFs and their relationship to end-user satisfaction levels were stated, noting the lack of evidence linking CSFs to helpdesk problems. A brief introduction to CSFs was provided, and their importance to academic helpdesk managers. Several references from literature provided evidence of the significance and relevance of this study. However, barriers and issues within higher education organizations, the ever-changing nature of technology, and the suitability of the survey itself tempered the meaning and application of this study. Eight research questions and eight hypotheses were stated that stem from the goals and the problem. Limitations and delimitations were noted and supported with references from literature. Finally, Chapter 1 provided definitions of terms used throughout this study. Chapter 2 will establish the criteria for this research and review related literature regarding academic helpdesk managers' CSFs and helpdesk problems. Chapter 2 will also present the context of this research to lay a foundation for an academic helpdesk model.

Chapter 2

Review of the Literature

Introduction

The literature review included the CSFs for helpdesks in higher education institutions as well as the literature concerning other aspects of this study including statistical tests. The literature review also provided a discussion of academic helpdesk problems that have been used in the questionnaire design.

A detailed literature search was conducted using several bibliographical sources such as ACM Digital Library, Cambridge Scientific Abstracts, EDUCAUSE, and IEEE Computer Society Digital Library. The literature review included many studies from universities that have implemented helpdesks. These case studies included the problems encountered and the successes realized. The preliminary literature review revealed several academic helpdesk problems. These problems are common among the institutional case studies and are discussed in this chapter. These problems were the basis for items on the questionnaire used in this study.

The review of literature begins with a definition of a helpdesk and its primary purpose followed by discussion of helpdesk problems encountered within higher education environments, and a delineation of several candidate CSFs. Several academic helpdesk problem areas were addressed in this chapter in order to provide the motivation for establishing a link between problems and CSFs. Thirty-three helpdesk problems have

been identified from literature and are itemized in the questionnaire (see Appendix A questions 2-7). In order to better understand the relationships between CSFs and problems, a helpdesk manager must know what types of problems they are faced with. External environmental changes, organizational changes within a higher education institution, and poor performance are sources of problems (Bullen & Rockart, 1981). Several areas are suggested as potential sources of CSFs. Thirty-three factors from the literature review have been identified as potential CSFs and are itemized in the questionnaire (see Appendix A questions 8-12). The CSFs are arranged in 16 sections from different perspectives beginning with the position of the helpdesk within a higher education institution to a more detailed view of the helpdesk operations.

There is a distinction between a call center and a helpdesk. A call center is a generic term used to cover helpdesks, travel reservation centers, customer service facilities, and general information lines (Verghis, 2003). A helpdesk refers to a formal organization that provides technical support to users for computer hardware and software problems (Govindarajulu, 2002; Verghis, 2003; Wooten, 2001).

The primary purpose of the helpdesk is to assist the end users who request help for hardware installation and software problems. Foley (1999), and Middleton and Marcella (1997) reported that the most general problem observed was end-user frustration. Cunningham and Lubbers (1998) reported that end users were attempting to fix their own problems because of the lack of available helpdesk staff. Cunningham and Lubbers also pointed out that insufficient helpdesk staff had negative affects on promoting the existence of a helpdesk and the services that it could provide.

Reasoner (2000) indicated that the main problem encountered at the University of Wyoming was using novice students to staff the call center and the students' lack of training. The University of Wyoming's experience is in contrast to the solution that Virginia Tech has used. Virginia Tech's multitiered helpdesk used the most novice student helpdesk staff to answer the most basic, repetitive problems (Adler, Bright, & Scott, 2001).

Yohe (1996) reported that users expected support instantly for any new technology despite shrinking budgets and staff sizes. Users expect to make a single contact that will result in an instant response by a person who knows everything about the hardware and software. Yohe also reported that staff sizes were small relative to the tasks because of a tight budget, and that because staff sizes are so small, they were required to do more resulting in work overload and staff burnout.

The increase in end-users' calls to the helpdesk is also the source of several problems. An increasing number of students, staff, and faculty have access to computers on the campus as well as at home. The increase in faculty requesting support for technology in the classroom, students requesting Ethernet cards installed on their computers, complaints that Internet access is too slow, and that computer software is too difficult to use are all examples of the problems helpdesks must face (Whiting & Everett, 2001). McClure, Smith, and Sitko (1997) reported that increasing demand for all services was growing beyond the helpdesk's capacity to provide support, and as a result their support quality was deteriorating. As an example, demand for dial-in lines and helpdesk support at the University of Virginia had increased 100% two years in a row. The failure of higher education helpdesk managers to identify the needs of the end users can create

problems of IT staff turnover, student staff attrition, high costs, loss of knowledge, and customer dissatisfaction (Niederman & Sumner, 2001).

McCord (2002) reported that universities considered outsourcing campus IT and support because of the cost of the IT enterprise, service levels, recruiting experienced and quality IT staff, and competitiveness, or challenge, of keeping up with other institutions. It is expensive to keep upgrading technology just to be in the forefront. Das, Soh and Lee (1999) posited that cost becomes secondary, and quality and client satisfaction become primary when outsourcing services. Das, Soh and Lee also noted that measures of IS effectiveness have moved from the product to the service. However, Kaludis and Stine (2000), and McClure, Smith, and Sitko (1997) claimed that even though smaller institutions could form consortia to take advantage of outsourcing services, they may still not meet their organizational goals, and the remaining IT staff feel like second-class citizens.

Nelson and Davenport (1996) reported on a change in the governance and strategic planning of Central Michigan University's IT infrastructure. The demand for hardware and software, and the lack of standards had created a chasm between what end users wanted and what IT management thought the end users needed. Higher education organization is not changing to meet the growth of IT.

Verghis (1993) reported that a great deal of knowledge and time were lost when two departments provided virtually the same support. Redundancy is costly, and can confuse the customers if different solutions are given for the same problem. The organization must first recognize the problem, and then establish guidelines for implementing solutions. Tucker and Barraza (2000) provided an example of a call center

where all users were supposed to call, and then a Tech-In-Residence was dispatched. The budget and management was shared between the department and computing support services, but there were inherent problems with this arrangement. The Technicians In Residence (TechIR) were student employees faced with the difficulty of trying to satisfy two managers. There was also a problem with departmental faculty and staff bypassing the helpdesk entirely and going directly to the TechIR. These issues must be dealt with in the service level agreement between the department and computer support services. Verghis, and Tucker and Barraza cited dropped calls, calls for the same problem, increasing complexity of calls, and end-user uncertainty of where to get support as some problems that arise out of duplication of effort and sharing support services.

Twitchell (1997) claimed that implementing a helpdesk at a university required technology, staff, and funding, but more importantly it required a management process along with a clear understanding of the customers' needs. Providing a helpdesk single point of contact for customers is only successful if management promotes the use of the services. Some customers have no idea what services are available. Service level agreements established the relationship between the helpdesk and the customer.

There is a growing demand for on- and off-site support. Sykes (2002) reported that an increasing demand for user support of networked access from both on- and off-campus stemmed from both students and faculty. Students may be distance learners, or part-time with off-hour needs. Faculty may be distance education teachers, or away at seminars and conferences.

Budgets are also a major concern and a source of several problems. Stern (2001) cited that budgets are reported as increasing and typically consume 30% for new IT

development. Purchasing the technology is well understood, and project management practices are up to the task. However, ongoing maintenance and service costs are poorly understood. As an example, the Information Technology Infrastructure Library (ITIL) at the University Sydney Library (USL) defined IT services as all support functions to maintain the technology infrastructure. ITIL provided service management best practices to help organizations strategically invest IT budgets (Stern, 2001).

The goals in this research were to identify CSFs for higher education helpdesk managers, and the relationships those CSFs have with end user satisfaction levels. The CSF goal was guided by the theoretical framework and interview procedures defined by Bullen and Rockart (1981). The objective of CSF interviewing is to understand the manager's goals and objectives within the context of their organization (Bullen & Rockart, 1981). Several factors have emerged as potential CSFs during the preliminary literature review. Factors that are similar are grouped together and discussed in the following sections.

Position of the Helpdesk Within the Higher Education Organization

Case studies from the literature provided an overall view of how helpdesks in higher education are related in the hierarchy of the school's administration. Foley (1999) reported that Lehigh University changed their organizational structure of support services. The rationale was that the six distinct service groups were overlapping in services provided to customers, thereby causing confusion and frustration. The six groups merged into one unit called Information Resource (IR). The result was a centralized-distributed support group. There is nothing new about 24-hours a day 7-days a week helpdesk within industry. Many universities often resort to outsourcing service support in

order to provide the service customers need (Kaludis & Stine, 2000). However, this is at a significant cost, even if the service level agreement is based on per incident fees for small colleges. Four universities on three different continents combined their collective helpdesk support via automatic email notification in order to provide a 24-hour helpdesk (Sykes, 2002). The intranets of each university utilized the Internet as their common medium. Access was via web portals, or email. The technical challenges of implementing a Follow the Sun solution were few, and easily solved, but the human issues proved much more challenging. The organizations involved must have an escalation process in place so that more difficult problems can be quickly solved.

The World Wide Web (WWW) provides the universal standard by which all higher education institutions can provide effective support to their customers. Middleton and Marcella (1997) proposed solutions for academic helpdesks to become adaptable and responsive. Consolidation tops the list and is reported as a growing trend among organizations with greater than 60 support functions. The aim is not to consolidate physical equipment, but to bring the knowledge together as a single knowledge base. This includes the gathering and management of knowledge using a common process or application. Merging IT and Library Information Systems is also suggested as a way to reduce costs and redundancy, but the benefits and risks of these types of mergers must be weighed carefully. Reengineering departments and services takes time, and the support of the affected organizations (Cook, 1996; Middleton & Marcella, 1997).

Administration of the Helpdesk

Helpdesk administration factors address the questions of management structure, reporting hierarchy, who is responsible for quality assurance, and whether there is a

preponderance of disorganization. In order to answer these questions, the researcher included factors that were from higher education “best practice” sources used to administrate their helpdesks. Customer support organizations grow and change with the technology needs of its end users. A healthy organization responds to change by continually assessing its own processes, procedures, standards of quality, and technology. Both small and large institutions must deal with similar IT support issues (Rhodes, Goveia, & Sierkowski 2000). A well-defined mission statement can help determine service priorities and provide continuity within the IT organization (Hammer & Champy, 2001). Middleton and Marcella (1997) cautioned against reengineering efforts that would alter the organizational structure, and cause tension and frustration. Many administrators see only the bottom line and fail to weigh the affects change has on staff moral and productivity.

Stage of Growth

Helpdesk managers would benefit from the knowledge of the stage of growth of their helpdesk. Magal, Carr, and Watson (1988) showed that information centers and helpdesks went through four stages of growth: (a) initiation, (b) expansion, (c) formalization, and (d) maturity. Bullen and Rockart (1981) reported that a manager's CSFs are temporal. Helpdesk managers could consider the stage of growth as a CSF and how it relates to helpdesk problems and the measures necessary to achieve their goals. Once that helpdesk manager has met a goal, it is crossed off their list. As the helpdesk evolves and technology becomes more pervasive within the organization, the helpdesk activities and objectives may change and helpdesk managers must adopt new strategies to handle the evolution (Guimaraes, Gupta, & Rainer, 1999).

Structure of the Helpdesk

Helpdesk structural factors delineate how the helpdesk is organized. The physical and logical structure of the helpdesk address issues such as centralized, decentralized, or distributed support services. Helpdesk structure can also be a combination of multitiered, web-based, telephone support, and walk-in support. In the early days of end-user support, a helpdesk was known as the Information Center (IC) (Rainer & Carr, 1998). The computers were large monoliths with simple dumb terminals situated in large computer rooms for the end user. This most certainly was centralized computing. However, with the advent of the PC more and more end users went back to their offices to work on their programs or budgets. End users were distributed throughout the organization. This decentralized the support services as well.

A common perception of current helpdesk support services is that there are few helpdesk analysts and staff trying to support many users with limited tools (Cahoon, Dunn, McCarron, & Munroe, 1997). Whiting and Eshbaugh (2000) defined a *central* helpdesk as a tightly woven relationship between the helpdesk and the academic institution where each has confidence in the other. The University of Wyoming modernized its support services by reestablishing the information center (Reasoner, 2000). Higher education organization recognizes the need for centralizing support services. Providing a single point of contact to the customers via phone support is the first step (Cahoon, Dunn, McCarron, & Munroe, 1997; Peebles, Stewart, Voss, & Workman, 2001; Rainer & Carr, 1998; Reasoner, 2000; Tucker & Barraza, 2000; Whiting & Eshbaugh, 2000). Almost every higher education institution with a helpdesk has implemented online FAQs and email support as a way to centralize support. The

availability of the FAQ is 24-hours a day 7-days a week, and provides the end user with answers to common problems.

More complex problems may require help from a real live helpdesk analyst, or access to help for more complex problems via an expert system. Littrell (1993) reported that Tennessee Technological University adopted a three-tier helpdesk structure consisting of consultants, specialist, and experts. Consultants were eligible to take an oral exam to advance to specialist after only two semesters. After another semester they were eligible to take a written exam for expert. The incentive was an increase in pay, more specialized projects, and the admiration of their peers.

Service Level Agreements

Service level agreements (SLA) are not well known in the academic helpdesk organization. Academic helpdesk managers may not know what an SLA is, how to use them successfully, or the types of problems encountered in their application. Implementing a helpdesk at a university requires technology, staff, and funding, but more importantly a management process and a clear understanding of the customers' needs (Foley, 1999). Providing a helpdesk single point of contact for customers is only successful if management promotes the use of the services. Some customers have no idea what services are available. SLAs establish the relationship between the helpdesk and customers. The purpose of the SLA is primarily to provide a benchmark to measure performance (Stern, 2001). The SLA does not improve customer satisfaction, per se, but delineates which groups are ultimately responsible, and what customers can expect. Creation of the SLA should include managers, helpdesk staff, and most importantly, the customer. Foley (1999) claimed that service standards are an excellent way for

organizations to focus on the needs of the client, and delineate service levels. Equally important, SLAs spell out what the helpdesk will not do. As technology changes, so to does the customer's need. The SLA is not a static document and must be reviewed regularly with the customer (Twitchell, 1997).

Staffing

Staffing factors include professional full-time employees, part-time employees, student employees, on-call hours and the normal hours of operation. Staffing factors also address issues of employee burnout, stress, reliability, and quality of work life. Govindarajulu and Reithel (1998) asked whether support came from formal or informal sources, and who else in other departments were available to answer questions. Bullen and Rockart (1981) recognized the importance of quality personnel as a CSF within the technology industry. Good helpdesk analyst are difficult to find, and costly to train. The hidden costs of training helpdesk staff are often overlooked (Perez & Moore, 2000; Phipps & Wellman, 2001).

The overwhelming majority of helpdesk case studies have discussed the advantages and disadvantages of hiring students as helpdesk analyst. Some of the traits to look for are strong communication skills, listening skills, empathy, motivation, enthusiasm, team player, multitasking skills, accepts change, takes responsibility, and logical and critical thinking skills (Das, Soh, & Lee, 1999; Perez & Moore, 2000). These preferences are also consistent with hiring practice in industry. "Growing our own", is what the University of Maryland Baltimore County believed made their helpdesk successful (Perez & Moore, 2000).

Other higher education institutions have tried hiring students as analyst on their helpdesks, but have met with difficulties such as lack of experience, lack of motivation, high turnover, low job commitment, and difficult to supervise (Reasoner, 2000). Similar to the Perez and Moore article on training students for helpdesks, the Tennessee Technological University overcame the disadvantages of student helpdesk analysts, and continues to reap the benefits of cost and quality (Littrell, 1993). Helpdesk analysts received pay incentives, preference for specialized projects, and recognition among their peers. Additional training in the form of online knowledge bases, vendor manuals, and other resources are available for the student analyst to keep up to date on the latest applications. Student employees are a viable solution for budget-conscience higher education institutions, and can be effective in terms of customer satisfaction (Perez & Moore, 2000).

Outsourcing

Outsourcing factors include hiring or retaining experts, vendor support, and consultants. The question as to what extent should outsourcing be considered is addressed. Outsourcing may be necessary for specialized software applications, complex hardware, or just general helpdesk support. Return on investment (ROI) is at the center of discussion when considering outsourcing (Kaludis & Stine, 2000; Oberlin, 1996; Peebles, Stewart, Voss, & Workman, 2001). The decision to outsource helpdesk services is typically driven by cost (Leach & Smallen, 1998; McCord, 2002). There may be some application specific system or departmental system that only a vendor or outsourced service provider can handle. In such a case, cost becomes secondary, and quality and client satisfaction become primary (McCord, 2002).

Das, Soh and Lee (1999) noted that measures of IS effectiveness have moved from the product to the service. Transaction cost economics (TCE) was one of the most instrumental frameworks for analysis of business activities and whether an organization should provide their own service or outsource. A high call volume, simple repetitive problems, and a common infrastructure characterize most helpdesks. It is for these reasons that making the decision to outsource a helpdesk is difficult. Based on economies of scale, an outsourced vendor could easily provide the first-level support (Kaludis & Stine, 2000). The deciding factors are then reliability and assurance. Reliability suggests the ability of the outsourced partner to provide the promised service dependably and accurately. The assurance attribute suggests trust and confidence brought about by previous reputation or brand name. However, more complex problems unique to academic institutions would be sufficient reason to keep all levels of the helpdesk in-house.

Enterprise resource management (ERM) would be one such process that could benefit initially by outsourcing to a vendor (Cook, 1996). Vendor arrangements typically provide access to services and support that would otherwise prove cost prohibitive (Phipps & Wellman, 2001). Whiting and Eshbaugh (2000) provided a detailed example of the transformational process from legacy business application to client/server. In the case of Princeton University, the financial department trained their own full-time staff to support the PeopleSoft financial application, relying on vendor training and minimal support. Confidentiality, security, and training for the financials module were paramount in the decision to partner with the central helpdesk support services. These PeopleSoft SMEs soon became the trainers for the other helpdesk analyst.

Training and Education

Training and education applies to both customers and helpdesk staff. Helpdesk managers must determine the amount of training the analyst receives prior to working the helpdesk. Ongoing training and education could also come in the form of documentation, seminars, or computer based training (CBT) (Adler, Bright, & Scott, 2001; Chipman & Long, 2000; Cunningham & Lubbers, 1998; Littrell, 1993; Marcella & Middleton, 1996; Peebles, Stewart, Voss, & Workman, 2001; Perez & Moore, 2000; Verghis, 1993).

Inevitably, the issues of training costs are involved. Fall semester at a university was the busiest time of the year for faculty, staff, and students at Texas A&M University. Chipman and Long (2000) described the Texas A&M Computing and Information Services' plan to indoctrinate the entire incoming freshman students to the computing resources available on and off campus. Their solution was to create a one-stop shopping experience where students could get help and training in convenient locations. During freshman orientation week and one week after classes began, Texas A&M computing and information services offered 30-45 minute classes on how to setup and configure personal computers to connect to the TAMU network.

Perez and Moore (2000) indicated that ongoing training for helpdesk staff could instill a positive work environment by helping student staff members develop a career path. End-user training can reduce the number of repeat calls for simple problems. Simply educating the customers on the location and use of online FAQs, knowledge bases, or other off-site sources can reduce the number of phone calls, emails, or walk-ins.

End users may be able to fix their own problems thus reducing the number of live contacts to the helpdesk (Yohe, 1996). End users fix the simplest, repetitive problems

(tier-0). Helpdesk staff can then address the more difficult problems (tier-1 through tier-4). Delic and Hoellmer (2000) posited that the cost of escalating a problem from tier-1 to tier-2 rises by a factor of four, and that an online knowledge base could reduce the solution time by 10.76%. As an example, the knowledge base at Indiana University receives over 75,000 hits per week and provides answers to the more common questions (Peebles, Stewart, Voss, & Workman, 2001).

Technology

Technology factors include all the software, hardware, phones, and processes that affect the helpdesk in terms of efficiency and effectiveness. IT has revolutionized higher education. Wireless networking, high-speed networking, and palm-top computing are just a few of the technologies available today. Even more profound is the profusion of information itself. Rare tomes that were once only available to a few select library patrons are now available via the World Wide Web. Complete student, faculty and staff records are maintained in a database. The technological tools are available to make all this a reality. The same technological tools and management processes are needed to support this infrastructure. The true value of IT in higher education is difficult if not impossible to measure (Peebles & Antolovic, 1999). In order to maximize the ROI, the IT helpdesk must keep the infrastructure running smoothly 24-hours a day 7-days a week and minimize costs through proactive measures. The tools and technology used to assure effective and efficient operations of an IT helpdesk are described in the following paragraphs.

Knowledge Bases

Knowledge base (KB) technology includes artificial intelligence (AI), expert systems (ES), frequently asked questions (FAQ), and web-based tools for both customers and helpdesk staff. It has been reported that helpdesk analyst spend about 60% to 70% of their time on solving repeated problems (Chang, Raman, Carlisle, & Cross, 1996). This fact would provide a valid argument for investing in a Case-based Reasoning (CBR) system. The specific type of CBR system for helpdesk use is syntactic analysis. This is a much more robust, and adaptable to larger domains. Such a system was used by Compaq and reported increases in first-call resolution from 50% to 87% (Chang, Raman, Carlisle, & Cross, 1996). Case-Based Reasoning (CBR) is the process of solving a problem based on previous knowledge gained from solving precedents. This technique is effective for customer service and helpdesks. A CBR system can be used to solve the most common recurring customer problems. Results show a decrease in calls, faster response times, and higher confidence in the support system.

Knowledge management is the key to a successful knowledge base. As with any knowledge base, it is a dynamic system and must continually be updated. Maintenance of the knowledge base comes from the knowledge workers tasked to update the system, and from the analysts who are continually adding new information. For such a system to be effective, it must improve call statistics and customer satisfaction (Coventry & Kane, 1993). The accuracy and timeliness of the solution also effects efficiency or cost. Delic and Hoellmer (2000) hypothesized that a knowledge base system would result in a savings of time, solve the problem on the first call, and enable helpdesk analyst to solve more and varied problems. These savings can have direct impact on costs. Delic and

Hoellmer also reported potential annual savings of $500,000 based on ten full-time helpdesk analysts. This projected savings alone could offset the cost of new hardware, and software upgrades.

Software

Software factors address helpdesk software that is designed to improve the process of providing support, logging problems, and collecting data for the KB. Issues such as ease of use, and Open Systems versus commercial off-the-shelf (COTS) must also be considered (Martin, Brown, DeHayes, Hoffer, & Perkins, 2002). Direct costs associated with the purchase of software and licensing can be monumental (Richard, Lassalle, Daigle, & Snyder, 2003). The average cost of an office automation suite such as Microsoft Office XP Standard is about $479 per workstation. Academic pricing and new licensing structures can save up to 30%, but that still results in a $150 cost per workstation.

An alternative to COTS products is Open Source solutions. Open Source technology, as defined by http://www.opensource.org, provides the software source code and free licenses to use the software technology. The available software technology ranges from complete operating systems such as RedHat Linux to the most atomic building block programming languages such as PHP, C++ and Java. Drew University evaluated an Open Source solution for their call-tracking software (Saul, Black, & Larsson, 2000). The problem that many higher education institutions have is budget and lack of customizable features unique to their institutions. Whiting and Everett (2001) reported that Princeton University decided to build rather than buy a call-tracking

application. Their solution, open problem manager (OPM), was written in PERL, an Open Source programming language.

The build rather than buy decision still has costs. There are the costs of the programming staffs' salary, the computer hardware and software required to develop the application, and the facilities and utilities. As with many software engineering projects, documentation and code ownership is paramount. Even though the application may be written using Open Source, the institution may choose to restrict licensing or even copyright the source code. In this case, it is imperative that all programs are documented with comments in the code, and that the programming staff understands the institution's knowledge licensing policies (Saul, Black, & Larsson, 2000).

Hardware

Hardware factors include the costs of installing, maintaining, and replacing hardware. Return on investment for hardware is not fully understood because of the lack of understanding of maintenance and support costs (Leach & Smallen, 1998; Peebles & Antolovic, 1999; Stern, 2001). Hardware does not have a counterpart such as Open Source software. Personal computers, network routers, wireless network cards, and palm-top computers must be purchased from some manufacturer that may include proprietary equipment. The only savings would be purchasing in volume within academic pricing structures. Some older workstations can be repaired instead of replaced. Replacement parts are usually available either from an original equipment manufacturer (OEM) or from third-party sources. If the computer is not too highly integrated, most components and plug-in boards can be easily and efficiently replaced. This requires IT staff skilled in hardware repair.

Leach and Smallen (1998) reported that the total cost of ownership (TCO) for IT includes both the initial cost and the annualized cost for maintaining the hardware. The average replacement cycle for most personal computers is about three to seven years, and network hardware lasts between five to ten years unless there is a major change in the network infrastructure (Leach & Smallen, 1998). Although the functional life cycle of the PC is much longer, the technological and economic value is much shorter (Leach & Smallen, 1998; Peebles & Antolovic, 1999; Stern, 2001).

Finance and Costs

Finance and cost factors deal with costs for each tangible element in a helpdesk such as staff, equipment, technology, and telephones. Indirect costs can include items such as management, administration, and other support for the staff and equipment. Hidden costs, mentioned in the staffing section, cover costs of training new people because of turnover, as well as the costs incurred from conducting business. Factors such as sources of funding and budgeting ideas, such as Activity Based Costing (ABC), are also discussed. Expenditures on hardware, software and staffing are well understood (Kaludis & Stine, 2000; Leach & Smallen, 1998; Oberlin, 1996; Peebles & Antolovic, 1999; Phipps & Wellman, 2001; Stern, 2001). In order to determine the ROI in IT, one must not only calculate the expenditures for the hardware, software and staffing, but also the perceived quality and value of using technology.

Qualitative measurement of customer satisfaction can serve as an indicator of IT value. Traditional accounting methods fail to specify costs required to operate a process, or provide the information by which processes can be reengineered to reduce costs and increase quality (Peebles & Antolovic, 1999; Stern, 2001). Legacy-based fiscal thinking

also leads to misunderstanding of both new client/server technologies and financial strategies. Technological advancement generates a demand in higher education institutions that financial officers are finding difficult to budget. Even as computer capabilities double every 18 to 24-months and the purchase prices continue to decrease, the costs of managing and maintaining IT continues to rise (Leach & Smallen, 1998; National Association of State Universities and Land-Grant Colleges, 1999; Oberlin, 1996).

The solution to controlling costs is not obvious or simple. Peebles and Antolovic (1999) posited that continuous quality measurement from the end users' perspective was necessary in order to obtain the perceived value of the current technology. Armed with this information, financial administrators could be able to predict the economic usefulness of IT, and IT helpdesks can strategically plan training for both customers and analysts. Stern (2001) suggested that asset tracking, standardized hardware and software purchases, and an SLA are primary tools to manage ongoing maintenance costs. Leach and Smallen (1998) reported that the total cost of ownership (TCO) required established benchmarks and comparative data in order for IT support services to be meaningful. In recent years, a great deal of emphasis has been placed on financing distance education and educational technologies instead of strategic planning and ongoing maintenance (Phipps & Wellman, 2001). The National Association of College and University Business Officers Advisory Report 99-3 has specified new terminology to describe IT within the context of financial accounting methods. Phipps and Wellman also pointed out a lack of common terminology, and provided three broad definitions for IT: (a) Building

infrastructure, (b) systems infrastructure, and (c) personnel infrastructure. The first two dealt specifically with the technology itself, while the last one addressed support services.

Considerable attention has been given to precisely measuring the cost for each activity in IT. Indiana University's information technology service (UITS) used activity-based costing (ABC) to measure real costs and activity-based management (ABM) to improve quality and reduce costs (Peebles & Antolovic, 1999). Indiana University's method has proven both efficient and effective, but it is a method best suited for large universities. Each higher education institution must evaluate its cost structures based on organizational goals, size, and funding levels.

A great deal of knowledge and time are lost when two departments provide virtually the same support (Verghis, 1993). Redundancy is costly, and can confuse the customers if different solutions are given for the same problem. The organization must first recognize the problem and then establish guidelines for implementing solutions. Salluzzo, Tahey, Prager, and Cowen (1999) reported that Educational Core Services, Educational Support, and the General Support ratios are useful in trend analysis. Over time, these ratios can suggest if a particular category is increasing or decreasing in its share of educational and general income (Salluzzo, Tahey, Prager, & Cowen, 1999). Ratio analysis can be used to measure institution-wide CSFs and provide the institution with the tools to improve its financial profile (KPMG, LLP and Prager, McCarth & Sealy, LLC, 2002).

Preparation, Execution, and Promotion

Proper preparation, execution, and promotion factors include issues of how to implement a helpdesk, and how to promote the use of the helpdesk. The primary goal is

to meet the customers' needs. Merging distributed support groups on a large campus is difficult, and may create workplace tension. Combining the knowledge of each group is even more difficult (Foley, 1999, Middleton & Marcella, 1997). Key to promoting the helpdesk is customer participation. Surveys on customer needs, quality and satisfaction should be conducted on a regular basis (Peebles, Stewart, Voss, & Workman, 2001). Maintaining the current customers is important, but attracting new customers will add to the continued success of a helpdesk.

It is also important to set goals for the helpdesk. Senior management must also be aware of the helpdesk's achievements (Wooten, 2001). When developing the message to send to customers and potential customers, it is important to identify the audience. Higher education institutions can be as small as a single-story building, or spread out over several city blocks. There will be some departments that feel left out, so it is important that each group be identified. It is helpful to understand the IT needs of those departments that have never used the helpdesk before, and then supply them with a clear description of what services can be provided. Wooten reported that IT support service's web page, email, newsletters and even career fairs are all excellent media to deliver the helpdesk message. It is also important for helpdesk personnel to provide demonstrations and speak at meetings in order to demonstrate the willingness and capabilities of the helpdesk.

Evaluation and Quality Control

Factors such as helpdesk and analyst performance, and customer satisfaction are discussed in most of the literature. Specifically, measures are sought that can be used for the helpdesk performance, and metrics to measure performance of the analysts. To some

extent, helpdesk managers also need to address ways to make the workplace fun and rewarding.

A true measure of the helpdesk's performance is through customer satisfaction surveys (Govindarajulu & Reithel, 1998; Mirani & King, 1994; Peebles, Stewart, Voss, & Workman, 2001). The diverse nature of end users and technology requires that the helpdesk know and understand what services are required (Prescott, Kilty, Franklin, Cleary, Lovgren, & Mai, 2001). Helpdesk performance metrics can also be quantified by using the capabilities of the automatic call routing (ACD) phone systems. These systems can provide reports on individual helpdesk analyst's time to answer a call, time spent on a problem call, and time off-line. A problem-tracking application, such as Remedy's ARS, can also record the time for problem resolution. While these hard numbers can be quantified and analyzed statistically on a monthly report, they can sometimes cause anxiety to helpdesk staff. The reason is that helpdesk staff believes these metrics will be used to figure out their pay raises, promotions, and selection for preferred projects.

Security

IT security has emerged as an important factor. Academic IT helpdesks must be concerned with issues of privacy and access to restricted online resources (Washburn & El-Bayoumi, 2003). End users are notorious for loosing or forgetting their passwords so helpdesk analysts much have access to password files in order to reset them. Recent concerns with SPAM, email virus, worms, and Trojan attacks make the issue of security even more important. Managers must ensure security for staff against hacking, virus, worms, and theft.

Summary

Chapter 2 presented the bibliographical resources the researcher used and reviewed the related literature for helpdesks and CSFs. Several academic helpdesk problems were addressed early in this chapter in order to explain the link between problems and CSFs. Sixteen major areas were suggested as potential sources of CSFs. The helpdesk problems and CSFs from the literature review have also provided the basis for questionnaire items. The initial literature review provided little evidence of the use of the CSF method at the helpdesk management level within academic institutions. However, some literature specifically addressed helpdesk efficiency and effectiveness implementations within higher education in terms of the problems identified. This lack of explicit CSFs and their relationships to helpdesk problems is the motivation for conducting this study. The contribution that this research will provide is a comprehensive choice of CSFs that all academic helpdesk managers will be able to use as a model or guideline to achieve their own goals and objectives. Chapter 3 will provide the step-by-step description of how the study was conducted, answering the questions of what was done, who performed each step, how each step was accomplished, when and in what order each step was done, where each step was done, and most importantly why.

Chapter 3

Methodology

Introduction

In this section the researcher will discuss the methods and procedures that were used to determine what factors were critical to the success of higher education helpdesks and their problems. Specifically, the procedures that were used were: (a) developing the survey questionnaire, (b) sampling the population, (c) discussion of the approval received from the Institutional Review Board (IRB) representative of the Graduate School of Computer and Information Sciences (GSCIS), (d) pre-testing the survey questionnaire using an expert panel, (e) emulating the survey questionnaire using a pilot study, (f) validating the survey questionnaire, (g) administrating the survey questionnaire, (h) analyzing the responses, and (i) presenting the results. The problem statement, goals, research questions, hypotheses, and limitations and delimitations were presented in Chapter 1. Chapter 3 will conclude with a discussion of ratio analysis and how survey questionnaire content validity and reliability were accommodated.

Overview of Procedures

The researcher gathered data about helpdesk CSFs, helpdesk problems, and variables of interest within higher education by using a questionnaire, reviews of the literature, case studies on strategic planning, and a review of helpdesk implementations in

higher education. The initial list of CSFs and helpdesk problems was derived from the literature. The literature review revealed several academic helpdesk problems common among higher education institutions. These problems have been the basis for items in the questionnaire. The surveys used by Marcella and Middleton (1996) and Magal, Carr and Watson (1988) were sources for some CSFs and served as models to create questions for the survey. The independent variables (IVs) are the CSFs identified in the literature review and through the expert panel review (see Appendix A questions 8-12). The helpdesk problems are the dependent variables (DVs) identified in the literature review and through the expert panel review (see Appendix A questions 2-7). The variables of interest are: (a) Carnegie classification, (b) institution control (public or private), (c) age in years of the helpdesk, (d) staffing levels, (e) number and complexity of end-user problems, (f) helpdesk structure, and (g) perceived customer satisfaction (see Appendix A questions 1 and 13-24).

There are 4,182 private and public degree-granting institutions in the US, according to the US Department of Education's National Center for Educational Statistics (Snyder & Hoffman, 2002). It is unclear what percentage of the 4,182 institutions has an IT helpdesk. Higher Education Publications, Incorporated publishes a Higher Education Directory that is more current than the NCES report. The population of interest included all accredited higher education institutions (as of the publishing date of the 2003 Higher Education Directory). The researcher used a random sample of 1,765 from the list of 4,282 profiles in the 2003 Higher Education Directory (http://www.hepinc.com). Microsoft Excel's Analysis Toolpak add-in random number generation capability was used to randomly select the 1,765 institutions. The randomly selected institutional data

was loaded in a Microsoft Excel spreadsheet with fifteen data fields provided from the Higher Education Directory (see Table 2). The data was then validated using the Federal Interagency Committee on Education code (FICE).

Table 2. Higher Education Directory Data Fields

Field Name	Description
Full Institution Name	Name of institution.
Institution Address	Main mailing address for institution.
Main Telephone	Central telephone number for the institution.
Direct Telephone	Direct telephone number for primary point of contact.
Main Fax	Direct fax number for the primary point of contact.
FICE	Federal Interagency Committee on Education.
Manpower Code	HED codes that identify and describe administrative officers.
Administrator Title	Title of administrator identified by the manpower code.
Administrator Name	Full name of administrator.
Affiliation/Control	Public, private not-for-profit, or private for-profit.
Carnegie Classification	Carnegie classification 2000 has eighteen classifications.
Email Address	Email address of primary point of contact.
Web Address	Base URL for the institution website.
Enrollment	Current enrollment.
Tuition	Annual undergraduate tuition and fees.

Note. From Higher Education Publications, Incorporated (2003). *2003 Higher education directory electronic version 8*. Retrieved August 15, 2003, from http://www.hepinc.com/FrameVersion8.htm.

The FICE codes are assigned by the Department of Education and are used as the primary identifier for each academic institution. The FICE code was used to randomly select the 1,765 higher education institutions. The manpower code identified the primary point of contact at the selected higher education institution. Five manpower codes were used: (a) Code 13 identifies a director of computing and information management, (b) code 14 identifies a director of computer center, (c) code 27 identifies a director of information office, (d) code 90 identifies a director of academic computing, and (d) code 91 identifies a director of administrative computing. Administrator title, name, and email address all correspond to the primary point of contact identified by the manpower code. In the event that the selected institution did not have one of the listed manpower codes, then the researcher located the person responsible for managing the helpdesk from the institution's website. If the selected institution did not have a website, then the researcher telephoned the main office and asked for the helpdesk manager's contact information.

Once the contact information and email addresses were validated, the researcher exported the email addresses to EForm's client interface and generated the initial request for participation. A thorough discussion of Eform's client interface is provided in this chapter under the *Software Tools* section. The researcher used four elements to achieve a high response rate (Dillman, 2000):

1. A pre-notice email (see Appendix B) was sent to all participants a few days before the official survey. It explained that an important survey will arrive and that participation will be greatly appreciated.
2. The official survey email (see Appendix C) included a detailed cover letter explaining why this survey is important, why they were selected, a statement of

confidentiality, an offer of summary results of the survey as a token of appreciation, and instructions for completing the questionnaire.

3. Once the participant had completed the online survey they were directed to a thank you web page (see Appendix D). This web page expressed the researcher's appreciation for participating, and provided the respondent with the researcher's contact information, and a link to the summary of results.

4. A follow-up email was sent to non-respondents approximately two weeks after the official survey email request indicating that the participant's response had not been received and reiterated the importance of this survey (see Appendix E).

The survey instrument was an online questionnaire (see Appendix A). The major advantages of using an online questionnaire are that data collection is more efficient and easier to tabulate and score, offers better anonymity to respondents, and is much more economical (Dillman, 2000; Patten, 1998). The questionnaire was an online HTML form and the data collected was stored in a database. Dillman (2000) recommended nine principles for constructing email surveys, and 14 principles for designing web surveys. The importance of sending a brief cover letter email and multiple reminder emails to the intended recipients must not be underestimated (Dillman, 2000). The researcher indicated in the cover letter and questionnaire that the identity of all respondents would be confidential and results would be reported only in the aggregate (see Appendix A and B). The construction of the web survey followed similar paper questionnaire design. The overall organization of the information and navigation information was designed to be clear, concise, and followed the least compliant browser (LCB) principle (Dillman, 2000). The researcher followed the email design principles for the initial email contact

and reminders, and the web design principles for the survey questionnaire. Designing and implementing a web survey using Dillman's procedures increased the response rate and reduced coverage error, sampling error, measurement error, and non-response error.

Software Tools

The questionnaire was an online HTML form created and administered using Eform version 4.0E by Beach Tech, Corporation. The three major components of Eform are (a) the client interface, (b) the server script, and (c) the database. The client interface allowed the researcher to construct questions and responses in a variety of formats. The response formats included single choice, multiple choice, fixed and variable length text response, yes/no response, floating-point numeric, and currency response. The client interface also created the initial email request, email reminder, and verification emails that were sent to the participants. The server script was called survey.cgi written in the PERL programming language that resided in the cgi-bin subdirectory on the host server. The script processed the online form, and then emailed the results to the researcher's email address hdsur2004@computervine.com. The PERL script was written by Beach Tech Corporation, and is not available as Open Source software and cannot be included as a listing in the appendix. The data returned via email was stored in a local database using the client interface application. The researcher had the option to export the data to either (a) Microsoft Access (.mdb), (b) Microsoft Excel (.xls), (c) text (.txt), (d) comma separated values (.csv), or (e) Foxpro (.dbf). For this survey, data was exported as a Microsoft Excel .xls file format because it was easier to import into SPSS.

The data exported from Eform was then imported into SPSS for Microsoft Windows. SPSS is a statistical analysis application created by SPSS, Incorporated. Data

was imported and converted into an SPSS local format for analysis. SPSS provided the results of statistical analysis, tables, and reports.

The overview of procedures described the tools, techniques, and resources that were used to construct this questionnaire. Once the initial questionnaire items were selected and reviewed, eight major steps were then followed before conducting the data analysis.

Major Steps

1. Sampling: The population for this study was managers of academic helpdesks from all accredited higher education institutions. Since there was little prior empirical research identifying CSFs in academic helpdesks and their relation to end-user problems, there was no meaningful way to estimate population variance to determine a sample size (Charles, 1998; DeVillis, 1991). Gumaraes, Gupta, and Rainer (1999) selected a sample size of 950 participants and received a rate of response of 19.5%. Magal, Carr, and Watson (1988) received a similar response rate of 21% from 1,490 randomly selected participants. In both studies, the response rates were considered typical and reasonable. For this study, the population of 4,282 profiles was based on the 2003 Higher Education Publication. In order to obtain a confidence level of 95% for the final survey questionnaire, the required number of completed questionnaires must be equal to or greater than 353. The expected response rate was 20%; therefore the sample size was 1,765. The actual number of usable responses was 411 (23%).

2. IRB Process: All surveys or assessments that involve human subjects have been reviewed and approved by Nova Southeastern University's Graduate School of Computer and Information Sciences (GSCIS) Institutional Review Board (IRB) representative (see Appendix F). The IRB process protects human subjects involved in research and ensures appropriate practices are being carried out. Both the researcher's dissertation committee and the IRB representative have approved the survey instruments, including the expert panel, pilot test, and questionnaire.
3. Expert Panel: The expert panel participated in the pre-testing stage that involved knowledgeable colleagues and analysts with diverse experience in the domain of research (Dillman, 2000). The preliminary list of questions and CSFs was posted online for the experts to review. The researcher used email, telephone, and an online chat hosted on the researcher's web site to formalize the survey questionnaire. Participants in the expert panel were excluded from the final questionnaire.
4. Pilot Study: The pilot study involved a pre-testing that emulated the survey procedures for the final study and in which the researcher attempted to discover any additional problems with questions and items that may not have been addressed by the expert panel (Dillman, 2000). The pilot study survey questionnaire questions were designed to determine correct wording and format for each question, yield valid responses, and establish consensus on important CSFs and end-user problems. Charles (1998) and Dillman (2000) suggested that sample sizes of 30 are sufficient for exploratory and pilot studies. The pilot study consisted of the formalized survey questionnaire from the expert panel review

sent to a stratified sample of 32 participants from the Higher Education Publications' 4,282 institutions listed in the Higher Education Directory. The target respondents were managers in the academic helpdesk, and represented proportional samples of the population by Carnegie classification. Participants in the pilot study were excluded from the final questionnaire. The delivery method was email and online forms. The researcher's committee and the IRB representative to approved the pilot study questionnaire before it was administered.

5. Questionnaire: The questionnaire was a multi-part, single instrument delivered as an online form. The final survey questionnaire was revised based on feedback from the pilot study. The feedback received from a pilot study typically results in changes such as adding or eliminating questions, and improving incentives to increase response rate (Dillman, 2000). The questionnaire was divided into three main parts: a) CSFs; b) end-user problems; c) variables of interest and demographics of the higher education institutions. The researcher's committee and the IRB representative approved the questionnaire before it was administered.
6. Validity: Content validity was accommodated through the use of the expert panel and pilot test. At least three experts in the field of academic helpdesk support services provided an external review of the questions for the questionnaires (Charles, 1998; DeVellis, 1991). Construct validity is the degree to which the survey questionnaire consistently measures the intended constructs (Charles, 1998).

7. Reliability: Reliability is the degree to which the survey questionnaire measures what it is supposed to measure expressed numerically as a coefficient (Charles, 1998; DeVellis, 1991). The researcher used Cronbach's Coefficient Alpha to measure the instrument index of reliability.

8. Questionnaire Implementation: The final questionnaire was implemented as a multi-part, single instrument online HTML form located on the researcher's domain http://www.computervine.com/survey/helpdesk/. Participants were contacted via email following the four elements to achieve a high response rate noted previously. Participants were given a User Name, Password, and a unique login ID that was used to control access to the questionnaire. When a participant clicked on the "Submit" button, the responses were emailed to hdsur2004@computervine.com. The questionnaire administration application, Eform 4.0E, periodically retrieved email and stored the responses in the database.

The researcher conducted the following statistical analyses using the data received from respondents: (a) descriptive statistics for the variables of interest, (b) a Chi-square significance test between the respondents and non-respondents to check for non-response bias, (c) a factor analysis to identify composite CSFs and helpdesk problems, (d) multiple regression to determine the degree of relationship between CSFs and helpdesk problems using the composite helpdesk problems identified from the factor analysis as dependent variables and the helpdesk CSFs as independent variables (e) MANOVA to determine the relationships between CSFs and the stage of growth of the helpdesk, (f) and ratio analyses (see Table 1).

Descriptive statistics for the variables of interest were used to describe the topology of the data and their closeness or distance of relationship (Leedy, 1997). The simplest data model that can be fitted to data is the mean (*M*) with variance (s^2) and standard deviation (SD) describing how well that model fits the data (Field, 2000). The variables of interest for this study included: (a) Carnegie classification, (b) institution control (public or private), (c) age in years of the helpdesk, (d) staffing levels, (e) number and complexity of end-user problems, (f) helpdesk structure, and (g) perceived customer satisfaction. The descriptive statistics included: (a) frequency of response, (b) percentage of response, (c) mean, (d) variance, (e) standard deviation, (f) minimum, and (g) maximum. Data was represented in tables, visual graphs, and charts.

A chi-square (χ^2) test for independence with $p < .05$ was used to check for significant association between two or more categorical variables (George & Mallery, 2003; Field, 2000). The first chi-square test for independence had categories of "Responded" and "Carnegie Classification". The "Responded" category had possible values of "Yes" or "No" and was coded as a "1" or "0" respectively. The "Carnegie Classification" category had as many as 19 possible values coded according to the Higher Education Publications (2003). The degrees of freedom (df) was calculated as follows: df = (rows – 1) * (columns – 1), df = 1 * 17 = 17 (Field, 2000). The second chi-square test for independence had categories of "Responded" and "Control". The "Control" category had possible values of "Public", "Private – not for profit", and "Private – for profit" coded as "1", "2", and "3" respectively, with df = 2.

Factor analysis of the CSFs and helpdesk problems were used to discover patterns in the relationships within each set of variables (Field, 2000; Pallant, 2001). Specifically,

principle components analysis (PCA) seeks to find the set of factors that can account for the variance in a set of variables (George & Mallery, 2003; Pallant, 2001). A PCA of CSFs and helpdesk problems indicated how many different factors were needed to explain the pattern of relationships among the variables, the nature of those factors, and how well the hypothesized factors explained the observed data (Field, 2000; George & Mallery, 2003; Pallant, 2001). The researcher followed similar techniques used by Magal, Carr, and Watson (1988), and Guimaraes, Gupta, and Rainer (1999): (a) calculate the correlation matrix, (b) extract and retain the component factors with relatively large eigenvalues (=> 1.0), (c) varimax (orthogonal) rotation in order to improve factor loading interpretation, and (d) interpret the results.

Composite CSF and helpdesk problem factors were analyzed using multiple regression. Multiple regression is used to predict an outcome from several predictors (Field, 2000; Pallant, 2001). Seven multiple regression procedures were completed for each composite helpdesk problem to answer the research questions and test hypotheses H1, H5, H6, H7, and H8. A Multivariate Analysis of Variance (MANOVA) is used to check for statistically significant differences when the design consists of two or more dependent variables with one or more independent variables (Field, 2000; Pallant, 2001). A MANOVA procedure followed by discriminant analysis was completed to answer research question 4 and test hypothesis H4.

Seven ratios were calculated from the results of this study. The principles of ratio analysis serve as a yardstick to measure the use of financial resources to achieve an institution's mission (KPMG, LLP and Prager, McCarth & Sealy, LLC, 2002; Salluzzo, Tahey, Prager, & Cowen, 1999). A higher education helpdesk manager could combine

the total helpdesk budget and all other direct costs including amount spent on training with the results from this study. Key statistical measures were converted into simple ratios to allow higher education institutions to compare their performance with similar institutions, or chart performance of CSFs. The seven ratios that were calculated are:

1. Number of students / Full-time professional helpdesk staff
2. Number of students / Part-time professional helpdesk staff
3. Number of students / Student helpdesk staff
4. Number of trouble calls a day / All helpdesk staff
5. Number of full-time helpdesk staff / Carnegie classification
6. Number of trouble calls a day / Carnegie classification
7. Average problem resolution time / Carnegie classification

Questionnaire items 1 and 17-21 were used to calculate the ratios. The results from these ratios provide helpdesk managers a valuable metric to compare with other similar institutions (Salluzzo, Tahey, Prager, & Cowen, 1999). For example, a high percentage for ratio number 3 might be an indication of too few helpdesk analysts, or problematic hardware or software. Over a longer period of time, a trend may emerge suggesting increases or decreases in helpdesk resources.

Formats for Presenting Results

Descriptive Statistics

Descriptive statistics provide a summarization of a set of data including population size (*N*), mean (*M*), mode, median (*Mdn*), and standard deviation (*SD*) (Field, 2000; Pallant, 2001). Six tables were used to display descriptive statistics about the

variables of interest: (a) Respondents by Carnegie classification, (b) respondents by institution control (public or private), (c) age in years of the helpdesk, (d) staffing levels, (e) number and complexity of end-user problems, (f) helpdesk structure, and (g) perceived customer satisfaction (see Appendix A questions 1 and 13-24).

The respondents by classification table used the Carnegie classification of Institutions of Higher Education, 2000 Edition, third revision. The respondents by Carnegie classification table indicated the Carnegie classification value, descriptive label, frequency of response, and percentage of response.

The respondents by control discussion used the Carnegie classification of Institutions of Higher Education, 2000 Edition, third revision, and Higher Education Publications 2003 Higher education directory. Control was public, private – not for profit, or private – for profit. The respondents by control discussion indicated the control value, 1, 2, or 3 respectively, a descriptive label, frequency of response, and percentage of response. In addition to the discussion, a pie chart provided a visual indication of the respondents by control.

The respondents by State table used the Carnegie classification of Institutions of Higher Education, 2000 Edition, third revision. The respondents by State indicated the two-letter abbreviation of the State, the State name, frequency of response, and percentage of response.

The indicated stage of growth table was based on responses to questionnaire item 15. Respondents were asked to choose a statement that best described their helpdesk's current situation. The respondents by indicated stage of growth table showed the stage

value, 1, 2, 3, or 4 respectively, a descriptive label, frequency of response, and percentage of response.

Questionnaire items 13, 20, and 21 were used to display the statistical mean, standard deviation, minimum, and maximum of helpdesk age, number of reported helpdesk problems per day, and time to resolve helpdesk problems. This table has columns for the variable name, mean, standard deviation, minimum, and maximum.

Questionnaire items 17, 18, and 19 were used in computing the statistical mean, standard deviation, minimum, and maximum of the number of professional full-time, professional part-time, and student staff. This table has columns for the variable name, mean, standard deviation, minimum, and maximum.

Helpdesk Problems and Critical Success Factors

Several tables were used to display the statistics for helpdesk problems and CSFs. The factor loading tables of the CSFs and helpdesk problems were used to show patterns in the relationships within each set of variables. The correlation tables were used to show the relationships between CSFs and helpdesk problems using the composite helpdesk problems identified from the factor analysis as dependent variables, the helpdesk CSFs as independent variables, and the degree of relationship between CSFs and stage of growth of the helpdesk (see Appendix A questions 2-12).

The mean importance ratios and standard deviations of the helpdesk problems table resulted from questionnaire items 2 through 7. The mean importance of helpdesk problems is the statistical average of all responses. The mean importance ratios and standard deviations of helpdesk problems table included the questionnaire item number,

descriptive label, mean score, and standard deviation. The mean scores were rank ordered with the highest score at the top and the lowest score at the bottom.

The mean importance ratios and standard deviations of the CSF table resulted from questionnaire items 8 through 12. The mean importance of CSFs is the statistical average of all responses. The mean importance ratios and standard deviations of CSFs table included the questionnaire item number, descriptive label, mean score, and standard deviation. The mean scores were rank ordered with the highest score at the top and the lowest score at the bottom.

The factor loading tables resulted from questionnaire items 2 through 12. Results from these items were factor analyzed to identify composite CSFs and helpdesk problems. Two tables were used to show the loadings for each questionnaire item to a composite factor. The composite factors were named after considering the individual helpdesk problems and CSFs that comprised it. The factor loading and reliability coefficients (α) tables were used to include the questionnaire item number, factor number, Cronbach Alpha (α) for each factor, eigenvalue for each factor, and percent variance for each factor.

The comprising factors table consisted of two tables showing each composite factor and the questionnaire items that loaded highest for each factor. Each composite factor was named after considering the individual helpdesk problems and CSFs that comprised it. The comprising factors table was used to include the factor name and number, eigenvalue, percent variance, mean, and loading for each composite factor. The minimum eigenvalue recommended to retain a factor is 1.0 (Nunnaly, 1978).

The correlations among the CSFs and helpdesk problems table was used to show the statistical significance between the composite CSFs and composite helpdesk problems at $p<.05$. The correlations among the CSFs and helpdesk problems table was used to include each composite CSF along the vertical axis, and each composite helpdesk factor along the horizontal axis. The intersection of each factor indicates the level of statistical relationship.

Four tables were developed to show the statistical effect that the stages of growth have on helpdesk CSFs. These tables show statistical means for each composite CSF across each stage of growth, the results of MANOVA, a follow-up discriminant analysis that shows the contribution of each variable in the stage of growth, and a structure matrix that shows the relationships between the CSFs in each stage of growth.

Ratio Analysis Table

Seven ratios, described in this chapter under section *Major Steps*, were calculated from the results of this study. The ratio analysis tables for ratios 5, 6, and 7 were broken down by each Carnegie classification. The discussion for ratios 1, 2, 3, and 4 included the mean value for the numerator and denominator, and the ratio. The questionnaire item numbers used for each ratio were also indicated.

Reliability and Validity

Content validity and reliability were discussed in this chapter under the Major Steps section. Additionally, the researcher used Cronbach's coefficient Alpha (α) to measure the instrument index of reliability. Nunnaly (1978) proposed reliability coefficients of 0.80 or higher is acceptable. However, Treacy (1985) suggested that

values of 0.70 or higher are considered acceptable. Given that this survey questionnaire was untested and the absence of any evidence linking helpdesk CSFs to helpdesk problems, a reliability coefficient of 0.50 or higher was considered sufficient (Srinivasan, 1985).Magal, Carr, and Watson (1988), and Guimaraes, Gupta, and Rainer (1999) suggested retaining ambiguously loaded factors in untested instruments. The researcher followed the same reasoning for retaining ambiguous helpdesk CSFs and problems, and assigned them to the factor on which they loaded the highest.

Summary

Chapter 3 provided a step-by-step description of how the study was conducted, answering the questions of what was going to be done, who did each step, how each step was accomplished, when and in what order each step was done, where each step was done, and most importantly why. The problem statement, goals, research questions, hypotheses, and limitations and delimitations were presented in Chapter 1. An overview of procedures outlined the sources and steps used to construct the survey questionnaire. A more detailed discussion provided information about the software tools and data gathering methods, the eight major steps required before conducting the data analysis, the statistical tests that were performed, and how the results were presented. Chapter 3 concluded with a discussion of how survey questionnaire reliability and validity were accommodated. Chapter 4 will present the results of this study, provide findings of outcomes, and summarize the results.

Chapter 4

Results

Introduction

Reviews of the literature, case studies on strategic planning, and a review of helpdesk implementations in higher education provided the initial list of 33 CSFs and 33 helpdesk problems. The literature review revealed several academic helpdesk problems common among higher education institutions. These problems have been the basis for items in the questionnaire. The surveys used by Marcella and Middleton (1996) and Magal, Carr and Watson (1988) were sources for some CSFs and served as models to create questions for the survey. Eight research questions and eight null hypotheses were posited (see Table 1 for a matrix that presents the hypotheses in relation to the research questions, questionnaire items, and the statistical tests to be used).

Data Analysis

The data analysis involved several steps. The first step was to compute descriptive statistics on the variables of interest (see Appendix G, Tables G1, G2, and G3). The next step was to compute two chi-square tests for independence based on participant response and control, and participant response and affiliation. Next, because a model for helpdesk CSFs and problems did not exist, the CSFs and helpdesk problems were factor analyzed to identify composite CSFs and helpdesk problems (see Appendix G, Tables G4, G5, G6,

G7, and G8). Regression analyses were then performed using multiple regression to determine the degree of relationship between CSFs and helpdesk problems using the composite helpdesk problems identified from the factor analysis as dependent variables and the helpdesk CSFs as independent variables. Seven regression models for each composite helpdesk problem were analyzed to determine the relationship between helpdesk CSFs and problems (see Appendix G, Table G7). Several comparisons were performed to determine the relationships between CSFs and the stage of growth of the helpdesk. The next step was to analyze the correlations among the composite helpdesk CSFs and problems in order to provide additional evidence of the relationship between helpdesk CSFs and problems. Finally, ratio analyses were conducted on several variables of interest (see Appendix G, Tables G8, G9, and G10).

Demographic Variables

The final questionnaire was implemented as a multi-part, single instrument online HTML form. The initial 1,765 participants were contacted via email and provided a link to the questionnaire website. Participants were given two weeks between the initial request and subsequent reminder to respond. Additionally, participants were given the option to reply to the email with 'No Thanks' in the subject line. Participants who answered 'No Thanks' were later selected for the chi-square non-response test statistic.

Of the 1,765 emails sent, only 1,718 were useable because of invalid email addresses. A total of 460 (27%) responses were received. A total of 411 (24%) completed the questionnaire and were considered useable. The other 49 (3%) had not completed the questionnaire and had responded with 'No Thanks' in the subject line. Sixty-three (15%) of the 411 respondents indicated that they did not have a helpdesk. The initial number of

responses to the first request to participate was 174 (10%). After the first email reminder was sent, an additional 129 (7%) responses were received. A second reminder was sent four weeks after the initial request. The second reminder netted another 108 (7%) responses.

The Carnegie classification of Institutions of Higher Education, 2000 Edition, third revision classifies all higher education institutions in one of three control categories: a) Public, b) Private - Not for Profit, and c) Private - for Profit. Of the 411 useable responses to this survey, 245 (59.61%) were classified as public control, 161 (39.17%) were classified as private - not for profit control, and 5 (1.22%) were classified as private - for profit control (see Figure 1).

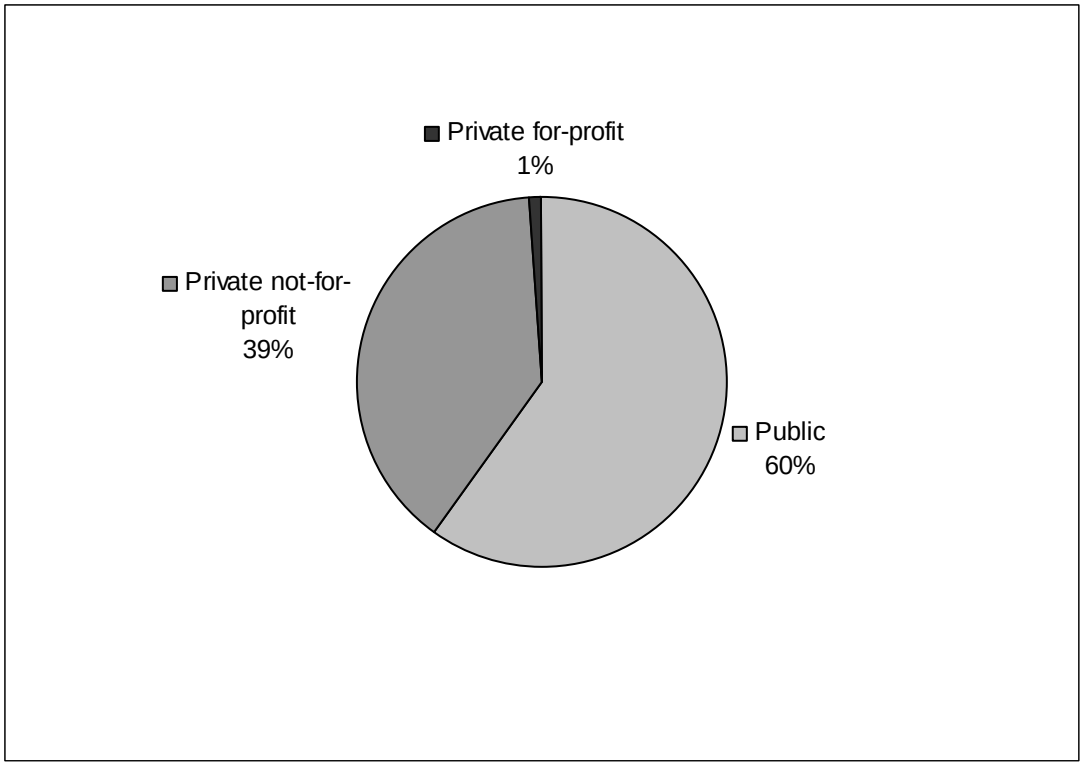

Figure 1. Percentage of Respondents By Control

Table G1 in Appendix G shows the respondents by Carnegie classification. All eighteen classifications are described in the Carnegie classification of Institutions of Higher Education, 2000 Edition, third revision. The most responses, 134 (32.6%), came from Associate's Colleges. The response rate percentages for each Carnegie classification in Table G1 is representative of the population percentages.

Table G2 in Appendix G shows the respondents by State. All 50 States are represented including America Samoa (AS), District of Columbia (DC), Federated States of Micronesia (FM), Guam (GU), Marshall Islands (MH), Northern Marianas (MP), Puerto Rico (PR), Palau (PW), and the Virgin Islands (VI). The most responses came from New York, 28 (6.8%), California, 27 (6.6%), Texas, 26 (6.3%), Pennsylvania, 24 (5.8%), and Illinois, 21 (5.1%).

Questionnaire item number 15 asked participants to choose the one of four descriptions that best indicated the stage of growth of their helpdesk. Of the 411 respondents who answered question 15, 97 (23.6%) classified themselves in stage 1 (Initiation). One hundred forty-seven (35.8%) classified themselves in stage 2 (Expansion). Another 64 (15.6%) classified themselves in stage 3 (Formalization), and only 28 (6.8%) classified themselves in stage 4 (Maturity) (see Figure 2). The remaining 75 responses were either "Don't Know" or no response. Participants were also asked to rate how accurately the stage of growth descriptions defined their current helpdesk using a 6-point Likert scale with 1 = Not Accurate to 5 = Extremely Accurate, and 0 = Don't Know (see Table 3).

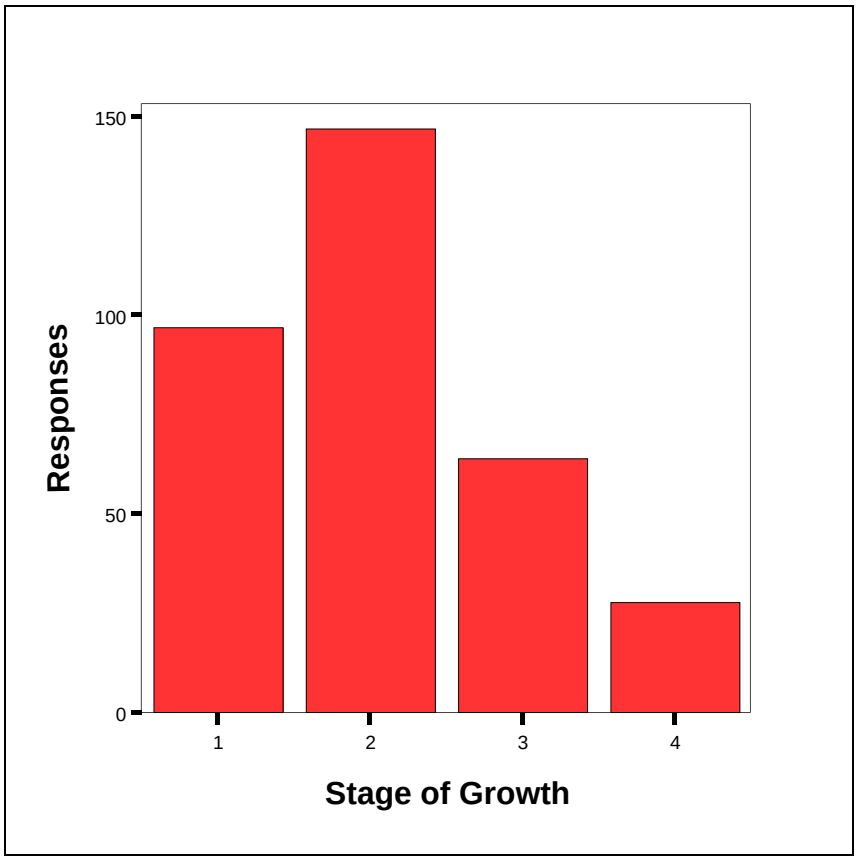

Figure 2. Respondents by Indicated Stage of Growth

Table 3. Descriptive Statistic for Accuracy of Description for Stage of Growth

Question #	Stage of Growth	Mean	Std. Dev.	Min.	Max.
16a	1 - Initiation	2.54	1.336	0	5
16b	2 - Expansion	2.76	1.345	0	5
16c	3 - Formalization	2.11	1.236	0	5
16d	4 - Maturity	1.71	1.174	0	5

Questionnaire item 14 asked participants how their organization's helpdesk came into being. The highest percentage responses were 'Informally grew based on needs' (51%) and 'Internal organization tasked to create helpdesk' (22.9%). The 13 'Other' responses varied from a combination of responses 1 and 4, to complete IT re-organization (see Table 4).

Table 4. Origination of Organization's Helpdesk

Description of Origination	Freq.	%
1 – Informally grew based on needs	180	51.6
2 – Consultants from industry	4	1.1
3 – Followed a model from other higher education institutions	25	7.2
4 – Internal Organization tasked to create helpdesk	80	22.9
5 – Don't Know	47	13.5
0 – Other	13	3.7

Questionnaire item 13 asked participants how long their institution has had a helpdesk. Responses ranged from 0 to 50 years, with an average age of 8.46 years (see Table 5). Fifty-five (16%) respondents indicated that their helpdesk was at least 10 years old. Twenty-seven responses indicated that their helpdesk was at least 18 years old.

Questionnaire item 20 asked participants what the average number of calls to the helpdesk were reported each day. The majority of respondents indicated that their helpdesk received fewer than 200 trouble calls per day, with an average of just over 85 calls (see Table 5).

Questionnaire item 21 asked participants what the average time in minutes to solve the most commonly reported problem (see Table 5). Although the average solution time was 19.35 minutes, several spikes in frequency occurred at the 5, 10, 15, 30, and 60-minute intervals.

Table 5. Descriptive Statistics for Helpdesk Age, Number of Reported Problems and Resolution Time

Question #	Variable	Mean	Std. Dev.	Min.	Max.
13	Helpdesk Age [a]	8.46	5.87	0	50
20	Reported Problems per day	85.03	160.49	0	1500
21	Time to Resolve Problem	19.35	29.81	0	240

[a] One response had an extreme value of 2003. It was not used in this analysis.

Questionnaire items 17, 18, and 19 asked participants how many full-time, part-time, and student helpdesk staff members they have (see Table 6). These results were also used in the ratio analyses for ratios 1, 2, and 3. Professional full-time staff are those staff members hired specifically for helpdesk support working at least 40 hours per week. Part-time staff are those staff members working less than 40 hours per week on the helpdesk. Student helpdesk staff are those who work either part-time or full-time on the helpdesk and are students at the institution. There were 18 extreme outliers greater than 11 full-time professional helpdesk staff. There were 16 extreme outliers greater than 5 part-time professional helpdesk staff. There were 29 extreme outliers greater than 25 student helpdesk staff. The majority of responses used a combination of full-time professionals and student helpdesk staff.

Table 6. Descriptive Statistics for Number of Full-time Staff, Part-time Staff, and Student Staff

Question #	Variable	Mean	Std. Dev.	Min.	Max.
17	Number of Professional Full-time Helpdesk Staff	4.20	6.05	0	60
18	Number of Professional Part-time Helpdesk Staff	1.11	2.13	0	80
19	Number of Part-time and Full-time Student Helpdesk Staff	7.90	11.99	0	80

Chi-square Tests

The chi-square test for independence between categorical variables "Responded" and "Control" tested whether there was any significance between the participants who responded and those who did not respond based on their control; public, private not-for-profit, and private for-profit. The significance level of .101 is larger than the alpha level .05, therefore not significant (see Table 7). This means that the proportion of participants that responded is not significantly different to participants that did not respond.

Table 7. Chi-square Test for Responded and Control

Test	Value	Df	Significance (2-sided)
Pearson Chi-Square	4.590[a]	2	.101*
N of Valid Cases	1718		

[a] 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.39.

* $p < .05$

The chi-square test for independence between categorical variables "Responded" and "Carnegie Classification" tested whether there was any significance between the

participants who responded and those who did not respond based on their Carnegie classification. The chi-square test using all 18 Carnegie classifications resulted in 9 classifications having expected counts less than five. The significance level of .107 is larger than the alpha level .05, therefore not significant (see Table 8). This means that the proportion of participants that responded is not significantly different to participants that did not respond.

Table 8. Chi-square Test for Responded and Carnegie Classification

Test	Value	df	Significance (2-sided)
Pearson Chi-Square	24.475[a]	17	.107*
N of Valid Cases	1718		

[a] 9 cells (25.0%) have expected count less than 5. The minimum expected count is .72.

* $p < .05$

Helpdesk Problems

Helpdesk managers were asked to indicate on a six-point Likert scale (1 = Not Concerned to 5 = Extremely Concerned, and 0 = Don't Know) the extent to which they were concerned with each helpdesk problem. Table G3 in Appendix G shows the mean scores and standard deviations of the 33 items. Lack of Adequate Helpdesk Staff Training, Increasing IT Costs, End-user Dissatisfaction, and Incorrect Solutions were the top problems identified by the helpdesk managers with means of 3.60, 3.59, 3.59, and 3.55, respectively. In contrast, helpdesk managers indicated that academic departments wanting their own helpdesk technician was the least of their concerns, with a mean of 1.98.

Critical Success Factors

Helpdesk managers were asked to indicate on a six-point Likert scale (1 = Not Important to 5 = Extremely Important, and 0 = Don't Know) the extent of importance that each item had on the success of their helpdesk organization. Table G4 in Appendix G shows the mean scores and standard deviations of the 33 items. Helpdesk managers indicated that Full-time Professional Staff, Interdepartmental Communications, Organizational and Management Support of the Helpdesk, Job Satisfaction, and a Centralized Helpdesk Structure were the most important factors to the success of their helpdesk, with means of 4.69, 4.39, 4.37, 4.29, and 4.23, respectively. In contrast, Outsourcing the Helpdesk was at the bottom, with a mean score of 1.40.

Principal Component Analysis

A preliminary principal component analysis (PCA) of helpdesk problems was performed on the data followed by a varimax (orthogonal) rotation to determine which linear components of the 33 helpdesk problems might contribute to identifying composite factors. The Pearson correlation coefficient matrix (R-Matrix) and one-tailed significance table did not indicate any singularity of data (Field, 2000). The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA) for all variables was .903, which indicated that patterns of correlation were relatively compact and that factor analysis should yield distinct and reliable factors. Bartlett's Test of Sphericity checks the null hypothesis that the original correlation matrix is an identity matrix (no relationship between variables). Bartlett's Test of Sphericity had a significance of $p<.001$, which is highly significant and therefore factor analysis is appropriate. Problem 7D ambiguously loaded on four factors. Based on the preliminary PCA results, question 7D was

eliminated from factor analysis but retained for individual analysis. This initial PCA revealed seven factors satisfying the minimum eigenvalue criterion of 1.0 (see Appendix G, Table G5).

Thirty out of the remaining 32 helpdesk problems loaded unambiguously on seven factors (i.e. with one loading of 0.5 and no other loadings greater than 0.4). Two problems, 7F and 5F, had primary loading coefficients of less than 0.5 but greater than 0.4. No composite helpdesk problems had secondary loadings (greater than 0.4 but lower than 0.5). Based on the same reasoning as Magal, Simha, Carr, Houston, and Watson (1988), and Guimaraes, Gupta, and Rainer (1999), the absence of evidence indicating that the two composite helpdesk problems are not important and because this instrument was previously untested, eliminating them from further analysis is not appropriate. Helpdesk problems 7F and 5F were assigned to the factor on which they loaded the highest (see Appendix G, Table G5).

Cronbach's alpha reliability coefficient ranged from .691 for Departmental Support Specialist (Factor 7) to .853 for User Satisfaction and Support (Factor 1). The Cronbach's alpha coefficients for each factor were considered acceptable.

The seven composite helpdesk problems explained 63.8% of the total variance. Table 9 lists each helpdesk problem composite factor, a descriptive name, eigenvalue, percent of explained variance, mean value, and Cronbach alpha. The composite factors are listed in highest eigenvalue and explained variance order. Each helpdesk problem that contributed to the composite factor is listed in highest loading order. The following descriptive names were assigned to each factor after considering each contributing helpdesk problem:

1. Factor 1 - User Satisfaction and Support
2. Factor 2 – Helpdesk Staff Training and Retention
3. Factor 3 – IT Cost & Budget
4. Factor 4 – Technology Gap
5. Factor 5 – Support Call Number and Complexity
6. Factor 6 – Campus Network Availability
7. Factor 7 – Departmental Support Specialist

Table 9. Helpdesk Problems Comprising the Seven Factors

Factor 1: User Satisfaction and Support (eigenvalue = 3.394, percent variance = 10.607, mean = 3.33, α = .853)			
Problem #	**Item Description**	**Mean**	**Loading**
2B	Incorrect problem solutions	3.55	.833
2A	Users dissatisfied with helpdesk	3.56	.809
2C	Users unclear where to get support	3.40	.766
2D	Users trying to fix their own computers	2.81	.661
Factor 2: Helpdesk Staff Training and Retention (eigenvalue = 3.279, percent variance = 10.246, mean = 2.99, α = .839)			
Problem #	**Item Description**	**Mean**	**Loading**
3F	Difficulty recruiting quality helpdesk staff	2.94	.741
3E	Student analyst helpdesk staff unreliable	2.59	.738

Table 9 *(continued)*. Helpdesk Problems Comprising the Seven Factors.

Problem #	Item Description	Mean	Loading
3D	Helpdesk staff not adequately trained	2.97	.719
3A	Lack of adequate helpdesk staff	3.60	.574
3C	Lack of adequate information for helpdesk staff to solve problem	3.09	.551
3B	Multiple helpdesk staff needed to resolve problem	2.72	.504
Factor 3: IT Cost & Budget (eigenvalue = 3.224, percent variance = 10.075, mean = 3.13, α = .824)			
Problem #	**Item Description**	**Mean**	**Loading**
7A	Decreasing IT budget	3.39	.784
7B	Increasing IT costs	3.59	.782
7C	Helpdesk cannot purchase latest technology	2.74	.747
7E	The Institution is not changing to meet growth of IT	3.15	.707
7F	Negative publicity on helpdesk	2.77	.416
Factor 4: Technology Gap (eigenvalue = 2.936, percent variance = 9.175, mean = 2.47, α = .847)			
Problem #	**Item Description**	**Mean**	**Loading**
4G	Heterogeneous hardware	2.52	.707
5E	Heterogeneous software	2.57	.671
4F	Increasing demands for hardware upgrades	2.48	.591

Table 9 *(continued)*. Helpdesk Problems Comprising the Seven Factors.

Problem #	Item Description	Mean	Loading
5D	Increasing demand for software upgrades	2.55	.545
4E	Computer hardware too slow	2.22	.538
Factor 5: Support Call Number and Complexity (eigenvalue = 2.679, percent variance = 8.372, mean = 2.99, α = .823)			
Problem #	**Item Description**	**Mean**	**Loading**
4C	Increasing number of calls	3.15	.696
4D	Increasing complexity of calls	3.12	.670
4B	Calls for same problem	2.97	.633
4A	Dropped Calls	2.72	.597
Factor 6: Campus Network Availability (eigenvalue = 2.616, percent variance = 8.175, mean = 2.26, α = .739)			
Problem #	**Item Description**	**Mean**	**Loading**
5A	Increasing complaints that Internet access is slow	2.24	.761
5B	Unreliable connection to university resources	2.13	.758
5C	Computer software too difficult to use	2.25	.546
5F	Call tracking system inadequate or non-existent	2.41	.454

Table 9 *(continued)*. Helpdesk Problems Comprising the Seven Factors.

Factor 7: Departmental Support Specialist (eigenvalue =2.302, percent variance = 7.193, mean = 2.61, α = .691)			
Problem #	**Item Description**	**Mean**	**Loading**
6D	Growing demand for support off campus	2.90	.661
6A	Academic departments want their own helpdesk technician	1.98	.650
6B	Faculty and staff pulling helpdesk technician away from other helpdesk duties	2.29	.621
6C	Growing demand for support on campus	3.28	.592

Note: Problem # refers to Helpdesk numbers in Table G3.

α shows the reliability coefficient values (Cronbach alpha)

A preliminary principal component analysis (PCA) of CSFs was performed on the data followed by a varimax (orthogonal) rotation to determine which linear components of the 33 CSFs might contribute to identifying composite factors. The Pearson correlation coefficient matrix (R-Matrix) and one-tailed significance table indicated that question 10C and 10D might suffer from singularity of data (Field, 2000). Additionally, the correlation coefficient matrix determinant was .00001163, which was barely higher than the required value of .00001. Closer examination of questions 10C and 10D revealed that these questions dealt with standardization of hardware and software. It is possible that respondents may have considered the two inseparable. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA) for all variables was .842, which indicated that

patterns of correlation were relatively compact and that factor analysis should yield distinct and reliable factors. However, the KMO MSA for individual variables 9A, 10C, and 10D were .683, .659 and .655 respectively. Generally, values between .5 and .7 are mediocre. Bartlett's Test of Sphericity checks the null hypothesis that the original correlation matrix is an identity matrix (no relationship between variables). Bartlett's Test of Sphericity had a significance of $p<.001$, which is highly significant and therefore factor analysis is appropriate. Based on the preliminary PCA results, questions 9A and 10D were eliminated from factor analysis but retained for individual analysis.

A second PCA was computed without question 9A and 10D. The Pearson correlation coefficient matrix (R-Matrix) and one-tailed significance table showed no singularity of data. Additionally, the correlation coefficient matrix determinant went up from .00001163, which was barely higher than the required value of .00001, to .0009284, which is much higher than the minimum required. The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA) for all variables was .863, which indicated that patterns of correlation are relatively compact and so factor analysis should yield distinct and reliable factors. Bartlett's Test of Sphericity checks the null hypothesis that the original correlation matrix is an identity matrix (no relationship between variables). Bartlett's Test of Sphericity had a significance of $p<.001$, which is highly significant and therefore factor analysis is appropriate. This second PCA revealed seven factors satisfying the minimum eigenvalue criterion of 1.0 (see Appendix G, Table G6).

Twenty out of the remaining 31 CSFs loaded unambiguously on seven factors (i.e. with one loading of 0.5 and no other loadings greater than 0.4). Seven CSFs, 9B, 8B, 10F, 11C, 12A, 12D, and12E, had primary loading coefficients of less than 0.5 but

greater than 0.4. One CSF, 8F, had secondary loadings of greater than 0.4 but lower than 0.5. Based on the same reasoning as Magal, Simha, Carr, Houston, and Watson (1988), and Guimaraes, Gupta, and Rainer (1999), the absence of evidence indicating that the eight CSFs are not important and because this instrument was previously untested, eliminating them from further analysis is not appropriate. CSFs 9B, 8B, 10F, 11C, 12A, 12D, and 12E were assigned to the factor on which they loaded the highest (see Appendix G, Table G6).

Cronbach's alpha reliability coefficient ranged from .499 for Helpdesk Support Availability (Factor 6) to .782 for Helpdesk Tools and Performance Metrics (Factor 2). The Cronbach's alpha for factor 6 was considered close enough to the minimum of .50 when used in previously untested survey instruments (Magal, Carr, & Watson 1988). The Cronbach's alpha coefficients for each factor were considered acceptable.

The seven composite CSFs explained 52.7% of the total variance. Table 10 lists each CSF composite factor, a descriptive name, eigenvalue, percent of explained variance, mean value, and Cronbach alpha. The composite factors are listed in highest eigenvalue and explained variance order. Each CSF that contributed to the composite factor is listed in highest loading order. The following descriptive names were assigned to each factor after considering each contributing CSF:

1. Factor 1 - Helpdesk Organization and Professionalism
2. Factor 2 - Helpdesk Tools and Performance Metrics
3. Factor 3 – IT Standards and Control
4. Factor 4 - Helpdesk Structure
5. Factor 5 - Helpdesk Implementation and Operation Costs

6. Factor 6 - Helpdesk Support Availability

7. Factor 7 - Contract Support.

Table 10. Helpdesk CSFs Comprising the Seven Factors

Factor 1: Helpdesk Organization and Professionalism (eigenvalue = 3.159, percent variance = 10.191, mean = 4.28, α = .721)

CSF #	Item Description	Mean	Loading
9G	Job Satisfaction	4.29	.698
12B	Definition of Helpdesk Mission Statement	3.68	.631
12F	Communications among all departments	4.39	.622
11D	Organizational & Management Support of Helpdesk	4.37	.582
9B	Staff – Professional Full-time	4.69	.418

Factor 2: Helpdesk Tools and Performance Metrics (eigenvalue = 3.014, percent variance = 9.722, mean = 3.45, α = .785)

CSF #	Item Description	Mean	Loading
10G	Call-tracking Software	4.12	.644
10H	Automatic Call Distribution System (ACD)	2.70	.636
10B	Helpdesk Performance Measurement	4.02	.601
10A	Customer Satisfaction Measurement	4.12	.558
11B	Promotion & Marketing of Helpdesk	3.20	.519

Table 10 *(continued)*. Helpdesk CSFs Comprising the Seven Factors

CSF #	Item Description	Mean	Loading
9E	Helpdesk Analyst Training	3.61	.517
8A	24X7 Support	2.45	.515
8B	Web-based FAQ Support	3.49	.440
Factor 3: IT Standards and Control (eigenvalue = 2.333, percent variance = 7.526, mean = 3.60, α = .652)			
CSF #	**Item Description**	**Mean**	**Loading**
10C	Standardized Hardware	4.06	.721
10E	Commercial-off-the-shelf Solutions (COTS)	3.22	.687
9F	End-user Training	4.07	.562
10F	Open Source Solutions	2.66	.497
11C	Control Procedures to Ensure Security	4.01	.412
Factor 4: Helpdesk Structure (eigenvalue = 2.315, percent variance = 7.468, mean = 1.92, α = .710)			
CSF #	**Item Description**	**Mean**	**Loading**
8G	Decentralized Helpdesk	1.76	.787
8H	Distributed Helpdesk	2.07	.764

Table 10 *(continued)*. Helpdesk CSFs Comprising the Seven Factors

Factor 5: Helpdesk Implementation and Operation Costs (eigenvalue = 2.073, percent variance = 6.689, mean = 2.36, α = .634)			
CSF #	**Item Description**	**Mean**	**Loading**
11A	Costs of Services to end users (charge back)	1.75	.646
12C	Advisory Committees	2.68	.595
12D	Service Level Agreements (SLA)	2.93	.462
12A	Reengineer IT Support	3.03	.433
12E	Outsourcing Helpdesk	1.40	.385

Factor 6: Helpdesk Support Availability (eigenvalue = 1.869, percent variance = 6.028, mean = 3.88, α = .499)			
CSF #	**Item Description**	**Mean**	**Loading**
8D	Email Support	4.13	.589
8C	Walk-in Support	3.68	.580
8E	Multitiered helpdesk	3.47	.547
8F	Centralized Helpdesk	4.23	.479

Factor 7: Contract Support (eigenvalue =1.597, percent variance = 5.152, mean = 2.61, α = .550)			
CSF #	**Item Description**	**Mean**	**Loading**

Table 10 *(continued)*. Helpdesk CSFs Comprising the Seven Factors

CSF #	Item Description	Mean	Loading
9C	Subject Matter Experts (SME)	3.60	.633
9D	Vendor Support	3.22	.624

Note: CSF # refers to CSF numbers in Table G4.

α shows the reliability coefficient values (Cronbach alpha)

Stage of Growth MANOVA Results

A one-way between-groups MANOVA was performed to investigate whether the composite helpdesk CSFs vary with the stages of growth (see Table 11). The dependent variables used were the seven CSFs as described in Table 10. The independent variable was stage of growth with values of 1, 2, 3, and 4 respectively.

Table 11. Mean Values of the Seven Composite CSF Scores for the Four Stages of Growth and Overall Means

Composite CSFs	Stage of Growth				
	1	2	3	4	All
Helpdesk Organization and Professionalism	4.1	4.3	4.4	4.3	4.3
Helpdesk Tools and Performance Metrics	3.1	3.4	3.6	3.9	3.4
IT Standards and Control	3.5	3.6	3.7	3.5	3.6
Helpdesk Structure	1.7	1.9	1.9	3.0	1.9
Helpdesk Implementation and Operation Costs	2.1	2.4	2.4	2.6	2.4
Helpdesk Support Availability	3.7	3.8	4.2	4.1	3.9
Contract Support	3.1	3.4	3.5	3.5	3.4

Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity. Box's Test of Equality of Covariance Matrices was significant at $p<.05$ suggesting that homogeneity was not met. However, the sample sizes for the grouping variable 'Stage of Growth' are small and significant differences should be treated with caution, and violation of this assumption is unclear (Field, 2000). The results indicated that there was a statistically significant difference among the stages of growth on the composite helpdesk CSFs: $F(7, 288) = 6.90$, $p < .001$; Wilks' Lambda = .79; partial eta squared (η^2) = .144 (see Appendix G, Table G7). When results for the composite CSFs (dependent variables) were considered separately, the only differences to reach statistical significance using a Bonferroni adjusted alpha level of .007, was: (a) Helpdesk Organization and Professionalism, $F(3, 292) = 4.52$, $p = .004$, partial eta squared (η^2) = .044; (b) Helpdesk Tools and Performance Metrics, $F(3, 292) = 7.81$, $p < .001$, partial eta squared (η^2) = .074; (c) Helpdesk Structure, $F(3, 292) = 9.84$, $p < .001$, partial eta squared (η^2) = .092; and (d) Helpdesk Support Availability, $F(3, 292) = 6.11$, $p < .001$, partial eta squared (η^2) = .059 (see Appendix G, Table G7).Additionally, the error sums of squares and cross-product matrix ($SSCP_E$) are substantially bigger than the model sums of squares and cross-product matrix ($SSCP_{M)}$. This suggests that the relationships between the helpdesk CSFs are more important in MANOVA significance rather than the individual CSFs. Field (2000) recommended that a significant MANOVA should be followed up with discriminant analysis to investigate the nature of the relationships between helpdesk CSFs. The stage of growth variate for stage 4 was not significant and had $n < 30$, so it was not reported in Table 12 and Table 13.

The standardized canonical discriminant function coefficients (see Table 12) indicated the relative contribution of each variable to the stage of growth. Helpdesk Structure and Helpdesk Tools and Performance Metrics contributed the most in stage of growth 1 (Initiation), .707 and .550 respectively. In contrast, IT Standards and Control had a negative contribution to stage of growth 1 (Initiation).

Table 12. Standardized Canonical Discriminant Function Coefficients

Composite CSF	Stage Of Growth[a]		
	1	2	3
Helpdesk Organization and Professionalism	.017	.243	.687
Helpdesk Tools and Performance Metrics	.550	.173	-.108
IT Standards and Control	-.493	.347	-.187
Helpdesk Structure	.707	-.543	-.146
Helpdesk Implementation and Operation Costs	-.024	-.065	.492
Helpdesk Support Availability	.335	.554	-.715
Contract Support	-.087	.074	.291

[a] Stage of Growth value 4 excluded because n < 30 and it is not significant.

The canonical variate correlation coefficients in the structure matrix (see Table 13) provided another way at looking at the relationship between helpdesk CSFs and stage of growth. High correlations, indicated by superscript 'b' in Table 13, represent the relative contribution of each dependent variable (CSF) to group separation (stage of growth) (Field, 2000).

Table 13. Structure Matrix

Composite CSF	Stage of Growth[a] 1	2	3
Helpdesk Structure	.755 [b]	-.318	.048
Helpdesk Tools and Performance Metrics	.628 [b]	.466	.296
Helpdesk Support Availability	.415	.750 [b]	-.361
IT Standards and Control	-.016	.519 [b]	.070
Helpdesk Organization and Professionalism	.324	.587	.611 [b]
Helpdesk Implementation and Operation Costs	.348	.274	.489 [b]
Contract Support	.270	.340	.457 [b]

Note: Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions. Variables ordered by absolute size of correlation within function.

[a] Stage of Growth value 4 excluded because n < 30 and it is not significant.

[b] Largest absolute correlation between each variable and any discriminant function

Regression Results

One goal of this study was to identify the relationships between composite CSFs and helpdesk problems, composite helpdesk problems and helpdesk structure, composite helpdesk problems and helpdesk acceptance, composite helpdesk problems and end-user training, and composite helpdesk problems and helpdesk staff training. In order to examine these relationships, correlation analysis was used to describe the strength and direction between variables (Field, 2000; Pallant, 2001). Specifically, Pearson product-moment correlation coefficient (*r)* was used as the test statistic.

Helpdesk Organization and Professionalism exhibited significant positive relationship with composite helpdesk problems User Satisfaction and Support (see Appendix G, Table G7). Additionally, the Helpdesk Organization and Professionalism CSF correlated significantly and positively with all composite helpdesk problems (see Table 14).

Helpdesk Tools and Performance Metrics did not have significant relationships with any composite helpdesk problems (see Appendix G, Table G7). However, the Helpdesk Tools and Performance Metrics CSF correlated significantly and positively with all composite helpdesk problems (see Table 14).

IT Standards and Control exhibited significant positive relationship with composite helpdesk problem Technology Gap (see Appendix G, Table G7). Additionally, the IT Standards and Control CSF correlated significantly and positively with all composite helpdesk problems except Campus Network Availability (see Table 14).

Helpdesk Structure exhibited significant positive relationship with composite helpdesk problems User Satisfaction and Support and Departmental Support Specialist (see Appendix G, Table G7). Additionally, the Helpdesk Structure CSF correlated significantly and positively with all composite helpdesk problems except Helpdesk Staff Training and Retention (see Table 14).

Helpdesk Implementation and Operation Costs exhibited significant positive relationship with composite helpdesk problems Helpdesk Staff Training and Retention, IT Cost & Budget, Technology Gap, Campus Network Availability, and Departmental Support Specialist (see Appendix G, Table G7). Additionally, the Helpdesk

Implementation and Operation Costs CSF correlated significantly and positively with all composite helpdesk problems (see Table 14).

Helpdesk Support Availability exhibited significant positive relationship with composite helpdesk problems Support Call Number and Complexity and Departmental Support Specialist (see Appendix G, Table G7). Additionally, the Helpdesk Support Availability CSF correlated significantly and positively with all composite helpdesk problems except User Satisfaction and Support (see Table 14).

Contract Support did not exhibit any significant relationships with composite helpdesk problems (see Appendix G, Table G7). However, the Contract Support CSF correlated significantly and positively with composite helpdesk problems Campus Network Availability, and Departmental Support Specialist (see Table 14).

Table 15 presents the results of the correlation analysis between composite helpdesk problems and how much of each training method was received by the end-user. According to Cohen (1988), *r* values between ± .10 and ±.29 are considered small, *r* values between ±.30 and ±.49 are considered medium, and *r* values between ±.50 and ±1.0 are considered large. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity, and homoscedasticity.

There was a small, positive correlation between the amount of FAQ training and all composite helpdesk problems except IT Cost & Budget and Technology Gap. There was a small, positive correlation (.10) between the amount of Documentation & Manuals training and the composite helpdesk problem Support Call Number and Complexity. Additionally, there were small, positive correlations (.10 and .01 respectively) between the composite helpdesk problem Technology Gap and the amount of Formal Classroom

Instruction training, and Technology Gap and Vendor Training & Certification. There was a small, positive correlation (.17) between the amount of Formal Classroom Instruction training and composite helpdesk problem Support Call Number and Complexity. Finally, there was a small, positive correlation (.12) between Vendor Training & Certification and helpdesk problem Campus Network Availability.

Table 16 presents the results of the correlation analysis between composite helpdesk problems and how much of each training method was received by the helpdesk staff. According to Cohen (1988), *r* values between ± .10 and ±.29 are considered small, *r* values between ±.30 and ±.49 are considered medium, and *r* values between ±.50 and ±1.0 are considered large. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity, and homoscedasticity.

There was a small, positive correlation (.09) between the amount of FAQ training and composite helpdesk problem User Satisfaction and Support. There was a small, positive correlation (.13) between the amount of Documentation & Manuals training and composite helpdesk problem Departmental Support Specialist. Computer Based Training negatively correlated with composite helpdesk problems Helpdesk Staff Training and Retention and IT Cost & Budget (-.11 and -.12, respectively). There was a small, positive correlation (.09) between the amount of Professional Organizational Seminars training and composite helpdesk problem Technology Gap. There was a small, negative correlation (-.09) between the amount of Formal Classroom Instruction training and composite helpdesk problem Staff. Finally, there was a small, negative correlation (-.11) between the amount of Vendor Training & Certification training and composite helpdesk problem IT Cost & Budget.

Table 14. Correlations Among Composite CSFs and Helpdesk Problems Variables

Composite CSFs	Composite Helpdesk Problems						
	User Satisfaction and Support	Helpdesk Staff Training and Retention	IT Cost & Budget	Technology	Support Call Number and Complexity	Resource Availability	Departmental Support Specialist
Recognition of Helpdesk	.21 **	.12*	.17*	.16*	.26**	.16*	.22**
Performance Metrics	.17 †	.13*	.14*	.16*	.28**	.17†	.22**
IT Standards and Control	.14 *	.11*	.15*	.24**	.16*	.09	.15*
Helpdesk Structure	.19 **	.07	.10*	.14*	.15*	.15*	.22**
Helpdesk Implementation and Operation Costs	.22 **	.22**	.23**	.28**	.26**	.23**	.28**
Helpdesk Support Availability	.07	.12*	.15*	.12*	.25**	.10*	.23**
Contract Support	.08	.06	.09	.07	.09	.10*	.15*

*$p < .05$. **$p < .001$. †$p = .001$.

Table 15. Correlation Results Among Helpdesk Problems and End-User Training

	Composite Helpdesk Problems						
Type of Training	User Satisfaction and Support	Helpdesk Staff Training and Retention	IT Cost & Budget	Technology	Support Call Number and Complexity	Resource Availability	Departmental Support Specialist
FAQs	.13*	.11*	-.004	.05	.16*	.04	.16*
Documentation & Manuals	.07	.01	-.008	.006	.10*	.01	.02
Computer Based Training (CBT)	-.02	.04	-.05	.02	.03	.02	.03
Professional Organizational Seminars	.001	-.01	.02	.06	.003	.05	.06
Formal Classroom Instruction	.06	.03	.002	.10*	.17*	.04	.08
Vendor Training & Certification	.05	.03	.001	.01*	.05	.12*	-.06

*$p < .05$.

Table 16. Correlation Results between Helpdesk Problems and Staff Training

	Composite Helpdesk Problems						
Type of Training	User Satisfaction and Support	Helpdesk Staff Training and Retention	IT Cost & Budget	Technology	Support Call Number and Complexity	Resource Availability	Departmental Support Specialist
FAQs	.09*	-.07	-.03	-.06	.09	-.09	.07
Documentation & Manuals	.08	-.05	-.003	.02	.07	-.02	.13*
Computer Based Training (CBT)	.01	-.11*	-.12*	-.03	.005	-.05	.02
Professional Organizational Seminars	.02	-.04	-.06	.09*	.06	.02	.08
Formal Classroom Instruction	.004	-.09*	-.08	-.002	.03	-.07	.01
Vendor Training & Certification	-.02	-.08	-.11*	.01	.03	-.04	.05

*$p < .05$.

Ratio Analyses

The average full-time equivalent (FTE) enrollment was computed from all survey respondents in all Carnegie classifications. FTE enrollment ranged from a minimum of 150 to a maximum of 114,327 (state college system). Ratios 1, 2, and 3 provide an overall average of the number of FTE students per the arithmetic mean of the indicated helpdesk staff (see Table 17). The number of trouble calls per day, Ratio 4, is the arithmetic mean of all respondents from all Carnegie classifications.

There are 18 Carnegie classifications from the Carnegie classification of Institutions of Higher Education, 2000 Edition, third revision. All specialized institutions, those with Carnegie classifications from 51 to 59, and Tribal Colleges and Universities, Carnegie classification of 60, were grouped together because there were only 28 (6.81%) responses across nine specialized institutions, and 1 (.24%) response for Tribal institutions. Appendix G Table G8, Table G9, and Table G10 show the nine Carnegie classifications for Full-time Helpdesk Staff, Number of Trouble Calls, and Average Problem Resolution Time ratios.

Table 17. Ratio Analyses

Question #	Description	Means	Ratio
	Ratio 1		
Q17	Number of FTE Students / Full-Time Professional Helpdesk Staff	7787[a] / 4.20	1854
	Ratio 2		
Q18	Number of FTE Students / Part-Time Professional Helpdesk Staff	7787[a] / 1.11	7015

Table 17 *(continued)*. Ratio Analyses

Question #	Description	Means	Ratio
	Ratio 3		
Q19	Number of FTE Students / Student Helpdesk Staff	7787[a] / 7.90	986
	Ratio 4		
Q20 / Q17,Q18,Q19	Number of Trouble Calls per day / All Helpdesk Staff	85.03 / 4.44	19.15

[a] Average of all respondents from all Carnegie classifications

Overall End-user Satisfaction Result

Questionnaire item 24 asked respondents what they believed was the overall end-user satisfaction of the institution's helpdesk. Of the 411 respondents who answered question 24, 49 (11.9%) responded as 'Excellent', 174 (42.3%) responded as 'Very good', 148 (36%) responded as 'Good', 26 (6.3%) responded as 'Not so good', and 8 (1.9%) responded with 'Don't Know'. No respondents answered as 'Poor'.

Summary

Chapter 4 presented a summary of the results for this study. This study developed a valid and reliable survey instrument to identify composite factors for helpdesk critical success factors and helpdesk problems. Descriptive statistics were computed and presented for the variables of interest, including Carnegie classification, higher education control, State, helpdesk age, number of reported problems per day, problem resolution time, and the number of full-time, part-time, and student staff. Two Chi-square tests for independence were computed and presented between categorical variables "Responded

and “Control”, and “Responded” and “Carnegie Classification”. Two tables presented the mean importance of the helpdesk CSFs and problems. A principle component analysis (PCA) was computed and presented for the 33 helpdesk problem and 33 CSFs, resulting in seven composite helpdesk problem factors, and seven composite CSFs. Cronbach’s alpha coefficient supported the reliability of the survey instrument’s composite factors. Multiple regression was used to analyze the relationship between CSFs and helpdesk problems. Seven regression models for each composite helpdesk problem were computed and presented in four tables. A MANOVA was computed and presented the relationship between composite helpdesk problems and the stage of growth. Additionally, seven ratios were developed and presented in four tables using average FTE and Carnegie classifications. The data analysis answered the eight research questions, and tested the eight hypotheses. Chapter 5 will discuss the results of this study and evaluate their implications with respect to the research questions and hypotheses.

Chapter 5

Conclusions

Introduction

In this study the researcher stated two goals. The first goal was to identify the critical success factors (CSF) for the higher education academic helpdesk manager. The second goal was to assess the relationships of CSFs to problems associated with end-user satisfaction levels within higher education. The outcomes for this study included the relationships between helpdesk CSFs and academic helpdesk problems. These relationships provided information that higher education helpdesk managers can use to monitor and improve performance and provide measures in assessing progress towards overall goals and objectives. There were eight research questions and eight hypotheses stated in Chapter 1.

Chapter 5 is organized to provide the reader quick access to the results of this study. This chapter contains the following sections: (a) Implications, (b) Practical Applications of the Findings, (c) Recommendations, (d) Constraints and Limitations of This Study, and (e) Contributions to the Field of Study and Advancement of Knowledge. The Implications section discusses the logical relations between the stated problems and hypotheses, and the significance of the proposition. Within the Implications section, each conclusion is clearly defined with the heading labeled *Conclusion* followed by a number. The *Practical Applications of the Findings* section discusses some potential benefits of

this study and how they benefit both the end-user and helpdesk staff. The *Recommendations* section is organized in two sub-sections and offers several recommendations for helpdesk practitioners and future research. The *Constraints and Limitations* section extends the suggestions for future research by providing details of the scope of this study and insight into problems encountered. The *Contributions to the Field of Study and Advancement of Knowledge* section is a suggestion of how this study may be useful to other areas outside of academic helpdesks. Finally, Table 20 summarizes the hypotheses results.

Implications

The Typical Helpdesk

A helpdesk is a generic name associated with the end-user support center, both internal and external, that is seen as an integral part of the support function responsible for multiple resources to solve technical issues to the end-user's satisfaction (Verghis, 2003). The accuracy of this description varies with the age of the helpdesk and the institution's needs. The majority of respondents indicated that their helpdesks were in the initiation (23.6%) and expansion (35.8%) stage (see Figure 2). These two stages are characterized by unplanned growth and ad-hoc solutions, with no formal budget and recognition in the organization's hierarchy.

The majority of respondents (85%) indicated that their institution had a helpdesk in the process of expanding (35.8%), and that they felt that end-user satisfaction was very good (42.3%). Most respondents (51.6%) indicated that they implemented a helpdesk based on needs of the end-users. The average age of the helpdesk is just over 8 years old,

and responds to an average of 85 problems a day in just over 19 minutes per problem. The typical academic helpdesk is staffed by a combination of professional full-time staff (4.2) and part-time students (7.9). Researchers and practitioners have noted that a helpdesk must change to meet the demands of the end users' needs, and that as new problems arise so too does the importance of critical success factors.

Demographic Variables

The survey results provided data on the location of the higher education institutions, the Carnegie classification, and organizational control. Tables G1 and G2 in Appendix G list each Carnegie classification and state, respectively. The most responses came from public institutions (60%) and associates colleges (32.6%). These percentages are slightly higher than the population from Higher Education Publications, Incorporated 2003 Higher education directory. This is to be expected given the increase in unemployment and that many adults were returning to college. This puts pressure on academic and administrative departments to cope with an influx of new students.

All geographic areas are well represented with most responses coming from New York (6.81%), California (6.57%), Texas (6.33%), and Pennsylvania (5.84%). These percentages are consistent with the population from Higher Education Publications, Incorporated 2003 Higher education directory.

The target population was managers of academic IT helpdesks. Two Chi-square tests were performed to determine whether non-respondents differed significantly with respect to 'Control' and 'Carnegie classification' (see Table 7 and Table 8).

Conclusion 1.

It is concluded that since there was no significant difference between respondents and non-respondents based on 'Control' and 'Carnegie classification', all responses were retained in this study, and are referred to as respondents in the following discussions.

Composite Helpdesk Critical Success Factors

Research question 1 asked what are the CSFs for an academic helpdesk. Critical success factors are defined as the few key areas of activity in which favorable results are absolutely necessary for managers to reach their goals (Bullen & Rockart, 1981). These are the factors that helpdesk managers should focus on. Respondents were asked to evaluate the importance of 33 items as potential CSFs for their helpdesk organization. The five items judged to be the most important were Full-time Professional Staff, Interdepartmental Communications, Organizational and Management Support of the Helpdesk, Job Satisfaction, and a Centralized Helpdesk Structure (see Appendix G, Table G4). Nearly all of the 33 CSFs appear to be important, but those at the top of the list with the highest mean value deserve the most analysis by helpdesk managers. Nine of the 33 CSFs have mean values less than 3.0 (midpoint of the 6-point Likert scale), suggesting that helpdesk managers did not find these factors to be too important. Additionally, the organization's stage of growth suggests that these helpdesks are not mature enough to address these factors.

However, 33 CSFs are a considerable number of factors for any helpdesk manager to concentrate on. Some CSFs correlated with other CSFs forming clusters of variables suggesting an underlying dimension known as factors (Field, 2000). Factor analysis was used to reduce the 33 CSFs into seven composite CSFs, which is a much

more manageable number of factors. Each composite CSF was then named after considering the individual items that had the highest factor loading (see Table 10). Not all of the individual CSFs were used in the composite CSFs. Questionnaire item 10D, Standardized Software, was excluded from factor analysis based on its similarity to questionnaire item 10C, Standardized Hardware. From the point of view of the helpdesk manager, standardized systems necessarily include the hardware and software, and would be much easier to support. For example, supporting 100 Dell Dimension workstations in a computing lab all configured with the same hardware and software is much easier than 100 different makes and models. Questionnaire item 9A, Student Staff, was excluded from factor analysis because it did not correlate well with any other factors. However, it was retained for further analysis because of the untested nature of the survey instrument. It would appear that questionnaire item 9A could best fit in with composite Factor 5, Helpdesk Implementation and Operation Costs. Hiring students as helpdesk analyst has advantages and disadvantages (Das, Soh, & Lee, 1999; Littrell, 1993; Perez & Moore, 2000; Reasoner, 2000). The ambiguity of hiring student staff explains why questionnaire item 9A failed to correlate.

Even though seven composite CSFs exist, the results suggest that they are not equally important. Helpdesk Organization and Professionalism, Helpdesk Tools and Performance Metrics, IT Standards and Control, and Helpdesk Structure have the four highest explained variances and means (see Table 10). These findings of explained variance confirm the importance of these factors and should be the focus of academic helpdesk managers.

Conclusion 2.

It is concluded that since there were statistically significant differences between the means of the importance of the helpdesk CSFs, null hypothesis H2 was rejected with a 95% confidence (see Table 20).

Composite Helpdesk Problems

Research question 2 asked what are the problems associated with higher education helpdesks. Helpdesk problems are defined as those specific tasks rising to importance as a result of unsatisfactory performance or environmental changes. Problems can affect the achievement of goals or performance in a CSF area (Bullen & Rockart, 1981). Survey respondents were asked to evaluate how concerned they were with 33 items as potential problems within their helpdesk organization. The four items helpdesk managers were most concerned with were Lack of Adequate Helpdesk Staff Training, Increasing IT Costs, End-user Dissatisfaction, and Incorrect Solutions (see Appendix G, Table G3). Nearly all of the 33 problems appeared to cause concern, but those at the top of the list with the highest mean value deserve the most analysis by helpdesk managers. Twenty-one of the 33 CSFs have mean values less than 3.0 (midpoint of the 6-point Likert scale), suggesting that helpdesk managers did not find these issues of much concern. Interestingly, the top helpdesk problem, Lack of Adequate Helpdesk Staff, mirrors the top helpdesk CSF, Professional Full-time Staff. Additionally, the organization's stage of growth suggests that these helpdesks have not matured enough to address these problems.

However, 33 helpdesk problems are a considerable number of issues for any helpdesk manager to concentrate on. Some helpdesk problems correlated with other

helpdesk problems forming clusters of variables suggesting an underlying dimension known as factors (Field, 2000). Factor analysis was used to reduce the 33 helpdesk problems into seven composite helpdesk problems. Each composite helpdesk problem was then named after considering the individual items that had the highest factor loading (see Table 9). Not all of the individual helpdesk problems were used in the composite problems. Questionnaire item 7D, Helpdesk Cannot Provide the Helpdesk Support Availability Expected by Users, was excluded from factor analysis because it loaded ambiguously on four factors. However, it was retained for further analysis because of the untested nature of the survey instrument. It would appear that questionnaire item 7D could best fit in with composite Factor 1, User Satisfaction and Support. Questionnaire item 7D is similar to 2A, Users Dissatisfied with Helpdesk, but focuses more on 'expected' rather than the 'actual' level of support received. This distinction may have escaped the helpdesk manager or they may not have had access to any user satisfaction data. The ambiguity of these two questions explains why questionnaire item 7D failed to correlate.

Even though seven composite helpdesk problems exist, the results suggest that they are not equally important. User Satisfaction and Support, Helpdesk Staff Training and Retention, Cost and Budget, and Technology Gap have the four highest explained variances and means (see Table 9). These findings of explained variance confirm the importance of these problems and should be the focus of academic helpdesk managers.

Conclusion 3.

It is concluded that since there were statistically significant differences between the means of the importance of helpdesk problems, null hypothesis H3 was rejected with a 95% confidence (see Table 20).

Relationships between Helpdesk CSFs and Helpdesk Problems

Research question 3 asked what are the relationships of the helpdesk CSFs to the problems associated with helpdesks within higher education environments. These relationships will change over time as certain problems are solved and new problems arise. In general, all composite CSFs exhibited some significant relationship with all composite problems (see Table 14). Contract Support, however, only weakly correlated with Campus Network Availability and Departmental Support Specialist.

However, a more in-depth analysis of the relationships was needed, so multiple regression was performed. Multiple regression seeks to predict the outcome (helpdesk problem) from seven predictor variables (CSFs). Table G7 in appendix G provides the results of the regression analysis. The $\mathbf{R^2}$ value for each dependent variable (helpdesk problem) is a measure of how much of the variability in the outcome is accounted for by the predictor variables (CSFs). The **B** value indicates the individual contribution of each composite helpdesk CSF predictor to the overall model.

Helpdesk composite Factor 5, Support Call Number and Complexity, has an $\mathbf{R^2}$ of .132, which means that support calls account for 13.2% of variation in helpdesk problems. Factor 1, Helpdesk Organization and Professionalism, and Factor 6, Helpdesk Support Availability, have the highest **B** values, but only Factor 6 is significant at $p<.05$. This says that as the importance of the Helpdesk Support Availability increases, so too

does the helpdesk manager's concern with Support Call Number and Complexity. Note that five of the composite CSFs are positively related and two composite CSFs are negatively related to Support Call Number and Complexity problem. A negative relationship says that as the importance of that composite CSF increases, the composite helpdesk problem decreases. However, neither of these is statistically significant.

Demand for support, Factor 7, has an $\mathbf{R^2}$ of .128, which accounts for 12.8% of variation in helpdesk problems. Factor 4, Helpdesk Structure, Factor 5, Helpdesk Implementation and Operation Costs, and Factor 6, Helpdesk Support Availability, have the highest **B** values, and are significant at $p<.05$, $p=.01$, and $p<.05$, respectively. This says that as the importance of these factors increases, so too does the helpdesk manager's concern with Departmental Support Specialist. Note that four of the composite CSFs are positively related and three composite CSFs are negatively related to demand for support problems.

Helpdesk problem Factor 4, Technology Gap, accounts for less than 10% of helpdesk problem variation. Factor 3, IT Standards and Control, and Factor 5, Helpdesk Implementation and Operation Costs, have the highest **B** values, and are significant at $p<.05$ and $p<.01$, respectively. This says that as the importance of these factors increases, so too does the helpdesk manager's concern with Technology Gap. Note that five of the composite CSFs are positively related and two composite CSFs are negatively related to demand for support problems.

Additionally, composite CSF Factor 5, Helpdesk Implementation and Operation Costs, plays a significant role in five of the seven composite helpdesk problems. Helpdesk managers identified Increasing IT Costs as the second most important helpdesk

problem (see Appendix G, Table G3). In general, the composite helpdesk CSFs are good indicators for the helpdesk problems.

Conclusion 4.

It is concluded that since there were statistically significant relationships between helpdesk CSFs and helpdesk problems, null hypothesis H1 was rejected with a 95% confidence (see Table 20).

Relationships between Helpdesk CSFs and Stages of Growth

Research question 4 asked what are the relationships of CSFs to stages of growth of the helpdesk. Four descriptions of stages of growth, similar to Magal, Carr, and Watson (1988), were provided in the questionnaire. The descriptions themselves should be of value to helpdesk managers as their helpdesk organization evolves. The data showed that most of the helpdesks were in the early stages of growth and that they have a statistically significant effect on the composite CSFs. Stage 4, Maturity, had less than 30 responses and was excluded from the discriminant analysis. The remaining three stages of growth showed that the only CSFs with statistical significance were Helpdesk Organization and Professionalism, Helpdesk Tools and Performance Metrics, Helpdesk Structure, and Helpdesk Support Availability. The first three CSFs also explain the most percentage of variance (see Table 10).

However, not all CSFs have the same importance in each stage of growth. Helpdesk Structure and Helpdesk Tools and Performance Metrics were considered more important in stage of growth 1, Initiation (see Table 13). In stage 2, Expansion, Helpdesk Support Availability and IT Standards and Control are more important, while stage 3, Formalization, shows Helpdesk Organization and Professionalism, Helpdesk

Implementation and Operation Costs, and Contract Support as the most important CSFs. Note that Helpdesk Structure has a negative correlation in stage 2, and Helpdesk Support Availability has a negative correlation in stage 3. The is important because the transition from stage 1 to stage 2 requires that the helpdesk manager shift his or her focus away from Helpdesk Structure. The transition from stage 2 to stage 3 indicates that helpdesk managers should shift their focus away from Helpdesk Support Availability. In general, the importance of the composite CSFs does vary with the stages of growth. As the helpdesk evolves, different problems and factors rise and fall in importance.

Conclusion 5.

It is concluded that since there were statistically significant relationships between the stages of growth and composite CSFs, null hypothesis H4 was rejected with a 95% confidence (see Table 20).

Relationships between Helpdesk Problems and Helpdesk Structure

Research question 5 asked what are the relationships of helpdesk problems to overall helpdesk's structure. Helpdesk structural factors delineate how the helpdesk is organized. The physical and logical structure of the helpdesk address issues such as centralized, decentralized, or distributed support services. Helpdesk structure can also be a combination of multitiered, web-based, telephone support, and walk-in support. Respondents believed that a centralized helpdesk structure was the best structure. Although six of the seven composite helpdesk problems exist and correlate with Helpdesk Organization and Professionalism, the data suggest that they are not equally important. CSF Factor 4, Helpdesk Structure, correlated significantly and positively with six composite helpdesk problems (see Table 14). However, it only exhibited a significant

positive relationship with two composite helpdesk problems, User Satisfaction and Support and Departmental Support Specialist (see Appendix G, Table G7). Where and when an end user can get support is very important to the Departmental Support Specialist problem. Respondents indicated that they did not feel 24X7 support was necessary. However, this is complemented by an overwhelming support of Web-based FAQs, email, and walk-in service. Helpdesk managers should conduct end-user satisfaction surveys in order to determine the best places and times to offer support.

Conclusion 6.

It is concluded that since there were statistically significant relationships between composite helpdesk problems and the structure of the helpdesk, null hypothesis H5 was rejected with a 95% confidence (see Table 20).

Relationships between Helpdesk Problems and Organizational Acceptance

Research question 6 asked what are the relationships of helpdesk problems to helpdesk organizational acceptance. Although all seven composite helpdesk problems exist and correlate with Helpdesk Organization and Professionalism, the data suggest that they are not equally important. CSF Factor 1, Helpdesk Organization and Professionalism, correlated significantly and positively with all composite helpdesk problems (see Table 14). However, it only exhibited a significant positive relationship with one composite helpdesk problem, User Satisfaction and Support (see Appendix G, Table G7). Both CSF Factor 1 and helpdesk problem Factor 1 explain the highest percentage of variance and have the highest means. This says that as the importance of recognition of the helpdesk within the institution's hierarchy rises, so too does the concern of user dissatisfaction. The rationale is that changes in organizational structure

affect how users obtain helpdesk support. Consolidation, reengineering, and mergers of IT departments must be carefully considered and end users must be involved at each step, otherwise IT support may devolve to a previous stage.

Conclusion 7.

It is concluded that since there were statistically significant relationships between composite helpdesk problems and the acceptance of the helpdesk, null hypothesis H6 was rejected with a 95% confidence (see Table 20).

Relationships between Helpdesk Problems and End-user Training

Research question 7 asked what are the relationships of helpdesk problems to end-user training. Respondents were asked to indicate on a six-point Likert scale (1 = No Training to 5 = A Lot of Training, and 0 = Don't Know) how much of each of the six types of training end users received. About 6.3% of helpdesk managers did not know how much training that end users received. End users may receive training from other sources other than their academic helpdesk. The results indicate that helpdesk managers believe that end users receive little or no training (see Table 18).

Table 18. Results of End User Training

Question #	Type of Training	Mean	Std. Dev.
23a	FAQs	2.59	1.135
23b	Documentation & Manuals	2.53	1.081
23c	Computer-Based Training (CBT)	2.04	1.061
23d	Professional Organization Seminars	1.86	1.158
23e	Formal Classroom Instruction	2.64	1.224
23f	Vendor Training & Certification	1.50	.934

The correlation analysis between composite helpdesk problems and end-user training supports this (see Table 15). Even though there were small positive correlations for six of the seven composite helpdesk problems, they were statistically significant at $p<.05$. FAQs had the most correlations with helpdesk problems, suggesting that the quantity and quality of the FAQs is insufficient. Perez and Moore (2000) suggested several delivery methods, but the most effective method is on the helpdesk organization's web site. In addition to publishing FAQs on the web site, the helpdesk must promote and market itself to the user community so they know where and how to find help.

Both Formal Classroom Instruction and Vendor Training & Certification received small positive correlations with composite helpdesk problem Technology Gap at a significance of $p<.05$ (see Table 15). As new technology finds its way onto the campus, helpdesk managers must find ways to support it. The results indicate that Formal Classroom instruction and Vendor Training & Certification may be the best way to deal with emerging technology problems and reduce the number of support calls.

Conclusion 8.

It is concluded that since there were statistically significant relationships between composite helpdesk problems and end-user training, null hypothesis H7 was rejected with a 95% confidence (see Table 20).

Relationships between Helpdesk Problems and Helpdesk Staff Training

Research question 8 asked what are the relationships of helpdesk problems to helpdesk staff training. Survey respondents were asked to indicate on a six-point Likert scale (1 = No Training to 5 = A Lot of Training, and 0 = Don't Know) how much of each of the six types of training helpdesk staff received. About 1.2% of helpdesk managers did

not know how much training that helpdesk staff received. Some helpdesk staff may receive training from other sources other than their academic helpdesk department. The results indicated that helpdesk managers believe that helpdesk analysts receive average or little training (see Table 19). There were small positive correlations for three of the seven composite helpdesk problems, and they were statistically significant at $p<.05$. FAQs had a small, positive correlation with helpdesk problem User Satisfaction and Support. FAQs can be a good source for new helpdesk staff, but should not be the only source of training. Professional Organizational Seminars had a small, positive correlation with helpdesk problem Technology Gap. When new technology is introduced to the organization, an effective and efficient training method is to hold a training seminar for the entire helpdesk staff rather than one helpdesk analyst.

Table 19. Results of Helpdesk Staff Training

Question #	Type of Training	Mean	Std. Dev.
22a	FAQs	2.91	1.101
22b	Documentation & Manuals	2.99	1.077
22c	Computer-Based Training (CBT)	2.27	1.114
22d	Professional Organization Seminars	2.18	1.028
22e	Formal Classroom Instruction	2.27	1.151
22f	Vendor Training & Certification	1.97	1.053

Documentation & Manuals showed a small, positive correlation with helpdesk problem Departmental Support Specialist. Sometimes the demand for support outpaces the helpdesk organization's ability to adequately train their staff. In these situations,

manuals and documentation (online and in print) are the only tools that helpdesk staff have at their disposal.

There were small negative correlations for two of the seven composite helpdesk problems, and they were statistically significant at $p<.05$ (see Table 16). Composite helpdesk problems Helpdesk Staff Training and Retention and IT Cost & Budget negatively correlated with Computer Based Training. CBTs have traditionally been used as an efficient and effective training alternative to formal classroom instruction. However, it would appear that this is not the case. Helpdesk managers believe that CBTs are poor indicators for quality helpdesk staff and keeping costs under control. Additionally, Formal Classroom Instruction and Vendor Training & Certification showed small negative correlations with helpdesk problems Helpdesk Staff Training and Retention and IT Cost & Budget, respectively. It would appear that training of any kind is not enough to address the problems of quality helpdesk staff and keeping costs down.

The results reported in Table 16 seem to indicate that helpdesk staff training is inadequate. Perhaps this is due to the fact that there is almost twice as many student helpdesk staff as professional full-time helpdesk staff (see Table 6). Even though the correlations between helpdesk staff training and composite helpdesk problems is small and negative, they are still statistically significant at $p<.05$.

Conclusion 9.

It is concluded that since there were statistically significant relationships between composite helpdesk problems and helpdesk staff training, null hypothesis H8 was rejected with a 95% confidence (see Table 20).

Table 20. Summary of Hypotheses Results

	Null Hypothesis	Result
H1	There are no statistically significant relationships between helpdesk CSFs and helpdesk problems.	Rejected
H2	There are no statistically significant differences between the means of the importance of helpdesk CSFs.	Rejected
H3	There are no statistically significant differences between the means of the importance of helpdesk problems.	Rejected
H4	There are no statistically significant relationships between the stages of growth and composite CSFs.	Rejected
H5	There are no statistically significant relationships between composite helpdesk problems and the structure of the helpdesk.	Rejected
H6	There are no statistically significant relationships between composite helpdesk problems and the acceptance of the helpdesk.	Rejected
H7	There are no statistically significant relationships between composite helpdesk problems and end-user training.	Rejected
H8	There are no statistically significant relationships between composite helpdesk problems and helpdesk staff training.	Rejected

Ratio Analyses

The results from the ratio analysis are only a snapshot of the current situation (see Table 17, Appendix G, Table G8, Table G9, and Table G10). Ratio 1 (1854) shows the

average full-time equivalent (FTE) enrollment per full-time professional helpdesk staff from all survey respondents in all Carnegie classifications. Basically this says that each full-time professional helpdesk analyst supports 1,854 end users. There are almost twice as many student helpdesk staff as professional full-time, which is why Ratio 3 (986) is a much small number than Ratio 1 (1854) or Ratio 2 (7015). A helpdesk is dynamic and requires a team effort. The combination of full- and part-time helpdesk staff coupled with physical and logical helpdesk structure determine how effective and efficient the helpdesk organization is. These three ratios could also be grouped together for an overall ratio of support staff to FTE for a value of 1753. A ratio that is decreasing over time might indicate that there are fewer end users to support, more helpdesk staff, or a combination of both.

Ratio 4 is a good indicator of the helpdesk effectiveness and success over a period of time. As the helpdesk staff gain experience, they should be able to handle more calls per day in a shorter time (see Table 5 and Table 17). Trend analysis would show this number decreasing. However, if the number was increasing, helpdesk managers should have a closer look at ratios 1, 2, and 3. Sometimes staff turnover has a negative impact on overall helpdesk efficiency and effectiveness.

Additional detailed analysis was provided for nine of the 18 Carnegie classifications in Appendix G, Table G8, Table G9, and Table G10. These three tables detail the Full-time Helpdesk Staff, Number of Trouble Calls, and Average Problem Resolution Time ratios by providing a numeric ratio for each Carnegie classification. The numerator is the mean value of all respondents in that Carnegie classification, and the denominator is the total number of respondents in that Carnegie classification.

These ratios are useful in comparing performance between institutions within the same Carnegie classification and how each institution compares nationally. A decreasing ratio for full-time helpdesk staff (see Appendix G, Table G10) might be a good indicator for the helpdesk's budget, but helpdesk managers must pay close attention to the number of trouble calls and average problem resolution time ratios (see Appendix G, Table G9 and Table G10). An increase in either of these ratios might signal a need to hire more staff or provide better training.

Practical Applications of the Findings

Many educational institutions responded to increasing demands for computer support services by instituting a helpdesk and maintaining a list of solutions to common problems (Cunningham & Lubbers, 1998). One potential benefit of the results of this research may lead to ways in which helpdesk managers could provide end users with the tools to help themselves by utilizing online FAQs and other documentation. In this way faculty, staff, and students could be productive in their own work, rather than wasting time trying to fix their own computer problems (Cunningham & Lubbers, 1998). The need for a helpdesk became evident as each academic department tackled issues of poor support, lack of training, and loss of knowledge related to growth (Cunningham & Lubbers, 1998; Twitchell, 1997; Verghis, 1993; Whiting & Everett, 2001).

Another potential benefit could be a clear understanding by end users of where and when to obtain support. Currently, there is a push to a more integrated, logically centralized environment for services and support (Chipman & Long, 2000; Cook, 1996; Reasoner, 2000; Tucker & Barraza, 2000; Whiting & Eshbaugh, 2000). Movement to a

logically centralized helpdesk coupled with SLAs may reduce the time end users spend looking for support and the response time from the helpdesk.

Perhaps the biggest potential benefit to academic helpdesk managers would be guidance on hiring helpdesk staff. Good helpdesk analysts are difficult to find and costly to train. However, the hidden costs, such as training and retaining helpdesk staff, are often overlooked (Perez & Moore, 2000; Phipps & Wellman, 2001). The literature has shown that some higher education institutions have tried hiring students as analysts for their helpdesks, but have met with difficulties such as lack of experience, lack of motivation, high turnover, low job commitment, and difficulty in supervising (Reasoner, 2000). A few higher education institutions, however, have made their helpdesks successful by developing a career path for the analyst, instilling a positive work ethic, and developing a continuous improvement plan to reduce cost and increase quality (Littrell, 1993; Perez & Moore, 2000).

The National Association of College and University Business Officers Advisory Report 99-3 specifies new terminology to describe IT within the context of financial accounting methods. Revenues are defined as gross tuition, and expenses are direct program costs. The results of this study could reveal academic support costs such as computer services and indirect costs such as utilities used by the helpdesk that could be used for a more accurate ratio of revenues to costs. Academic IT support costs and the value of that support are not very well understood (KPMG, LLP, and Prager, McCarth & Sealy, LLC, 2002). The results of this study could provide guidance to higher education helpdesk managers for the direct support of technology-heavy courses such as distance education.

The seven ratios that were calculated in this study have been classified as Natural Classification Ratios (Salluzzo, Tahey, Prager, & Cowen, 1999). These results can be valuable in trend analysis in support of the Educational Core Services Ratio, the Educational Support Ratio, and the General Support Ratio (Salluzzo, Tahey, Prager, & Cowen, 1999). The seven ratios calculated in this study are:

1. Number of students / Full-time helpdesk staff
2. Number of students / Part-time helpdesk staff
3. Number of students / Student helpdesk staff
4. Number of trouble calls a day / All helpdesk staff
5. Number of Full-time helpdesk staff / Carnegie classification
6. Number of trouble calls a day / Carnegie classification
7. Average problem resolution time / Carnegie classification

The principles of ratio analysis can serve as a yardstick to measure the use of financial resources to achieve the institution's mission (KPMG, LLP and Prager, McCarth & Sealy, LLC, 2002; Salluzzo, Tahey, Prager, & Cowen, 1999). A higher education helpdesk manager could combine the total helpdesk budget and all other direct costs including amount spent on training with the results from this study. Key statistical measures could be converted into simple ratios to allow higher education institutions to compare their performance with similar institutions, or chart performance of CSFs.

Recommendations

The most important recommendation that this research can suggest is for all managers to evaluate their specific goals and objectives, and focus on those factors that

are absolutely necessary to reach those goals and objectives. Regardless of the industry or level within the hierarchy, managers can benefit from a clear understanding of the CSF method (Bullen & Rockart, 1981). The following sections contain recommendations specific to academic helpdesk practitioners and general recommendations for future research.

Recommendations for Practitioners

This study only considered the perceptions of academic IT helpdesk managers on those factors and problems they identified as most important. The results suggest several recommendations for practicing helpdesk managers. The following recommendations are offered in order of priority based on the results of this study and experience of the researcher.

Recommendation 1.

User Satisfaction and Support explains the highest percentage of variance among the seven composite helpdesk problems (see Table 9). It is recommended that academic helpdesks offer end users a 'One Stop Shop' approach with a single phone number, web page, and email address for all their hardware and software support needs. Good human-computer interaction (HCI) guidelines suggest no more that three clicks or presses of phone buttons for the end user to find the resource they are looking for. In the case of a FAQ web page, the end user should not have to click more than three links to reach a possible solution. In the case of automatic call distribution (ACD), the end user should not have to make more than three numbered choices to reach the helpdesk. Email requests for support should automatically respond with an acknowledgement of receipt of

request for support and an indication of the typical response time. Additionally, email responses should provide a link to the web page FAQs and the helpdesk's phone number.

Recommendation 2.

The preponderance of helpdesks continues to grow and expand. Most academic IT helpdesks were started based on the needs of the end users (see Figure 2, Table 3, and Table 4). It is recommended that helpdesk managers take a more proactive approach in developing the helpdesk. Academic IT helpdesks in the Initiation stage should focus on helpdesk structure, tools, and performance metrics. Helpdesks in the Expansion stage should focus on offering a variety of support options such as FAQ, email, walk-in, and on-site during different times, as well as promoting standardized COTS hardware and software. Academic IT helpdesks in the Formalization stage should focus on defining a helpdesk mission statement and communicating that with all levels of management and departments, as well as hiring and retaining full-time professional staff.

Recommendation 3.

The average FTE enrollment for all respondents is just over 7,788 (see Table 17). It is recommended that higher education institutions that have a single physical location with fewer than 4000 end users should use a centralized helpdesk structure. A centralized structure is easier to control and manage, and can also be staffed with fewer helpdesk analysts. It is recommended that institutions that are geographically dispersed with more than 4000 end users should use a distributed helpdesk structure. A distributed structure has the benefits of centralized control and faster response times, but higher costs due to staffing. In both structures, the first line of support should be end user self-help solutions (tier-0) such as FAQs and knowledge bases. If end users fail to find the solution

themselves, then a tier-1 helpdesk analysts takes the initial call and attempts to solve the problem in less than the average problem resolution time of 19.35 minutes (preferably about half that time). If no resolution is reached within that time frame, the tier-1 analyst should escalate the problem to a more experienced tier-2 analyst. Escalation continues to tier-3 then SMEs until the problem is resolved.

Recommendation 4.

Helpdesk Tools and Performance Metrics explains the second highest percentage of variance among the seven composite CSFs (see Table 10). It is recommended that all academic helpdesks adopt a web-based helpdesk application capable of tracking each helpdesk request and solution, generating a searchable knowledge base, and generating reports for performance metrics. The availability and ease of implementing a web-based helpdesk is growing as the cost continues to decrease (Verghis, 2003).

Recommendation 5.

The third highest reported helpdesk problem is end user dissatisfaction (see Appendix G, Table G3). It is recommended that helpdesk managers conduct routine customer satisfaction surveys. The best opportunity to solicit feedback from the end user is after problem resolution either via a web-based link or simple phone interview. Aggregate results of customer satisfaction surveys should also be posted on a web page or published in the campus newsletter. This also addresses the most important CSF, Helpdesk Organization and Professionalism, by promoting departmental communication and a positive view of the helpdesk (see Table 10).

Recommendation 6.

Helpdesk Staff Training and Retention explains the second most variance among the seven composite helpdesk problems (see Table 9). Respondents indicated that their current helpdesk staff received average or little training, and that four of the seven types of training correlated negatively (see Table 16 and Table 19). It is recommended that helpdesk managers hire and retain qualified, full-time helpdesk staff. At a minimum, the helpdesk should have one full-time professional analyst. Training should be an ongoing responsibility of both the helpdesk analyst and management. It is recommended that helpdesk managers create a training program that is career oriented. The training program should offer monetary rewards as well as recognition among his or her peers. Respondents indicated that outsourcing the helpdesk was the least critical success factor (see Table 10, and Appendix G, Table G4). However, helpdesk managers should consider augmenting helpdesk staff with outsourced support specialist or vendor support during the busiest times of the academic year or during difficult migration efforts.

Recommendation 7.

Technology Gap explains the fourth highest percentage of variance among the seven composite helpdesk problems (see Table 9). Helpdesk support for all hardware and software is difficult. Each department may have a unique hardware or software requiring support, and students will most likely bring their own computers from home. Demand for off-campus support is also a factor. It is recommended that helpdesk managers work closely with each department to determine their hardware and software requirements, then establish SLAs that detail what hardware and software the helpdesk will support.

The helpdesk should provide web page links and contacts for the hardware and software that is not supported through the SLAs.

Recommendation 8.

IT Cost & Budget explains the third highest percentage of variance among the seven composite helpdesk problems and fifth highest percentage among the seven CSFs (see Table 9 and Table 10). Also, Helpdesk Implementation and Operation Costs significantly and positively correlated with all composite helpdesk problems suggesting that increasing helpdesk problems raises the costs or running a helpdesk (see Table 14). There is no easy solution or simple recommendation that can address all institutions. New uses for older hardware should be sought, as well as extending the lifetime of hardware from the industry average of 5 years to 7 years. Consideration should be give to Open Source solutions for both hardware and software, especially where there is a strong online support community. It is recommended that academic helpdesk managers follow the recommendations described in this study.

Recommendations for Future Research

Further study is needed about user satisfaction of academic support services. Two methods suggested by Pather, Erwin, and Remenyi (2003) are proposed. The Service Quality (SERVQUAL) method is primarily interested in service quality and the measure of the degree of customer satisfaction within an organization. Metrics should measure service quality of the end user using both expectations and perceptions of service. The Gap Model introduces the concept that user satisfaction involves a service-quality perspective of the IS department and that consumer satisfaction research is therefore an appropriate reference discipline for research into user satisfaction.

The results of this study may be used in further studies that establish a model by which all academic institutions can use to create their helpdesk. The general principles and classifications of current helpdesk practice could provide the foundations of a helpdesk taxonomy.

Additionally, detailed information on budgets should be collected in order to provide financial officers with a better ratio. The seven composite CSFs could serve as the assessed metrics in a Balanced Score-Card framework, similar to the MIT/Stanford helpdesk benchmarking project (Management by Facts: Benchmarking university IT services, starting with the IT help desk, 2003, September 4).

Constraints and Limitations of the Study

A constraint in this study was that only helpdesk managers were asked to complete the survey. The perceptions of end-user satisfaction and training were based solely on the manager's experience and helpdesk metrics available to the manager.

An attempt was made to address only academic helpdesks. In light of recent outsourcing of IT services in the corporate sector, it could be that the logical choice for an academic helpdesk is for the institution to focus on its core competencies and relegate IT support services to businesses specialized in IT support (Kaludis & Stine, 2000; Leach & Smallen, 1998; McCord, 2002). Phipps and Wellman (2001) suggested that an alternative to outsourcing could be leasing IT from vendors. The advantage of vendor arrangements is that it offered long-term cost savings, improved support, and training. Therefore, best practices suggested from corporate helpdesks were not considered.

The survey was conducted just before the start of the fall semester. Several participants responded that they were very busy, but they would complete the questionnaire. The total number of respondents may have been greater if the survey had been conducted later in the fall semester after registration. This does not lessen the validity or reliability of the survey.

Contributions to the Field of Study and Advancement of Knowledge

The knowledge gained from interviewing helpdesk managers and identifying their CSFs aided in determining each manager's specific standards and required data that allowed adjustments of the performance for each CSF. The general technique of CSF interviewing and analysis posed by Bullen and Rockart (1981) can be adapted to new electronic mediums used by Dillman (2000), and Schonlau, Fricker, Jr., and Elliott (2001).

Summary

In this study the researcher had two goals. The first goal was to identify the critical success factors (CSF) for the higher education academic helpdesk manager. The second goal was to assess the relationships of CSFs to problems associated with end-user satisfaction levels within higher education environments. This study also indicated the importance of certain CSFs for academic helpdesk managers. Based on the importance and significance of these CSFs, the results showed the relationships and impacts CSFs have on helpdesk problems. Through factor analysis of 33 CSFs and 33 helpdesk

problems, seven composite CSFs and seven composite helpdesk problems were developed.

This study has provided several significant and practical results. First, a sample of academic IT helpdesk managers provided data on their perception of the importance of several factors that are critical to the success of the academic helpdesk. The IT helpdesk managers also provided data on their perception of the severity of current academic IT helpdesk problems. Overall, academic helpdesk managers consider staffing and increasing costs very important to the success of their helpdesk. This study is descriptive rather than prescriptive and helpdesk manages should focus on the CSFs they believe are most important for their organization. In addition, it is important that helpdesk managers examine the perspective that end users and upper management have towards the helpdesk. Managers at each level of the organization have their specific set of CSFs and must be considered within the context of all the higher-level developments concerning strategic mission and institutional objectives.

Second, this study provided a detailed analysis of the relationships between the helpdesk manager's seven composite CSFs and seven composite helpdesk problems. The results indicated that all composite CSFs exhibited some significant relationship with all composite problems. The implication is that a helpdesk manager's most critical issues correlate with the problems that the helpdesk is having. Further detailed analysis revealed that the most significant and lingering CSFs are Helpdesk Implementation and Operation Costs and Helpdesk Structure. Helpdesk Organization and Professionalism and Helpdesk Support Availability were the next two most significant CSFs that correlated with the helpdesk's problems. Although the remaining three composite CSFs have less of an

impact on helpdesk problems, all seven composite CSFs have a much larger impact on overall helpdesk problems than do individual CSFs. This is an important distinction that helpdesk managers must be aware of in order to make their helpdesk more efficient and effective.

Third, this study investigated whether the composite helpdesk CSFs varied with the stages of growth. Four Stage of Growth descriptions were provided to the helpdesk mangers, but only stages 1, 2, and 3, received enough responses (n>30) for detailed analysis. A MANOVA followed by discriminant analysis was used to determine whether the significance and strength of the relationship of the composite CSFs varied with the Stage of Growth. The results indicated that there was a statistically significant difference between the three stages of growth. Helpdesk Structure and Helpdesk Tools and Performance Metrics were considered more important in the Initiation stage, Helpdesk Support Availability and IT Standards and Control are more important in the Expansion stage, while Helpdesk Organization and Professionalism, Helpdesk Implementation and Operation Costs, and Contract Support are the most important CSFs in the Formalization stage.

Fourth, this study provided data describing academic helpdesk managers' perception of how the logical and physical structure of the helpdesk should be. Helpdesk managers felt that a centralized helpdesk with walk-in support, email support, and web-based FAQs is the best solution for their organization. Further, they indicated that 24X7 support was not necessary. The implication is that self-help and automated support will cover off-hours.

Fifth, the data from this study supported a significant relationship between helpdesk organizational acceptance and user dissatisfaction. The helpdesk manager's perception of their organization's place in the institution's hierarchy has an affect on the helpdesk to deliver effective and efficient services. Both upper management and end users must see the helpdesk as an official and necessary function. Continuous customer satisfaction surveys, end-user training, and positive helpdesk promotion are integral to successful organizational acceptance.

Sixth, the data from this study supported a small, but statistically significant, relationship between helpdesk problems and end-user training. Data supported the perception of the helpdesk manager that end-users do not receive enough training. In particular, FAQs had the most correlations with helpdesk problems, suggesting that the quantity and quality of the FAQs is insufficient. In order to support the self-help, web-based helpdesk model, helpdesk managers must do a better job at writing FAQs.

Seventh, the data from this study supported a small, but statistically significant, relationship between helpdesk problems and helpdesk staff training. Surprisingly, CBTs negatively correlated with Helpdesk Staff Training and Retention and IT Cost & Budget problems. The data supports the perception of the helpdesk managers that CBTs are insufficient training tools despite their low cost. A combination of ongoing training and real-world experience would seem to be the best ingredients for quality helpdesk staff and improving customer satisfaction.

Finally, several ratios were developed to aid helpdesk managers in quantifying the status, sources, and uses of financial resources. Several key statistical measures were converted into simple ratios to allow higher education institutions to compare their

performance with similar institutions, or chart performance of CSFs. The combination of full- and part-time helpdesk staff coupled with physical and logical helpdesk structure determine how effective and efficient the helpdesk organization is. These ratios, however, are just a snapshot of the current situation and should be re-sampled on regular intervals in order to establish a trend.

The results of this study provided recommendations for practitioners, recommendations for further study, and anticipated who will benefit from this research. The potential benefits of the results of this study were analyzed and synthesized with current practice. Helpdesk staffing, levels of service and support offered by the helpdesk, and training users to help themselves may be potentially beneficial to the overall health of the helpdesk. The projected outcomes were discussed in terms of the two stated goals, eight research questions, and eight hypotheses. Table 20 provides a summary of the results of hypotheses testing. Practical applications were discussed in context of the overall financial health of the helpdesk. Eight recommendations were provided to assist academic helpdesk managers in determining the health of their institution's helpdesk. The results of this study along with NACUBO financial accounting methods and ratio analysis methods could be used for trend analysis and CSF performance metrics. Within the survey population, further study on user satisfaction is recommended using either the SERVQUAL or Gap Model method. The results of this study and a user satisfaction study could be useful in establishing a helpdesk taxonomy. Finally, a general CSF interviewing and analysis technique adapted to new electronic mediums was offered as a contribution to the field of study and the advancement of knowledge.

The pervasiveness of computers and technology on the campus has allowed students, staff, and faculty to perform a multitude of tasks by controlling their own environments and setting their own priorities. As the use of IT increases on the campus, so too does their dependence on support from helpdesks. This study provided additional, current evidence that helpdesks are an integral part of the academic institution and must remain agile and attentive to the end-user's needs.

Appendix A

Questionnaire

Academic Helpdesk Survey

Critical Success Factors of Academic Helpdesk Managers

Thank you for helping with this survey on identifying critical success factors for managers of helpdesks in a higher education environment and the unique problems they face. You are part of a random sample that has been asked to assist with this survey. The estimated time to complete the questionnaire is 30 minutes. A progress bar will indicate the percentage completed.

In accordance with Nova Southeastern University's Internal Review Board process, your responses will be confidential. Your name will not be used in the reporting of this information in publications or presentations. The results of the survey will be reported in terms of the group, not in terms of the individual. Thus your anonymity and confidentiality will be protected.

Should you have any difficulties in responding please email me at: parrottr@nova.edu or call (xxx) xxx-xxxx.

If you prefer to print your questionnaire and return it, please mail it to:
Richard Parrott.

Login ID: [ ]

Note: Your Login ID is located in the invitation email. If you have lost or forgotten your Login ID, please email parrottr@nova.edu.

Log In

Questions 13-22 based on: (Magal, Carr, & Watson, 1988; Marcella, & Middleton, 1996)

1. **Do you have a helpdesk?** *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear).*

- ○ Yes – Proceed to next question.
- ○ No helpdesk – Click the No radio button, and then **click here to skip to question 24**.

Next Question

Previous Question

2. Please rate the extent to which you are concerned with the following issues within your helpdesk organization. *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear).*

		Not Concerned 1	2	3	4	Extremely Concerned 5	Don't Know 0
a.	Users dissatisfied with helpdesk	○	○	○	○	○	○
b.	Incorrect problem solutions	○	○	○	○	○	○
c.	Users unclear where to get support	○	○	○	○	○	○
d.	Users try to fix their own computers	○	○	○	○	○	○

Next Question

Previous Question

3. Please rate the extent to which you are concerned with the following issues within your helpdesk organization. *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear.)*

	Not Concerned 1	2	3	4	Extremely Concerned 5	Don't Know 0
a. Lack of adequate helpdesk staff	○	○	○	○	○	○
b. Multiple helpdesk staff needed to resolve problem	○	○	○	○	○	○
c. Lack of adequate information for helpdesk staff to solve problem	○	○	○	○	○	○
d. Helpdesk staff not adequately trained	○	○	○	○	○	○
e. Student helpdesk staff unreliable	○	○	○	○	○	○
f. Difficulty recruiting quality helpdesk staff	○	○	○	○	○	○

Next Question

Previous Question

4. Please rate the extent to which you are concerned with the following issues within your helpdesk organization. *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear.)*

	Not Concerned 1	2	3	4	Extremely Concerned 5	Don't Know 0
a. Dropped Calls	○	○	○	○	○	○
b. Calls for same problem	○	○	○	○	○	○
c. Increasing number of calls	○	○	○	○	○	○
d. Increasing complexity of calls	○	○	○	○	○	○
e. Computer hardware too slow	○	○	○	○	○	○
f. Increasing demands for hardware upgrades	○	○	○	○	○	○
g. Heterogeneous hardware	○	○	○	○	○	○

Next Question

Previous Question

5. Please rate the extent to which you are concerned with the following issues within your helpdesk organization. *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear.)*

		Not Concerned 1	2	3	4	Extremely Concerned 5	Don't Know 0
a.	Increasing complaints that Internet access is slow	○	○	○	○	○	○
b.	Unreliable connection to university resources	○	○	○	○	○	○
c.	Computer software too difficult to use	○	○	○	○	○	○
d.	Increasing demand for software upgrades	○	○	○	○	○	○
e.	Heterogeneous software	○	○	○	○	○	○
f.	Call tracking system inadequate or non-existent	○	○	○	○	○	○

Next Question

Previous Question

6. Please rate the extent to which you are concerned with the following issues within your helpdesk organization. *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear.)*

	Not Concerned 1	2	3	4	Extremely Concerned 5	Don't Know 0
a. Academic departments want their own helpdesk technician	○	○	○	○	○	○
b. Faculty and Staff pulling helpdesk technician away from other helpdesk duties	○	○	○	○	○	○
c. Growing demand for support on campus	○	○	○	○	○	○
d. Growing demand for support off campus	○	○	○	○	○	○

Next Question

Previous Question

7. Please rate the extent to which you are concerned with the following issues within your helpdesk organization. *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear.)*

	Not Concerned 1	2	3	4	Extremely Concerned 5	Don't Know 0
a. Decreasing IT budget	○	○	○	○	○	○
b. Increasing IT costs	○	○	○	○	○	○
c. Helpdesk cannot purchase latest technology	○	○	○	○	○	○
d. Helpdesk cannot provide the level of support expected by users	○	○	○	○	○	○
e. The Institution is not changing to meet growth of IT	○	○	○	○	○	○
f. Negative publicity on helpdesk	○	○	○	○	○	○

Next Question

Previous Question

8. Please rate the extent of importance that each item has on the success of your helpdesk organization. *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear).*

	Not Important 1	2	3	4	Extremely Important 5	Don't Know 0
a. 24X7 Support	○	○	○	○	○	○
b. Web-based FAQ Support	○	○	○	○	○	○
c. Walk-in Support	○	○	○	○	○	○
d. Email Support	○	○	○	○	○	○
e. Multitiered helpdesk	○	○	○	○	○	○
f. Centralized Helpdesk [1]	○	○	○	○	○	○
g. Decentralized Helpdesk [2]	○	○	○	○	○	○
h. Distributed Helpdesk [3]	○	○	○	○	○	○

Next Question

1. *Centralized Helpdesk* – Defined as a tightly woven relationship between the helpdesk and the academic institution where each has confidence in the other and provides support or information on demand from a single point of contact (Marcella & Middleton, 1996; Whiting & Eshbaugh, 2000).

2. *Decentralized Helpdesk* – Defined as a number of completely autonomous and independent support centers, or staff, providing small portions of the organization's overall information technology needs (Cook, 1996).

3. *Distributed Helpdesk* – Defined as a number of physically separate support centers, or staff, logically centralized with strong guidance and high objectives from a single point of contact (Cook, 1996; Drucker, 1986).

Previous Question

9. Please rate the extent of importance that each item has on the success of your helpdesk organization. *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear).*

	Not Important 1	2	3	4	Extremely Important 5	Don't Know 0
a. Staff – Students	○	○	○	○	○	○
b. Staff – Professional Full-time	○	○	○	○	○	○
c. Subject Matter Experts (SME)	○	○	○	○	○	○
d. Vendor Support	○	○	○	○	○	○
e. Helpdesk Analyst Training	○	○	○	○	○	○
f. End-user Training	○	○	○	○	○	○
g. Job Satisfaction	○	○	○	○	○	○

Next Question

Previous Question

10. Please rate the extent of importance that each item has on the success of your helpdesk organization. *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear).*

	Not Important 1	2	3	4	Extremely Important 5	Don't Know 0
a. Customer Satisfaction Measurement	○	○	○	○	○	○
b. Helpdesk Performance Measurement	○	○	○	○	○	○
c. Standardized Hardware	○	○	○	○	○	○
d. Standardized Software	○	○	○	○	○	○
e. Commercial-off-the-shelf Solutions (COTS)	○	○	○	○	○	○
f. Open Source Solutions	○	○	○	○	○	○
g. Call-tracking Software	○	○	○	○	○	○
h. Automatic Call Distribution System (ACD)	○	○	○	○	○	○

Next Question

Previous Question

11. Please rate the extent of importance that each item has on the success of your helpdesk organization. *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear).*

	Not Important 1	2	3	4	Extremely Important 5	Don't Know 0
a. Costs of Services to end users (charge back)	○	○	○	○	○	○
b. Promotion & Marketing of Helpdesk	○	○	○	○	○	○
c. Control Procedures to Ensure Security	○	○	○	○	○	○
d. Organizational & Management Support of Helpdesk	○	○	○	○	○	○

Next Question

Previous Question

12. Please rate the extent of importance that each item has on the success of your helpdesk organization. *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear).*

	Not Important 1	2	3	4	Extremely Important 5	Don't Know 0
a. Reengineer IT Support	○	○	○	○	○	○
b. Definition of Helpdesk Mission Statement	○	○	○	○	○	○
c. Advisory Committees	○	○	○	○	○	○
d. Service Level Agreements (SLA)	○	○	○	○	○	○
e. Outsourcing Helpdesk	○	○	○	○	○	○
f. Communications among all departments	○	○	○	○	○	○

Next Question

Previous Question

13. **How long has your institution had a helpdesk?** *(To answer, use the mouse to click in the textbox. Numeric data only).*

[ ] Years. *(Enter numeric data only.)*

Next Question

Previous Question

14. **Which one of the following best describes how your helpdesk came into being?**
(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear).

- ○ Informally grew based on needs
- ○ Consultants from industry
- ○ Followed a model from other higher education institutions
- ○ Internal organization tasked to create helpdesk
- ○ Don't Know
- ○ Other (Please Specify) [ ]

Next Question

Previous Question

15. Which one of the following Stages best describes your helpdesk's current situation? *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear).*

- ○ **Stage 1:** Helpdesk most frequently evolved out of a need to coordinate the proliferation of end-user computing in an organization. Users' hardware varies widely. Helpdesk staff is small, consisting perhaps of one or two people.
- ○ **Stage 2:** Steep increases in hardware, software, and users. Unplanned growth characterized by growing duties and responsibilities for the helpdesk staff. Number and variety of users increases.
- ○ **Stage 3:** Primary objective is to control the run-away growth, particularly in expenditures. Managerial activities are formally and consciously conducted in an attempt to curb this tremendous growth. User skills are relatively high, placing demands on the helpdesk staff to possess a very high level of expertise.
- ○ **Stage 4:** More global nature. Separate helpdesks may be created within the organization, absorbing the functions and responsibilities of the centralized helpdesk. Highly specialized helpdesk staff. Multiple helpdesks may be independent, having their own budgets and decision-making process.

Next Question

Previous Question

16. Please rate how accurately the previous Stage descriptions defined your helpdesk organization. *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear.)*

	Not Accurate 1	2	3	4	Extremely Accurate 5	Don't Know 0
a. Stage 1	○	○	○	○	○	○
b. Stage 2	○	○	○	○	○	○
c. Stage 3	○	○	○	○	○	○
d. Stage 4	○	○	○	○	○	○

Next Question

Previous Question

17. **How many full-time professional staff (excluding students) work on the helpdesk?**
(To answer, use the mouse to click in the textbox. Enter a whole number only).

[ ] Full-time professional helpdesk staff. *(Whole number only.)*

Next Question

Previous Question

18. **How many part-time professional staff (excluding students) work on the helpdesk?**
(To answer, use the mouse to click in the textbox. Enter a whole number only).

[ ] Part-time professional helpdesk staff. *(Whole number only.)*

Next Question

Previous Question

19. **How many student staff (part- and full-time) work on the helpdesk?** *(To answer, use the mouse to click in the textbox. Enter a whole number only).*

Student helpdesk staff. *(Whole number only.)*

Next Question

Previous Question

20. **On average, how many calls or trouble tickets are reported per day?** *(To answer, use the mouse to click in the textbox. Enter a whole number only).*

Tickets per day. *(Enter numeric value. Whole numbers only.)*

Next Question

Previous Question

21. Think about the most commonly reported helpdesk problem. On average, how long does it take to resolve this problem? *(To answer, use the mouse to click in the textbox and enter numeric data only)***.**

[ ] Minutes to resolve problem. *(Enter numeric value.)*

Next Question

Previous Question

22. How much of each of the following training methods does the helpdesk analyst receive? *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear.)*

	No Training 1	2	3	4	A Lot of Training 5	Don't Know 0
a. FAQS	○	○	○	○	○	○
b. Documentation & Manuals	○	○	○	○	○	○
c. Computer-based Training (CBT)	○	○	○	○	○	○
d. Professional Organization Seminars	○	○	○	○	○	○
e. Formal Classroom Instruction	○	○	○	○	○	○
f. Vendor Training & Certification	○	○	○	○	○	○

Next Question

Previous Question

23. How much of each of the following training methods does the end user receive? *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear.)*

	No Training 1	2	3	4	A Lot of Training 5	Don't Know 0
a. FAQS	○	○	○	○	○	○
b. Documentation & Manuals	○	○	○	○	○	○
c. Computer-based Training (CBT)	○	○	○	○	○	○
d. Professional Organization Seminars	○	○	○	○	○	○
e. Formal Classroom Instruction	○	○	○	○	○	○
f. Vendor Training & Certification	○	○	○	○	○	○

Next Question

Previous Question

24. Overall, how is end-user satisfaction with your institution's technology? *(To answer, use the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear).*

- ○ Excellent
- ○ Very good
- ○ Good
- ○ Not so good
- ○ Poor
- ○ Don't Know

Submit Responses

Appendix B

Sample Pre-notice Email

Nova Southeastern University
Graduate School of Computer and Information Sciences

3301 College Avenue
Fort Lauderdale, FL 33314
(954) 262-2000
1-800-986-2247

March 28, 2004

J. J. Smith, PhD
Director of Academic Computing Services
Anywhere University
12345 USA St.
Cityname, ST, 012345
jjsmith@anywhereuniversity.edu

A few days from now you will receive an email requesting you to complete a brief questionnaire for an important study that I am conducting as part of my dissertation at Nova Southeastern University. The questionnaire will take approximately 30-minutes to complete.

The questionnaire concerns identifying critical success factors for managers of helpdesks in a higher education environment and the unique problems they face.

I am emailing a pre-notice because research has shown that many people are more likely to respond to surveys if they have advanced notice. This study is important for higher education IT helpdesks and will provide helpdesk managers with valuable data to help them meet their helpdesk goals.

Thank you for your time and consideration. The generous help of professionals like you can make this research a success.

Richard D. Parrott
PhD Candidate
Nova Southeastern University
Graduate School of Computers and Information Sciences

Appendix C

Sample Survey Cover Letter and Instructions

Nova Southeastern University
Graduate School of Computer and Information Sciences

3301 College Avenue
Fort Lauderdale, FL 33314
(954) 262-2000
1-800-986-2247

April 18, 2004

J. J. Smith, PhD
Director of Academic Computing Services
Anywhere University
12345 USA St.
Cityname, ST, 012345
jjsmith@anywhereuniversity.edu

I am emailing you to request your help in a study that concerns identifying critical success factors for managers of helpdesks in a higher education environment and the unique problems they face. This survey is part of an important study that I am conducting as part of my dissertation at Nova Southeastern University.

It is my understanding that you are a manager or director of an academic IT helpdesk. I am contacting a random sample of accredited higher education intuitions and asking them about helpdesk problems, critical success factors, and staffing.

Results from this survey will provide helpdesk managers in higher education with valuable data to help them meet their helpdesk goals. Understanding critical success factors and helpdesk problems' relationships will provide information that higher education helpdesk managers can use to monitor and improve performance, and provide measures to achieve overall goals and objectives.

In accordance with Nova Southeastern University's Internal Review Board process, your responses are confidential. Your name will not be used in the reporting of this information in publications or presentations. The results of the survey will be reported in terms of the group, not in terms of the individual. When you submit your responses to this questionnaire you will use the provided LoginID. Thus your anonymity and confidentiality will be protected. This survey is voluntary. However, you can help me by taking approximately 30-minutes to share your experiences and knowledge about academic helpdesks. If for some reason you prefer not to respond, please let me know by replying to this email stating 'no thanks' in the subject line.

As a small token of my appreciation, all participants who complete the survey will receive a copy of the results.

If you have any questions or comments about this study, I would be happy to talk with you. My email address is: parrottr@nova.edu, or you can call me at (xxx) xxx-xxxx.

Thank you very much for helping me with this important survey.

Richard D. Parrott
PhD Candidate
Nova Southeastern University
Graduate School of Computers and Information Science

Instructions for Academic Helpdesk Survey
Critical Success Factors of Academic Helpdesk Managers

Thank you for helping with this survey on identifying critical success factors for managers of helpdesks in a higher education environment and the unique problems they face. You are part of a random sample that has been asked to assist with this survey. The estimated time to complete the questionnaire is 30 minutes. A progress bar will indicate the percentage completed.

In accordance with Nova Southeastern University's Internal Review Board process, your responses will be confidential. Your name will not be used in the reporting of this information in publications or presentations. The results of the survey will be reported in terms of the group, not in terms of the individual. Thus your anonymity and confidentiality will be protected.

Should you have any difficulties in responding please email me at: parrottr@nova.edu or call (xxx) xxx-xxxx.

If you prefer to print your questionnaire and return it, please mail it with the email cover letter and instructions to:

Richard Parrott

Step 1: Click on the following URL http://www.computervine.com/survey/helpdesk/ , or copy/paste the URL in your address bar of your browser.

Step 2: When prompted for User Name and Password, enter **nsu** (note that 'nsu' is all lower case letters). You will be re-directed to the welcome page.

Step 3: Enter your Login ID: **10198** .

Step 4: Click on the 'Log In' Button.

Step 5: Answer questionnaire items by using the mouse to click on your choice. If you make a mistake, click on the correct choice and the previous answer will disappear.

Step 6: When you have answered each item, click on 'Next Question' to proceed.

Step 7: If you have made a mistake or would like to change your response, click on 'Previous Question'.

Step 8: Answer questionnaire items 13, 17 through 20 by using the mouse to click in the textbox, then enter a whole number only.

Step 9: After you have answered questionnaire item 24, click the 'Submit' button to transmit your responses. You will be redirected to a thank you web page.

Appendix D

Thank You Web Page

Academic Helpdesk Survey

Critical Success Factors of Academic Helpdesk Managers

Thank you for helping with this survey on identifying critical success factors for managers of helpdesks in a higher education environment and the unique problems they face.

Please bookmark this web page in your browser by pressing **Ctrl+D**

As a token of my appreciation, check this web page, http://www.computervine.com/survey/helpdesk/thankyou.html, between May 30, 2004 and August 31, 2004 for the aggregate results of this study. When prompted for User Name and Password, enter **nsu** (note that 'nsu' is all lower case letters). A link for the results will be prominently displayed.

Should you have any further questions, please email me at: parrottr@nova.edu or call (xxx) xxx-xxxx.

Appendix E

Sample Follow-up Email for Non-respondents

Nova Southeastern University
Graduate School of Computer and Information Sciences

3301 College Avenue
Fort Lauderdale, FL 33314
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April 24, 2004

J. J. Smith, PhD
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Last week a survey cover letter and instructions was emailed to you. I am requesting your help in a study that concerns identifying critical success factors for managers of helpdesks in a higher education environment and the unique problems they face. This survey is part of an important study that I am conducting as part of my dissertation at Nova Southeastern University.

If you have already completed the online questionnaire, please accept my sincerest thanks. If you have not completed the online questionnaire, then please do so today. I am especially grateful for your help because the results from this survey will provide helpdesk managers in higher education with valuable data to help them meet their helpdesk goals.

If you did not receive the original request, or it was misplaced, please email me at: parrottr@nova.edu, or you can call me at (xxx) xxx-xxxx.

If for some reason you prefer not to respond, please let me know by replying to this email stating 'no thanks' in the subject line.

Thank you very much for helping me with this important survey.

Richard D. Parrott
PhD Candidate
Nova Southeastern University
Graduate School of Computers and Information Science

Appendix F

IRB Research Protocol and Approval Letter

Research Protocol

Description of Study

Purpose and Potential Benefits: In the last fifteen years, information technology (IT) customer support has increased in importance within higher education. The pervasiveness of computers and technology on the campus has allowed students, staff, and faculty to perform a multitude of tasks by controlling their own environments and setting their own priorities. Qualified professional system and user support services have lagged demand (Paulson, 2001; Rice, Collins-Jarvis, & Zydney-Walker, 1999; Yohe, 1999).

The purpose of this study is to investigate end-users' satisfaction level of the higher education helpdesk and how end-users' satisfaction level affects a helpdesk manager's critical success factor performance and goals. This study's first goal is to identify the critical success factors (CSF) for a higher education academic helpdesk manager. The second goal is to assess the relationships of CSFs to problems associated with end-user satisfaction levels within a higher education environment.

One benefit of this research may suggest ways in which end users can help themselves by utilizing online FAQs or other documentation. Many educational institutions responded to increasing demands for computer support services by instituting a helpdesk so that faculty, staff, and students could be productive in their own work, rather than wasting time trying to fix computer problems (Cunningham & Lubbers, 1998). The need for a helpdesk became evident as each academic department tackled issues of poor support, lack of training, and loss of knowledge because of growth (Cunningham & Lubbers, 1998; Twitchell, 1997; Verghis, 1993; Whiting & Everett, 2001).

Another potential benefit is a clear understanding by end users of where to obtain support and what hours are offered. Currently, there is a push to move toward a more integrated, logically centralized environment for services and support (Chipman & Long, 2000; Cook, 1996; Reasoner, 2000; Tucker & Barraza, 2000; Whiting & Eshbaugh, 2000). Movement to a logically centralized helpdesk coupled with SLAs may reduce the time end users spend looking for support and the response time from the helpdesk.

Perhaps the biggest benefit to academic helpdesk managers would be guidance on hiring helpdesk staff. Good helpdesk analysts are difficult to find and costly to train. However, the hidden costs, such as training and retaining helpdesk staff, are often overlooked (Perez & Moore, 2000; Phipps & Wellman, 2001). Literature has shown that some higher education institutions have tried hiring students as analysts on their helpdesks, but have met with difficulties such as lack of experience, lack of motivation, high turnover, low job commitment, and difficulty supervising (Reasoner, 2000). A few higher education institutions, however, have made their helpdesks successful by developing a career path for the analyst, instilling a positive work ethic, and developing a continual improvement plan to reduce cost and increase quality (Littrell, 1993; Perez & Moore, 2000).

The results of this study will be used primarily for partially fulfilling the requirements for the degree of Doctor of Philosophy at Nova Southeastern University, Graduate School of Computer and Information Sciences.

Location of Study: The questionnaire and data collection activities of this study will take place on the Internet.

Dates of Study: Start Date: 05/05/04; End Date: 06/05/04

Subjects:

Sample Size and Composition: The population for this study will be managers of academic helpdesks from all accredited higher education institutions. Since there is no prior empirical research identifying CSFs in academic helpdesks and their relation to end-user problems, there is no meaningful way to estimate population variance to determine a sample size (Charles, 1998; DeVillis, 1991). Gumaraes, Gupta, and Rainer (1999) chose a sample size of 950 participants and received a rate of response of 19.5%. Magal, Carr, and Watson (1988) received a similar response rate of 21% from 1,490 randomly selected participants. In both studies, the response rates were considered typical and reasonable. For this study, the population of 4,282 profiles will be based on the 2003 Higher Education Publication. In order to obtain a confidence level of 95% for the final survey instrument, the required number of completed questionnaires should be equal to or greater than 353. The expected response rate will be 20%; therefore the sample size will be 1,765.

Subject Selection and Eligibility Requirements: The expert panel will participate in a pre-testing stage that will involve knowledgeable colleagues and analyst with diverse experience in the domain of research (Dillman, 2000). The questionnaire will initially be constructed and reviewed using literature and a panel of five experts from higher education institutions that have an academic helpdesk. Participants in the expert panel will be excluded from the final questionnaire.

The pilot study will involve a pre-testing that emulates the survey procedures for the final study and in which the researcher will attempt to discover any additional problems with questions and items that may not have been addressed by the expert panel (Dillman, 2000). The pilot study survey questionnaire questions will be designed to determine correct wording and format for each question, yield the most valid responses, and establish consensus on important CSFs and end-user problems. Charles (1998) and Dillman (2000) suggested that sample sizes of 30 are sufficient for exploratory and pilot studies. The pilot study will consist of the formalized survey instrument from the expert panel review sent to a stratified sample of 32 participants from the Higher Education Publications' 4,282 institutions listed in the Higher Education Directory. The target respondents will be managers in the academic helpdesk, and will represent proportional samples of the population by Carnegie classification. Participants in the pilot study will be excluded from the final questionnaire.

The final survey questionnaire will be a multi-part, single instrument delivered as an online form. The survey questionnaire will be the revised questionnaire based on feedback from the pilot study. The feedback received from a pilot study typically results in changes such as adding or eliminating questions, and improving incentives to increase response rate (Dillman, 2000). The questionnaire will be divided into three main parts: a) CSFs; b) end-user problems; c) variables of interest and demographics of the higher education institutions.

Methods and Procedures

Overview: The researcher will gather data about helpdesk CSFs, helpdesk problems, and variables of interest within higher education by using a questionnaire, reviews of the literature, case studies on strategic planning, and a review of helpdesk implementations in higher education. The initial list of CSFs and helpdesk problems will be derived from the literature. The preliminary literature review revealed several academic helpdesk problems common among higher education institutions. These problems will be the basis for items in the questionnaire. The surveys used by Marcella and Middleton (1996) and Magal, Carr and Watson (1988) will serve as sources of some CSFs and as models to create questions for the survey. The independent variables (IVs) will be the CSFs identified in the literature review and through the expert panel review (see Appendix A questions 8-12). The helpdesk problems will be the dependent variables (DVs) identified in the literature review and through the expert panel review (see Appendix A questions 2-7). The variables of interest are: (a) Carnegie classification, (b) institution control (public or private), (c) age in years of the helpdesk, (d) staffing levels, (e) number and complexity of end-user problems, (f) helpdesk structure, and (g) perceived customer satisfaction (see Appendix A questions 1, 13-24).

There are 4,182 private and public degree-granting institutions, according to the US Department of Education's National Center for Educational Statistics (Snyder & Hoffman, 2002). It is unclear what percentage of the 4,182 institutions has an IT helpdesk. Higher Education Publications, Incorporated publishes a Higher Education Directory that is more current than the NCES report. The population of interest includes all accredited higher education institutions (as of the publishing date of the 2003 Higher Education Directory). The researcher will use a random sample of 1,765 from the list of 4,282 profiles in the 2003 Higher Education Directory (http://www.hepinc.com). Microsoft Excel's Analysis Toolpak add-in random number generation capability will be used to randomly select the 1,765 institutions. The randomly selected institutional data will be loaded in a Microsoft Excel spreadsheet with fourteen data fields provided from the Higher Education Directory.

The FICE is a unique identifier that will be used to randomly select the 1,765 higher education institutions. The manpower code will identify the primary point of contact at the selected higher education institution. Five manpower codes will be used: (a) Code 13 identifies a director of computing and information management, (b) code 14 identifies a director of computer center, (c) code 27 identifies a director of information office, (d) code 90 identifies a director of academic computing, and (d) code 91 identifies a director

of administrative computing. Administrator title, name, and email address all correspond to the primary point of contact identified by the manpower code. In the event that the selected institution does not have one of the listed manpower codes, then the researcher will locate the person responsible for managing the helpdesk from the institution's website. If the selected institution does not have a website, then the researcher will telephone the main office and ask for the helpdesk manager's contact information. Once the contact information and email addresses are validated, the researcher will export the email addresses to EForm's client interface and generate the initial request for participation. The researcher will use four elements to achieve a high response rate (Dillman, 2000):

1. A pre-notice email will be sent to all participants a few days before the official survey. It will explain that an important survey will arrive and that participation will be greatly appreciated.
2. The official survey email will include a detailed cover letter explaining why this survey is important, why they were selected, a statement of confidentiality, and an offer of summary results of the survey as a token of appreciation.
3. Once the participant has completed the online survey they will be directed to a thank you web page. This web page will express the researcher's appreciation for participating and provide the respondent with the researcher's contact information.
4. A follow-up email will be sent to non-respondents approximately two weeks after the official survey email request indicating that the participant's response has not been received and reiterate the importance of this survey. The follow-up email will include the same information as the official survey email.

The survey instrument will be an online questionnaire. The major advantages of using an online questionnaire are that data collection is more efficient and easier to tabulate and score, offers better anonymity to respondents, and is much more economical (Dillman, 2000; Patten, 1998). The questionnaire will be an online HTML form and the data collected will be stored in a database. Dillman (2000) recommended nine principles for constructing email surveys, and 14 principles for designing web surveys. The importance of sending a brief cover letter and multiple reminder emails to the intended recipients must not be underestimated (Dillman, 2000). The researcher will indicate in the cover letter that the identity of all respondents will be confidential and results will be reported only in the aggregate. The construction of the web survey follows similar paper questionnaire design. The overall organization of the information and navigation must be clear, concise, and follow the least compliant browser (LCB) principle (Dillman, 2000). The researcher will follow the email design principles for the initial email contact and reminders, and the web design principles for the survey instrument. Designing and implementing a web survey using Dillman's procedures will increase the response rate and reduce coverage error, sampling error, measurement error, and non-response error.

Measures and Administration: The researcher will conduct the following statistical analyses: (a) descriptive statistics for the variables of interest, (b) a Chi-square significance test between the respondents and non-respondents to check for non-response

bias, (c) a factor analysis to identify composite CSFs and helpdesk problems, (d) MANOVA to determine the degree of relationship between CSFs and helpdesk problems using the composite helpdesk problems identified from the factor analysis as dependent variables and the helpdesk CSFs as independent variables (e) MANOVA to determine the degree of relationship between CSFs and stage of growth of the helpdesk (see Table 1). Descriptive statistics for the variables of interest describe the topology of the data and their closeness or distance of relationship (Leedy, 1997). A chi-square (χ^2) test for independence will be used to check for significant association between two or more categorical variables (George & Mallery, 2003; Field, 2000). The factor analysis on the CSFs and helpdesk problems will help discover patterns in the relationships within each set of variables. Specifically, principle components analysis (PCA) seeks the set of factors that can account for all the variance in a set of variables. A PCA on CSFs and helpdesk problems will suggest how many different factors will be needed to explain the pattern of relationships among the variables, the nature of those factors, and how well the hypothesized factors explain the observed data. The composite CSF and helpdesk problem factors will be analyzed with a MANOVA. Four MANOVA procedures will be completed to answer the research questions and test hypotheses H1, H4, H5, and H6. In addition, **Six/Seven** ratios will be calculated from the results of this study. The results from these ratios will provide helpdesk managers a valuable metric to compare with other similar institutions (Salluzzo, Tahey, Prager, & Cowen, 1999).

The questionnaire will be an online HTML form created and administered using Eform version 4.0E by Beach Tech, Corporation. The three major components of Eform are (a) the client interface, (b) the server script, and (c) the database. The client interface allows the researcher to construct questions and responses in a variety of formats. The response formats include single choice, multiple choice, fixed and variable length text response, yes/no response, floating-point numeric, and currency response. The client interface also creates the initial email request, email reminder, and verification emails that are sent to the participants. The server script is called survey.cgi written in the PERL programming language that resides in the cgi-bin subdirectory on the host server. The script processes the online form, then emails the results to the researcher's email address helpdesk@computervine.com. The PERL script was written by Beach Tech Corporation, and is not available as Open Source software and cannot be included as a listing in the appendix. The data returned via email will be stored in a local database using the client interface application. The researcher will have the option to export the data to either (a) Microsoft Access (.mdb), (b) Microsoft Excel (.xls), (c) text (.txt), (d) comma separated values (.csv), or (e) Foxpro (.dbf). For this survey, data will be exported as a Foxpro .dbf III file format because it is easier to import into SPSS.
The data exported from Eform will then be imported into SPSS for Microsoft Windows. SPSS is a statistical analysis application created by SPSS, Incorporated. Data will be imported and converted into SPSS local format for analysis. SPSS will provide the results of statistical analysis, tables, and reports.

Costs and Payments to the Participants: There is no cost for participating in this study. Participation is entirely voluntary. There is no penalty for withdrawal from this study.

There are no payments offered to the participants. Participants who complete the questionnaire will be offered access to final aggregate results.

Confidentiality: Information obtained in this study and questionnaires is strictly confidential unless disclosure is required by law. The participant's name will not be used in the reporting of information in publications or presentations. The results of the survey will be reported in terms of the group, not in terms of the individual. Thus anonymity and confidentiality will be protected. Access to the questionnaire requires a user ID, a password, and a login ID. Any printed hard copies of the data or data on any storage media will be maintained under lock and key in the researcher's home.

Potential Risks to Subjects:

a. Confidentiality and loss of privacy:
Likelihood: rare
Minimization: See Subject Confidentiality above.

Risks/Benefits Ratio: The risks to participants are minor. One benefit of this research may suggest ways in which end users can help themselves by utilizing online FAQs or other documentation. Many educational institutions responded to increasing demands for computer support services by instituting a helpdesk so that faculty, staff, and students could be productive in their own work, rather than wasting time trying to fix computer problems (Cunningham & Lubbers, 1998). The need for a helpdesk became evident as each academic department tackled issues of poor support, lack of training, and loss of knowledge because of growth (Cunningham & Lubbers, 1998; Twitchell, 1997; Verghis, 1993; Whiting & Everett, 2001).
Another potential benefit is a clear understanding by end users of where to obtain support and what hours are offered. Currently, there is a push to move toward a more integrated, logically centralized environment for services and support (Chipman & Long, 2000; Cook, 1996; Reasoner, 2000; Tucker & Barraza, 2000; Whiting & Eshbaugh, 2000). Movement to a logically centralized helpdesk coupled with SLAs may reduce the time end users spend looking for support and the response time from the helpdesk.
Perhaps the biggest benefit to academic helpdesk managers would be guidance on hiring helpdesk staff. Good helpdesk analysts are difficult to find and costly to train. However, the hidden costs, such as training and retaining helpdesk staff, are often overlooked (Perez & Moore, 2000; Phipps & Wellman, 2001). Literature has shown that some higher education institutions have tried hiring students as analysts on their helpdesks, but have met with difficulties such as lack of experience, lack of motivation, high turnover, low job commitment, and difficulty supervising (Reasoner, 2000). A few higher education institutions, however, have made their helpdesks successful by developing a career path for the analyst, instilling a positive work ethic, and developing a continual improvement plan to reduce cost and increase quality (Littrell, 1993; Perez & Moore, 2000).

Consent Forms: Subjects will be recruited as noted above in the 'Sample Size and Composition' section. Participants are randomly chosen so will not be required to sign a consent form before participating in this study.

Subject: IRB Approval
From: "James Cannady" <j.cannady@computer.org>
Date: Thu, 15 Apr 2004 21:07:19 -0400
To: "'Richard Parrott'" <parrottr@nova.edu>

Richard,

After reviewing your IRB Submission Form and Research Protocol I have approved your proposed research for IRB purposes. Your research has been determined to be exempt from further IRB review based on the following conclusion:

Research using survey procedures or interview procedures where subjects' identities are thoroughly protected and their answers do not subject them to criminal and civil liability.

Please note that while your research has been approved, additional IRB reviews of your research will be required if any of the following circumstances occur:

1. If you, during the course of conducting your research, revise the research protocol (e.g., making changes to the informed consent form, survey instruments used, or number and nature of subjects).

2. If the portion of your research involving human subjects exceeds 12 months in duration.

Please feel free to contact me in the future if you have any questions regarding my evaluation of your research or the IRB process.

Dr. Cannady

James Cannady, Ph.D.
Assistant Professor

Graduate School of Computer and Information Sciences
Nova Southeastern University

954.262.2085
cannady@nova.edu

Appendix G

Tables of Results

Table G1. Respondents by Carnegie Classification

Value	Carnegie Classification (CC2000) Label	Frequency	%
15	Doctoral/Research Universities—Extensive	37	9.00
16	Doctoral/Research Universities—Intensive	30	7.30
21	Master's Colleges and Universities I	85	20.68
22	Master's Colleges and Universities II	15	3.65
31	Baccalaureate Colleges—Liberal Arts	34	8.27
32	Baccalaureate Colleges—General	42	10.22
33	Baccalaureate/Associate's Colleges	5	1.22
40	Associate's Colleges	134	32.60
51	Specialized Institutions—Theological seminaries and other specialized faith-related institutions	3	0.73
52	Specialized Institutions—Medical schools and medical centers	4	0.97
53	Specialized Institutions—Other separate health profession schools	5	1.22
54	Specialized Institutions—Schools of engineering and technology	4	0.97
55	Specialized Institutions—Schools of business and management	2	0.49
56	Specialized Institutions—Schools of art, music, and design	0	0.00

Table G1 (*continued*). Respondents by Carnegie Classification

Carnegie Classification (CC2000)			
Value	**Label**	**Frequency**	**%**
57	Specialized Institutions—Schools of law	2	0.49
58	Specialized Institutions—Teachers colleges	2	0.49
59	Specialized Institutions—Other specialized institutions	6	1.46
60	Tribal colleges and universities	1	0.24

Note: From Carnegie Foundation for the Advancement of Teaching: *The Carnegie Classification of Institutions of Higher Education, 2000 Edition, third revision.* Retrieved October 30, 2003, from http://www.carnegiefoundation.org/Classification/downloads/cc2000-public.zip

Table G2. Respondents by State

Abbreviation	**State**	**Frequency**	**%**
AK	Alaska	1	0.24
AL	Alabama	8	1.95
AR	Arkansas	6	1.46
AS	American Samoa	0	0.00
AZ	Arizona	7	1.70
CA	California	27	6.57
CO	Colorado	6	1.46
CT	Connecticut	3	0.73
DC	District of Columbia	1	0.24
DE	Delaware	1	0.24

Table G2 (*continued*). Respondents by State

Abbreviation	State	Frequency	%
FL	Florida	11	2.68
FM	Federated States of Micronesia	0	0.00
GA	Georgia	7	1.70
GU	Guam	0	0.00
HI	Hawaii	2	0.49
IA	Iowa	10	2.43
ID	Idaho	3	0.73
IL	Illinois	21	5.11
IN	Indiana	15	3.65
KS	Kansas	5	1.22
KY	Kentucky	9	2.19
LA	Louisiana	3	0.73
MA	Massachusetts	9	2.19
MD	Maryland	9	2.19
ME	Maine	2	0.49
MH	Marshall Islands	0	0.00
MI	Michigan	11	2.68
MN	Minnesota	8	1.95
MO	Missouri	10	2.43
MP	Northern Marianas	1	0.24

Table G2 (*continued*). Respondents by State

Abbreviation	State	Frequency	%
MS	Mississippi	2	0.49
MT	Montana	1	0.24
NC	North Carolina	16	3.89
ND	North Dakota	3	0.73
NE	Nebraska	5	1.22
NH	New Hampshire	1	0.24
NJ	New Jersey	13	3.16
NM	New Mexico	1	0.24
NV	Nevada	1	0.24
NY	New York	28	6.81
OH	Ohio	15	3.65
OK	Oklahoma	7	1.70
OR	Oregon	7	1.70
PA	Pennsylvania	24	5.84
PR	Puerto Rico	2	0.49
PW	Palau	0	0.00
RI	Rhode Island	1	0.24
SC	South Carolina	5	1.22
SD	South Dakota	1	0.24
TN	Tennessee	13	3.16

Table G2 (*continued*). Respondents by State

Abbreviation	State	Frequency	%
TX	Texas	26	6.33
UT	Utah	1	0.24
VA	Virginia	17	4.14
VI	Virgin Islands	0	0.00
VT	Vermont	3	0.73
WA	Washington	5	1.22
WI	Wisconsin	12	2.92
WV	West Virginia	3	0.73
WY	Wyoming	2	0.49

Note: From Carnegie Foundation for the Advancement of Teaching: *The Carnegie Classification of Institutions of Higher Education, 2000 Edition, third revision.* Retrieved October 30, 2003, from http://www.carnegiefoundation.org/Classification/downloads/cc2000-public.zip

Table G3. Mean Importance Ratios of the Helpdesk Problems

Question #	Problem Description	Mean	Std. Dev.
3A	Lack of adequate helpdesk staff	3.60	1.298
7B	Increasing IT costs	3.59	1.256
2A	Users dissatisfied with helpdesk	3.56	1.421
2B	Incorrect problem solutions	3.55	1.451
2C	Users unclear where to get support	3.40	1.370

Table G3 (*continued*). Mean Importance Ratios of the Helpdesk Problems

Question #	Problem Description	Mean	Std. Dev.
7A	Decreasing IT budget	3.39	1.403
6C	Growing demand for support on campus	3.28	1.296
7D	Helpdesk cannot provide the level of support expected by users	3.27	1.249
4C	Increasing number of calls	3.15	1.267
7E	The Institution is not changing to meet growth of IT	3.15	1.471
4D	Increasing complexity of calls	3.12	1.244
3C	Lack of adequate information for helpdesk staff to solve problem	3.09	1.236
3D	Helpdesk staff not adequately trained	2.97	1.310
4B	Calls for same problem	2.97	1.181
3F	Difficulty recruiting quality helpdesk staff	2.94	1.430
6D	Growing demand for support off campus	2.90	1.366
2D	Users trying to fix their own computers	2.81	1.412
7F	Negative publicity on helpdesk	2.77	1.401
7C	Helpdesk cannot purchase latest technology	2.74	1.370
4A	Dropped Calls	2.72	1.422
3B	Multiple helpdesk staff needed to resolve problem	2.72	1.205
3E	Student analyst helpdesk staff unreliable	2.59	1.539
5E	Heterogeneous software	2.57	1.290

Table G3 (*continued*). Mean Importance Ratios of the Helpdesk Problems

Question #	Problem Description	Mean	Std. Dev.
5D	Increasing demand for software upgrades	2.55	1.211
4G	Heterogeneous hardware	2.52	1.354
4F	Increasing demands for hardware upgrades	2.48	1.350
5F	Call tracking system inadequate or non-existent	2.41	1.488
6B	Faculty and Staff pulling helpdesk technician away from other helpdesk duties	2.29	1.348
5C	Computer software too difficult to use	2.25	1.088
5A	Increasing complaints that Internet access is slow	2.24	1.313
4E	Computer hardware too slow	2.22	1.282
5B	Unreliable connection to university resources	2.13	1.395
6A	Academic departments want their own helpdesk technician	1.98	1.379

Table G4. Mean Importance Ratios of the CSFs

Question #	CSF Description	Mean	Std. Dev.
9B	Staff – Professional Full-time	4.69	.691
12F	Communications among all departments	4.39	.825
11D	Organizational & Management Support of Helpdesk	4.37	.805
9G	Job Satisfaction	4.29	.826
8F	Centralized Helpdesk	4.23	.990

Table G4 (*continued*). Mean Importance Ratios of the CSFs

Question #	CSF Description	Mean	Std. Dev.
10D	Standardized Software	4.15	.920
8D	Email Support	4.13	.858
10A	Customer Satisfaction Measurement	4.12	.940
10G	Call-tracking Software	4.12	1.152
9F	End-user Training	4.07	.905
10C	Standardized Hardware	4.06	.985
10B	Helpdesk Performance Measurement	4.02	.981
11C	Control Procedures to Ensure System Security	4.01	1.119
9A	Staff – Students	3.68	1.304
8C	Walk-in Support	3.68	1.213
12B	Definition of Helpdesk Mission Statement	3.68	1.095
9E	Helpdesk Analyst Training	3.61	1.213
9C	Subject Matter Experts (SME)	3.60	1.207
8E	Multitiered helpdesk	3.47	1.397
8B	Web-based FAQ Support	3.40	1.182
9D	Vendor Support	3.22	1.221
10E	Commercial-off-the-shelf Solutions (COTS)	3.22	1.268
11B	Promotion & Marketing of Helpdesk	3.20	1.206
12A	Reengineer IT Support	3.03	1.346
12D	Service Level Agreements (SLA)	2.93	1.448

Table G4 (*continued*). Mean Importance Ratios of the CSFs

Question #	CSF Description	Mean	Std. Dev.
10H	Automatic Call Distribution System (ACD)	2.70	1.716
12C	Advisory Committees	2.68	1.246
10F	Open Source Solutions	2.66	1.322
8A	24X7 Support	2.45	1.298
8H	Distributed Helpdesk	2.07	1.386
8G	Decentralized Helpdesk	1.76	1.208
11A	Costs of Services to end users (charge back)	1.75	1.277
12E	Outsourcing Helpdesk	1.40	1.046

Table G5. Factor loadings and Reliability Coefficients (α) for the 7 Helpdesk Problem Factors

Helpdesk	Factor						
Problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2B	.833						
2A	.809						
2C	.766						
2D	.661			.326			
3F		.741					
3E		.738					
3D		.719					
3A		.574	.355				

Table G5 (*continued*). Factor loadings and Reliability Coefficients (α) for the 7 Helpdesk Problem Factors

Helpdesk Problem	Factor 1	2	3	4	5	6	7
3C	.368	.551					
3B		.504					.301
7A			.784				
7B			.782	.335			
7C			.747				
7E			.704				
7F[a]	.314		.416		.311		
4G				.707			
5E				.671			
4F				.591		.348	
5D				.545	.334	.300	
4E				.538		.424	
4C					.696		
4D				.315	.670		
4B	.345				.633		
4A	.376				.597		
5A						.761	
5B						.758	
5C					.313	.546	

Table G5 (*continued*). Factor loadings and Reliability Coefficients (α) for the 7 Helpdesk Problem Factors

Helpdesk Problem	Factor 1	2	3	4	5	6	7
5F[a]			.388		.371	.454	
6D							.661
6A							.650
6B						.359	.621
6C							.592
Cronbach Alpha (α)	.853	.839	.824	.847	.823	.739	.691
Eigenvalue	3.394	3.279	3.224	2.936	2.679	2.616	2.302
Percent of Variance	10.607	10.246	10.075	9.175	8.372	8.175	7.193

Note: The highest loadings are underlined. All factor loadings less than 0.3 are not displayed.

[a] Primary loading <0.5

Table G6. Factor loadings and Reliability Coefficients (α) for the 7 CSF Factors

CSF	Factor 1	2	3	4	5	6	7
9G	.698						
12B	.631				.347		

Table G6 (*continued*). Factor loadings and Reliability Coefficients (α) for the 7 CSF Factors

CSF	Factor						
	1	**2**	**3**	**4**	**5**	**6**	**7**
12F	.622						
11D	.582						
9B[a]	.418						.385
10G		.644					
10H		.636					
10B	.470	.601					
10A	.467	.558					
11B		.519					
9E		.517					.328
8A		.515					
8B[a]		.440		.359		.305	
10C			.721				
10E			.687				
9F	.436		.562				
10F[a]			.497				
11C[a]	.314		.412				
8G				.787			
8H				.764			
11A					.646		

Table G6 (*continued*). Factor loadings and Reliability Coefficients (α) for the 7 CSF Factors

CSF	Factor						
	1	**2**	**3**	**4**	**5**	**6**	**7**
12C					.595		
12D[a]					.462		
12A[a]				.320	.453		
12E[a]				.309	.385		
8D						.589	
8C						.580	
8E				.375		.547	
8F[a,b]			.463			.479	
9C							.633
9D							.624
Cronbach Alpha (α)	.721	.785	.652	.710	.634	.499	.550
Eigenvalue	3.159	3.014	2.333	2.315	2.073	1.869	1.597
Percent of Variance	10.191	9.722	7.526	7.468	6.689	6.028	5.152

Note: The highest loadings are underlined.

[a] Primary loading <0.5

[b] Secondary loading <0.5 and >0.4

Table G7. Regression Results

Dependent Variable: User Satisfaction and Support (R^2 = .085)		**B**	***SE* B**	**Beta**	***t*-value**
CSF #	**Independent Variable**				
1	Helpdesk Organization and Professionalism	.353	.143	.179*	2.464
2	Helpdesk Tools and Performance Metrics	.003	.116	.002	.025
3	IT Standards and Control	.035	.108	.021	.320
4	Helpdesk Structure	.137	.062	.134*	2.209
5	Helpdesk Implementation and Operation Costs	.180	.105	.126	1.725
6	Helpdesk Support Availability	-.056	.104	-.033	-.533
7	Contract Support	-.096	.076	-.083	-1.261

Dependent Variable: Helpdesk Staff Training and Retention (R^2 = .053)		**B**	***SE* B**	**Beta**	***t*-value**
CSF #	**Independent Variable**				
1	Helpdesk Organization and Professionalism	.065	.122	.039	.534

Table G7 (*continued*). Regression Results

Dependent Variable: Helpdesk Staff Training and Retention (R^2 = .053)		**B**	***SE* B**	**Beta**	***t*-value**
CSF #	**Independent Variable**				
2	Helpdesk Tools and Performance Metrics	-.010	.098	-.008	-.104
3	IT Standards and Control	-.015	.092	-.011	-.163
4	Helpdesk Structure	-.002	.053	-.002	-.036
5	Helpdesk Implementation and Operation Costs	.251	.089	.208**	2.810
6	Helpdesk Support Availability	.099	.089	.070	1.114
7	Contract Support	-.045	.065	-.047	-.702

Dependent Variable: IT Cost & Budget (R^2 = .067)		**B**	***SE* B**	**Beta**	***t*-value**
CSF #	**Independent Variable**				
1	Helpdesk Organization and Professionalism	.150	.129	.085	1.166
2	Helpdesk Tools and Performance Metrics	-.061	.105	-.045	-.587
3	IT Standards and Control	.041	.098	.027	.414
4	Helpdesk Structure	.023	.056	.025	.405

Table G7 (*continued*). Regression Results

Dependent Variable: IT Cost & Budget (R^2 = .067)		**B**	***SE* B**	**Beta**	***t*-value**
CSF #	**Independent Variable**				
5	Helpdesk Implementation and Operation Costs	.244	.095	.188*	2.564
6	Helpdesk Support Availability	.127	.095	.084	1.337
7	Contract Support	-.040	.069	-.038	-.573

Dependent Variable: Technology Gap (R^2 = .098)		**B**	***SE* B**	**Beta**	***t*-value**
CSF #	**Independent Variable**				
1	Helpdesk Organization and Professionalism	.112	.124	.066	.906
2	Helpdesk Tools and Performance Metrics	-.048	.099	-.037	-.488
3	IT Standards and Control	.191	.093	.133*	2.053
4	Helpdesk Structure	.041	.055	.046	.750
5	Helpdesk Implementation and Operation Costs	.264	.091	.210**	2.907
6	Helpdesk Support Availability	.038	.090	.027	.428
7	Contract Support	-.075	.065	-.075	-1.148

Table G7 (*continued*). Regression Results

Dependent Variable: Support Call Number and Complexity (R^2 = .132)		**B**	***SE* B**	**Beta**	***t*-value**
CSF #	**Independent Variable**				
1	Helpdesk Organization and Professionalism	.240	.124	.137	1.940
2	Helpdesk Tools and Performance Metrics	.172	.100	.129	1.729
3	IT Standards and Control	-.030	.093	-.021	-.326
4	Helpdesk Structure	.052	.054	.056	.955
5	Helpdesk Implementation and Operation Costs	.163	.091	.127	1.801
6	Helpdesk Support Availability	.206	.091	.137*	2.261
7	Contract Support	-.121	.066	-.117	-1.827

Dependent Variable: Campus Network Availability (R^2 = .066)		**B**	***SE* B**	**Beta**	***t*-value**
CSF #	**Independent Variable**				
1	Helpdesk Organization and Professionalism	.119	.123	.071	.970

Table G7 (*continued*). Regression Results

Dependent Variable: Campus Network Availability (R^2 = .066)		**B**	***SE* B**	**Beta**	***t*-value**
CSF #	**Independent Variable**				
2	Helpdesk Tools and Performance Metrics	.042	.099	.032	.424
3	IT Standards and Control	-.062	.093	-.044	-.665
4	Helpdesk Structure	.069	.054	.078	1.267
5	Helpdesk Implementation and Operation Costs	.219	.090	.177*	2.419
6	Helpdesk Support Availability	.037	.090	.026	.415
7	Contract Support	-.025	.065	-.025	-.384

Dependent Variable: Departmental Support Specialist (R^2 = .128)		**B**	***SE* B**	**Beta**	***t*-value**
CSF #	**Independent Variable**				
1	Helpdesk Organization and Professionalism	.157	.116	.095	1.349
2	Helpdesk Tools and Performance Metrics	-.016	.094	-.012	-.165
3	IT Standards and Control	-.054	.089	-.039	-.604

Table G7 (*continued*). Regression Results

Dependent Variable: Departmental Support Specialist (R^2 = .128)		**B**	***SE* B**	**Beta**	***t*-value**
CSF #	**Independent Variable**				
4	Helpdesk Structure	.119	.051	.138*	2.345
5	Helpdesk Implementation and Operation Costs	.222	.086	.184†	2.592
6	Helpdesk Support Availability	.214	.085	.152*	2.501
7	Contract Support	-.016	.062	-.017	-.264

* p<.05. ** p<.01. † p=.01.

Table G8. Ratio Analysis of Full-time Helpdesk Staff per Carnegie Classification

Carnegie Classification 2000 Description	**Means**	**Ratio**
15 - Doctoral/Research Universities-Extensive	[a] 9.5	
	[b] 37	.26
16 - Doctoral/Research Universities-Intensive	[a] 6.24	
	[b] 30	.21

Table G8 (*continued*). Ratio Analysis of Full-time Helpdesk Staff per Carnegie Classification

Carnegie Classification 2000 Description	Means	Ratio
21 - Master's Colleges and Universities I	[a] 3.82 / [b] 85	.05
22 - Master's Colleges and Universities II	[a] 2.63 / [b] 15	.18
31 - Baccalaureate Colleges-Liberal Arts	[a] 2.75 / [b] 34	.08
32 - Baccalaureate Colleges-General	[a] 2.03 / [b] 42	.05
33 - Baccalaureate/Associate's Colleges	[a] 1.5 / [b] 5	.30
40 - Associate's Colleges	[a] 3.30 / [b] 134	.03
51 – 59, 60 All Specialized Institutions, Tribal colleges and universities	[a] 4.58 / [b] 29	.16

[a] Average of all respondents from each Carnegie Classification

[b] Number of respondents from each Carnegie Classification

Table G9. Ratio Analysis of Number of Trouble Calls per Carnegie Classification

Carnegie Classification 2000 Description	Means	Ratio
15 - Doctoral/Research Universities-Extensive	[a] 276.5 / [b] 37	7.5
16 - Doctoral/Research Universities-Intensive	[a] 204.48 / [b] 30	6.8
21 - Master's Colleges and Universities I	[a] 62.76 / [b] 85	.7

Table G9 *(continued)*. Ratio Analysis of Number of Trouble Calls per Carnegie Classification

Carnegie Classification 2000 Description	Means	Ratio
22 - Master's Colleges and Universities II	[a] 46.67 / [b] 15	3.1
31 - Baccalaureate Colleges-Liberal Arts	[a] 47.22 / [b] 34	1.4
32 - Baccalaureate Colleges-General	[a] 22.27 / [b] 42	.5
33 - Baccalaureate/Associate's Colleges	[a] 7.5 / [b] 5	1.5
40 - Associate's Colleges	[a] 50.78 / [b] 134	.4
51 – 59, 60 All Specialized Institutions, Tribal colleges and universities	[a] 53.26 / [b] 29	1.8

[a] Average of all respondents from each Carnegie Classification

[b] Number of respondents from each Carnegie Classification

Table G10. Ratio Analysis of Average Problem Resolution Time per Carnegie Classification

Carnegie Classification 2000 Description	Means	Ratio
15 - Doctoral/Research Universities-Extensive	[a] 11 / [b] 37	.30
16 - Doctoral/Research Universities-Intensive	[a] 20.72 / [b] 30	.70
21 - Master's Colleges and Universities I	[a] 17.24 / [b] 85	.20
22 - Master's Colleges and Universities II	[a] 16.13 / [b] 15	1.07

Table G10 (*continued*). Ratio Analysis of Average Problem Resolution Time per Carnegie Classification

Carnegie Classification 2000 Description	Means	Ratio
31 - Baccalaureate Colleges-Liberal Arts	[a] 30.41 / [b] 34	.90
32 - Baccalaureate Colleges-General	[a] 19.97 / [b] 42	.48
33 - Baccalaureate/Associate's Colleges	[a] 16.5 / [b] 5	3.3
40 - Associate's Colleges	[a] 20.21 / [b] 134	.15
51 – 59, 60 All Specialized Institutions, Tribal colleges and universities	[a] 20.17 / [b] 29	.70

[a] Average of all respondents from each Carnegie Classification

[b] Number of respondents from each Carnegie Classification

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