INFORMATION TECHNOLOGY INFRASTRUCTURE LIBRARY PROBLEM MANAGEMENT PRACTICES IN HIGHER EDUCATION: A MATURITY MODEL APPROACH

By

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DEDICATION

For my wonderfully supportive and understanding family:
Adria, Grace, and Brock

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My co-workers at Boise State University provided priceless feedback and input into the survey design and wording. Their assistance was greatly appreciated.

AUTOBIOGRAPHICAL SKETCH OF THE AUTHOR

I grew up in McMinnville, Oregon with my parents and younger brother. I attended Northwest Nazarene University 1994 to 1998 and received a Bachelors of Science in Engineering Physics.

After College, I had a few odd jobs including PC manufacturing at Micron Electronics. In 1999, I started working for MCI Worldcom through a temp agency. I supported HP Pavilion computers, DeskJet Printers, and early PhotoSmart product. I continued to work for MCI Worldcom for the next year.

In April of 2000, I was hired as a Technical Support Specialist (TSS) by Boise State University. As a TSS, I performed first and second level technical support. My duties included answering phone calls, emails, and resolving issues either over the phone or by onsite visit.

Just over a year later, I was promoted to Lead TSS. The new duties included supervising 10 Full-Time TSS staff, 4 to 5 students, and scheduling Help Desk coverage. Another key aspect of the Lead TSS job is being the technical reference for the TSS, Student Help Desk staff, and Network Administrators.

In 2005, I began my course work to complete a Masters of Science in Management Information Systems degree while working full-time for Boise State University. This thesis is the culmination of my work on this degree.

ABSTRACT

This study addresses the movement from a traditional to an ITSM approach for Help Desk services in Higher Education. The central goal of the study was the development of a Problem Management Maturity Model. The Problem Management Maturity Model was constructed by reviewing the Information Technology Infrastructure Library Problem Management literature for core components to include in the model. The data collected from surveys of Help Desk managers was used to place Higher Education institutions on the specific level of the Problem Management Maturity Model. Several different hypotheses about predictors for Problem Management maturity were tested but none proved to successfully predict process maturity. Nevertheless, the resulting Problem Management Maturity Model can be used to support continuous process improvement for Problem Management processes.

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LIST OF ABBREVIATIONS

Abbreviation	**Description**
CMDB	Configuration Management Database
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integrated
CMMI-SVC	Capability Maturity Model Integrated for Services
HDI	Help Desk Institute
HEF	Higher Education Forum
ITIL	Information Technology Infrastructure Library
ITSM	Information Technology Service Management
itSMF	Information Technology Service Management Forum
PMM	Problem Management Maturity
PDCA	Plan-Do-Check-Act

INTRODUCTION

Information Technology and business are difficult to align. Why is this so? At first glance it would seem that this is a frivolous question, however it is the primary question to be answered by organizations since the early days of electronic computing. Information Technology Service Management is a philosophy used to manage the Information Technology within an organization, which, at heart is focused on the customer's viewpoint. The aim of Information Technology Service Management (ITSM) is to assist the Information Technology unit of an organization to better understand the business. In reverse, ITSM allows the business to leverage its Information Technology capital to achieve business goals. It is believed that ITSM can align the services provided by Information Technology and the business itself.

ITSM is a concept for managing Information Technology. The concept is implemented with a process driven approach and with a keen eye on continually improving the processes. One process-based framework for developing an ITSM approach is the Information Technology Infrastructure Library (ITIL). ITIL is one of the most popular methods for improving services in Europe (Ann, 2007) and has been gaining popularity in North America.

Both ITSM and ITIL have a very broad focus and impact on the organization. The general overall impact of implementing ITIL has been thoroughly studied. The information provided by those studies however, has only considered the whole. This study considered Problem Management, a specific portion of the foundation for ITIL-

based ITSM. Problem Management is interesting because it assists with the identification of service flaws. These flaws can significantly reduce the usability, availability, and serviceability for the customer. Problem Management has been typically considered a bolt-on component to an ITIL implementation, and therefore, it has not been considered a key component for a process improvement. Nevertheless, it is of interest to better understand the value proposition provided by Problem Management to the organization and the other ITIL processes.

Problem Management in Higher Education was selected as the area of focus of this thesis for two reasons. First, as yet no study of Problem Management had been undertaken. Higher Education was chosen because of the author's work experience at a university (see autobiographical sketch, v). Secondly, a broad but small group of initial respondents with similar business goals was needed which Higher Education institutions matched.

Background

Traditional Information Technology (IT) practices are built on a technology and technology-provider focused approach where the technology and the needs of the IT department drive the solutions. As IT becomes more and more essential to the organization, the traditional model fails to serve the strategic needs of the overall organization. In the book, "Does IT matter?," Carr (2004) argues that IT is becoming a commodity within the global economy and is no longer a differentiator between companies and therefore repeats the same path as railroads, electricity, and highways did before IT. Therefore, IT is an essential component of business today and is becoming an

ordinary but complex utility for the businesses of tomorrow. It is time for the paradigm of IT in organizations to change to embrace their dependence on IT and work at developing IT by focusing more on services provided to customers than the technologies that provide the services.

IT Service Management (ITSM) instead transitions the management of IT from technology to the services provided to the customer. With ITSM, the business needs become the driver and the customer becomes the focus. The goal is to align IT and business strategy, or more optimistically, make IT an enabler of business goals. There is a strong emphasis upon getting the back-office processes in line to deliver IT services that support the creation of value within the enterprise. This emphasis continues the drive towards the commoditization of IT but creates a stronger dependence on the services provided by IT. As Nicholas Carr (2004) implied, how often does one worry if the power will be on when the switch is flipped for the light? ITSM supports this movement in IT by adding a layer of abstraction to the delivery of IT. One should think of ITSM as picking where the outlets in the wall will be and the types of light fixtures that will be used. The customer does not care how the power is delivered but simply that the required service is provided (i.e. it lights the room or runs the dishwasher).

ITSM allows the service provider to provide ubiquitous IT services with an increased reliability and supportability while working to provide the new services required by the organization. Let's consider an example of an IT service that has become a utility. One of the most universal and mature IT services provided today is email. Almost everyone has at least one email address. ITSM allows the IT organization to use

process and controls to provide the email service either through in-sourcing or outsourcing. These practices from ITSM allow the support organization, especially a Help Desk, to focus on the quality of the service. The Help Desk using the framework provided by ITSM models can work with the service owner to manage change in the system and provide valued input about problems with the service. A Help Desk, by tracking information related to the inquiries about the email service, could provide valued input on the trends in the inquiries to identify potential or existing problems with the service.

In this scenario, the customer does not care if the email system is Microsoft Exchange, Google Gmail, or Novell GroupWise but only that the email messages are delivered. Additionally, a customer cares that they can report an issue with service and that the customer's expectations (as set by the Help Desk) are met 100% of the time. Using ITSM to reduce the inconsistency in language between IT and the business improves communication. The improved communication and realistic expectations set by ITSM can allow the organization to focus on either enhancing existing services (i.e. adding automated distribution of reports from an ERP system via email) or developing new services to meet the business' requirements.

Goals for Research Study

This study addresses the movement from a traditional to an ITSM approach for Help Desk services in Higher Education. To the extent that implementing prescribed ITSM practices will benefit an organization, there must be some means to determine the extent of ITSM implementation. This research proposes and tests a maturity scale for

organizations implementing ITSM in terms of core best practices drawn from the ITIL framework for ITSM. Using the ITIL framework, the research examines the Problem Management process at a practical level with a special focus placed on the Help Desk services viewpoint. The examination of Problem Management was accomplished by surveying Help Desk Managers at a sampling of Higher Education institutions.

The creation and testing of a practical model for Problem Management for smaller organizations (10,000 to 20,000 students), is an outcome of the research. The goals of this research project are:

- To build a method to assess the extent of implementing ITIL Problem Management best practices
- Prioritize practices to implement which will increase best practice alignment
- Provide a resource for even the smallest organizations to enter into ITIL and continue to improve.

In the real world, implementing all aspects of ITIL is a costly and difficult undertaking for even the largest institution. This study hopes to eliminate some of the barriers to getting the most out of the institution's ITSM investment.

The research has put some real world information about using ITIL Problem Management process framework in the hands of the decision makers, especially Help Desk managers. Armed with this real world information about Problem Management in Higher Education the decision makers can make timely corrections or additions to their Problem Management processes that have a significant positive impact on the process.

Problem Management at higher education institutions, in the Help Desk or Customer/User Support departments, is of primary interest for the study. Higher education institutions must support diverse IT infrastructures usually with very limited resources. These constraints require IT departments to find creative ways to improve services. Problem Management may provide the best possible opportunity for return on investment without significant expenditures on tools or other systems to support ITSM.

LITERATURE REVIEW

Research literature on ITSM, ITIL, and IT operations is varied in context and focus. The literature covers six distinct areas: an ITIL component overview, case studies (on IT operations), empirical studies, a review of the state of ITSM Service Operation research, a review of the criteria catalog approach, and a review of Capability Maturity Model Integration (CMMI).

ITIL Component Overview

There are various open and proprietary frameworks to build an ITSM approach, such as Capability Maturity Model Integration (CMMI), Control Objectives for Information and related Technology (COBIT), and Microsoft Operations Framework (MOF). However, the most widely applied framework is Information Technology Infrastructure Library (ITIL), currently in version 3 (ITILv3). The reason is this: ITILv3 provides a best practice-based framework to implement, operate, support, and improve IT services. The British Office of Government Commerce originally developed ITIL (Tan, Cater-Steel, Toleman, & Seaniger, 2007). The IT Service Management Forum (itSMF) coordinated the update to version 3 of ITIL (Bon, et al. 2007).

ITIL is a conceptual framework - it does not prescribe how to perform a certain process. “ITIL books are descriptive not prescriptive, meaning they focus on processes and organizational structures that have been shown to be effective, rather than offering instructions on how to implement these practices” (Flora, 2008). This aspect of ITIL

makes it difficult for an organization to determine both what practical process to put in place and to what extent it has been successful in implementing the best practice.

ITIL has been used to build British Standard BSI 15000, which was in turn used to build the International Organization for Standardization ISO 20000 standard. ISO standards propose a compliance-based approach to ITSM with strong alignment to ITIL. "Indeed, as the ITIL represents best practice, rather than a formal specification it is not meaningful to claim 'compliance', due to the wide interpretation that this could possibly mean" (Breslin, 2004). The compliance requirements for these standards are well outside the scope of this research.

Figure 1 shows the relationship between ITSM, ITIL and key ITILv3 components. ITILv3 is comprised of 5 volumes or sets of related process guidelines (Office of Government Commerce, 2008). This study is focused on Service Operation. "The purpose of Service Operation is to deliver agreed levels of service to users" (Alison, et al. 2007). Services managed by Service Operation processes are in "production" in a traditional IT model. This is the stage where the customer and/or business is using and receiving value from the services provided by IT.

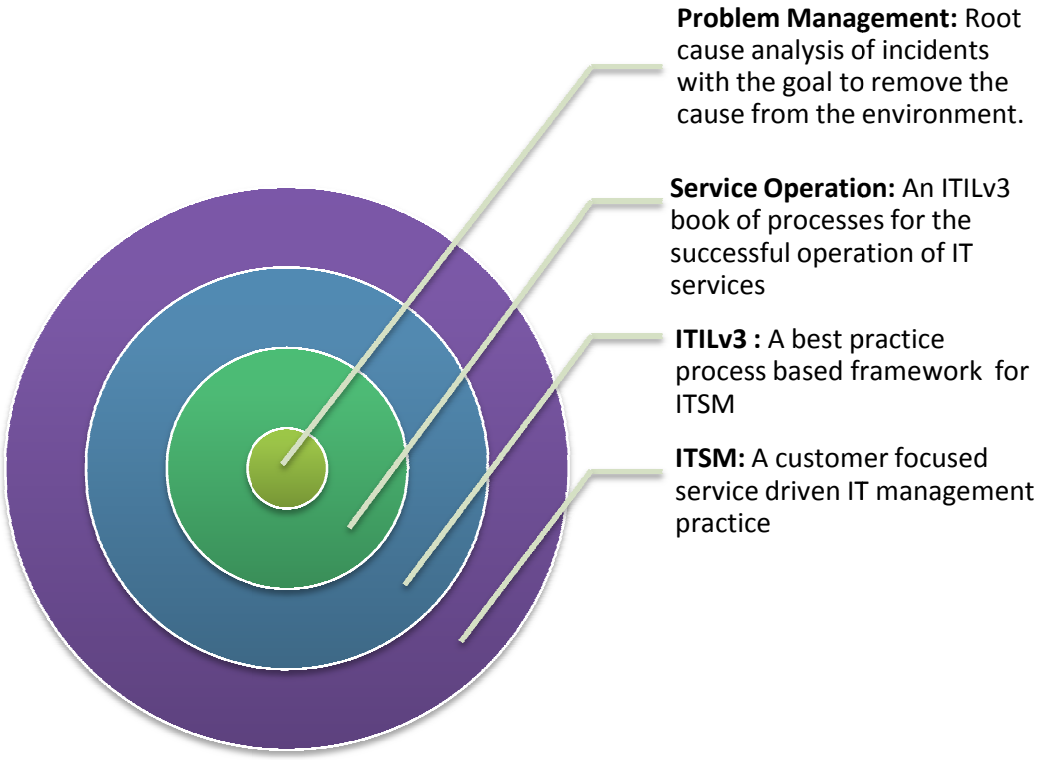


Figure 1: ITSM Relationship Model

Table 1 identifies the ITILv3 books, processes and functions (Alison, et al. 2007; Office of Government Commerce, 2007). The Service Operation area covers the five processes and four functions shown. The 5 processes within Service Operation run in parallel.

Table 1. ITIL Version 3 Processes & Functions

ITILv3 Book	**Processes & Functions**	
Service Strategy	Strategy Generation, Financial Management, Demand Management, Service Portfolio Management	
Service Design	Service Catalogue Management, Service Level Management, Capacity Management, Availability Management, IT Service Continuity Management, Information Security Management, Supplier Management	
Service Transition	Transition Planning and Support, Change Management, Service Asset and Configuration Management, Release and Deployment Management, Service Validation and Testing, Evaluation, Knowledge Management	
Service Operation	**Processes**	**Functions**
	Event Management, Incident Management, Problem Management, Access Management, Request fulfillment	Service Desk, Technical Management, Application Management, IT Operations Management (IT Operations Control & Facilities Management)
Continual Service Improvement (CSI)	7-step Improvement Process, Service Reporting, Service Measurement	

One important trigger for Problem Management is an incident, which is "an unplanned interruption to an IT service or reduction in the quality of an IT Service" (Bon, et al. 2007, p.134). Problems usually emerge from one or more incidents with an unknown cause. The goal of Problem Management is to "prevent problems and incidents, eliminate repeating incidents, and minimize the impact of incidents that cannot be prevented" (Bon, et al. 2007, p.140). Incident Management provides the structure for resolving incidents by working to restore service as quickly as possible. Although processes like Incident Management can trigger Problem Management, it still stands on its own as an individual process. By analogy, Incident Management is like calling the firefighters to come put out the fire, while Problem Management is like installing smoke detectors, sprinklers, and publicizing fire prevention. Problem Management provides value by reducing the number of errors in the IT infrastructure providing the services, which should reduce the number of incidents related to the services (Office of Government Commerce, 2004; Office of Government Commerce, 2007)

Review Case Studies on IT Service Operations

A number of case studies illustrate the positive and negative impacts on organizations, which add process and structure to their Service Operation functions. However, most of the case studies do not address ITIL specifically. Instead they emphasize introducing structured and repeatable processes such as those prescribed by ITIL. The Service or Help Desk is frequently the area of focus for these studies.

Davis and Maxwell (2004) outlined the steps the University of West Florida took to consolidate its Help Desk from many points of contact to a single point of contact and information for the University. As a result, the Help Desk was seen as an asset to the organization by the removal of the requirement for the customer to select the correct location to call for assistance.

In the article, "Help Desk, Beyond Evolution: The Transformation of the Princeton University Help Desk," the author focused on adding tools to improve the service of the organization (Jones, 1996, pp. 81-83). The introduction of new tools will always disrupt the current processes for an organization, so the introduction of a new tool drove Princeton to redesign their processes. The resulting process was well received and "even the most incorrigible employees" liked the new method by the end of the first week (Jones, 1996, p. 82). The new system was a success for Princeton because it built a more collaborate environment by removing the old paper based method. Electronic records of the calls also had the added advantage of starting Princeton down the road to building a formalized Incident Management process.

In the article, "ITIL as common practice reference model for IT service management: formal assessment and implications for practice," the authors performed four case studies on different ITIL implementation projects in German organizations (Hochstein, Zarnekow, & Brenner, 2005, pp.). These case studies examined the outcomes of ITIL implementations to demonstrate the benefits and deficiencies of ITIL. The authors found that, "… the use of ITIL is obviously cost effective, certainly in the companies and organisations considered in the case studies" (Hochstein, et al. 2005, p. 4). Incident and Change Management were considered in two of the case studies while the other two case studies focused on ITILv2 Service Support book. The Service Support book contains the processes: Configuration Management, Change Management, Incident Management, Problem Management, and Release Management (Office of Government Commerce, 2004). There is no discussion of Problem Management specifically.

Review of ITIL Related Empirical Studies

An effort has been placed on substantiating ITIL as beneficial and aligning IT and the business, which should result in a quality service provided to the customers. The ITIL authors boldly state that its processes can provide better alignment, but the writers do not provide any empirical evidence to validate this theory (England, 2006). There are several studies in which it is shown that IT service management via ITIL does provide measurable benefits to the organization.

Potgieter, Botha, and Lew (2004) undertook one such study. They endeavored to study if there was an improvement in customer service as the number of ITIL related activities increased in an organization. The authors contrasted an organization's

perception of service quality with the number of calls per user, before, during, and after adding ITIL processes. They concluded, "That both customer satisfaction and operational performance improve as the activities in the ITIL framework increases" (Cater-Steel & Pollard, 2008; Potgieter, et al. 2004). A weakness of this study is the limited depth of specific individual topics and failure to address the benefits of individual processes such as Problem Management. This limited depth did not provide any opportunities for the authors to explore which particular ITIL activities have the most impact for the organizations studied. Also, the use of the subjective measure, customer satisfaction, makes it difficult to objectively compare with other studies.

According to Cater-Steel & Pollard, "to date there has been little research undertaken into ITIL implementation" (2008, p. 3). Additionally, all of the ITIL implementation research has taken place internationally in reports from Potgieter, Botha, and Lew in South Africa, Hochstein, Zarnekow, & Brenner in Germany, and Cater-Steel, Toleman, and Tan in Australia, United Kingdom and New Zealand (Cater-Steel & Pollard, 2008). Four years earlier, Potgieter, et al. (2004) also asserted, "very little academic material exists" on ITIL or other ITSM frameworks. This factor limits the amount of empirical research information available about ITSM and specifically ITIL, and thus increases the possible impact of a study of Problem Management in Higher Education.

Review of ITSM Research

There are a number of articles that address the broader area of trends in ITSM industry and research. For example, Galup, Quan, Dattero, & Conger (2007, p. 49) assert

that, “Despite the significant growth of ITSM practice in industry, little scholarly work exists on this topic.” In their review of ITSM research, the authors set the stage of how critical services (in general) are to the industrialized nations around the world. Services are critical to industrialized nations because their economies have moved from being heavily based in agriculture and manufacturing to a service based economy. The authors continue to discuss several different service management frameworks that IT could be using but do not endorse any particular model.

Additionally, Cater-Steel and Toleman (2007) assert that IT students will demand a quality education including ITSM because the students are endeavoring to improve their job opportunities. With the IT industry continuing to embrace ITSM, Higher Education institutions must, therefore, embrace ITSM and start including it in their curriculum. The need for solid classroom instruction, as well as informed industry practice, must be supported by solid and well-rounded research.

Review of Criteria Catalog Analysis

Benner, Radisic, & Schollmeyer (2002) presented a model for evaluating service management processes in their paper entitled, “A Criteria Catalog Based Methodology for Analyzing Service Management Processes.” The authors used a criteria based catalog approach, which takes a body of knowledge about a best practice (in this case ITIL) and allows one to break it down into individual components and evaluate existing processes against the best practice model. The resulting output is a numerical value showing how the process relates to the best practice model. The numerical result can be used to produce a set of recommended changes to bring the process used by the organization into

better alignment with the best practice model. The authors state that the criteria based catalog can be changed to fit the business needs for the process but the catalog is purely based on the best practice model provided by ITIL. ITIL was not intended to be taken at face value. It was intended to be adapted to the institution's unique needs.

Benner, et al. (2002) recommended using a criteria based model for analyzing the characteristics of a process. Their method requires an organization to use a process framework like ITIL to build a scenario-independent, domain-specific, criteria catalog. They reference tools like the itSMF ITIL Self Assessment to speed the development of the criteria based catalog. Lastly, one has to adapt the catalog to one's needs by adding or removing criteria and then applying it to one's scenario. The lack of a pre-existing criteria catalog for Problem Management would require a person to develop tools to perform the measurement. It could be a difficult and time-consuming process.

Table 2 considers a small portion of a possible criteria-based catalog item for Problem Management. Benner, et al. (2002, p.151) suggest breaking Problem Management down into a couple of different large groupings. One grouping is Effectiveness of Activities. This grouping could be further broken down in a criterion such as Assessment of Work-around testing. It would result in the following table for the criterion (Benner, et al. 2002, p. 151).

Table 2. Example of Manifestation of Criteria Catalog

Assessment of Work-around testing	Rating	Score
A work-around receives complete testing on most use cases	Succeeds	3
A work-around receives limited testing on some use cases	Acceptable	2
A work-around receives minimal testing on critical use cases	Poor	1
A work-around is not tested	Fails	0

The Assessment of Work-around testing was encompassed in the Problem Management Maturity model to be presented in this study using Quality Assurance for the results (Appendix A, item G). Looking at each possible level for item G, there are four cases for testing a work-around. The levels outlined in the model are the development of experience and logical iterations of states of attributes. It is possible to have a significantly large number of combinations of these states using a criteria catalog. It is important to note that most of the states will be illogical combinations of events and therefore can be disregarded. The logical combinations of attributes to produce states should be sufficiently represented by the model presented in this thesis.

Most of the model presented in this paper contains criteria that would break down into several different items in a criteria based catalog. Although, an item such as priority of Problem Tickets (Appendix A, item H) in itself is a single criterion for a criteria catalog.

The criteria catalog produces a fine grained look into one's process but it requires an appreciably more time consuming assessment activity. It requires one to develop or locate a generic process catalog, customize it to meet the desired scenario, and then to apply it. The model to be presented in this study provides a quick peek into the maturity of a process where the criteria catalog makes one linger in the details to gain any basic understanding of the process and its traits.

Review of Capability Maturity Model Integration

The path to quality IT services is through rigorous processes (Persse, 2006). "Process maturity" is a way to measure the capabilities and deficiencies of these

processes. Grouping a set of capabilities and deficiencies will allow one to build a maturity level. Being able to measure process maturity allows the organization to identify gaps or deficiencies to work on while keeping the aspects of the process that function properly.

Capability Maturity Model Integration (CMMI) was developed by the Software Engineering Institute (SEI) at Carnegie Mellon University (Persse, 2006). It was birthed out of several groups using the Capability Maturity Model (CMM) for software engineering, systems engineering, and integrated product and process development separately, then realizing the need for a single integrated model (Persse, 2006).

Figure 2 shows the different maturity levels for CMMI via a stage model (Godfrey, 2004). The model demonstrates the different maturity levels and how they build on the previous level.

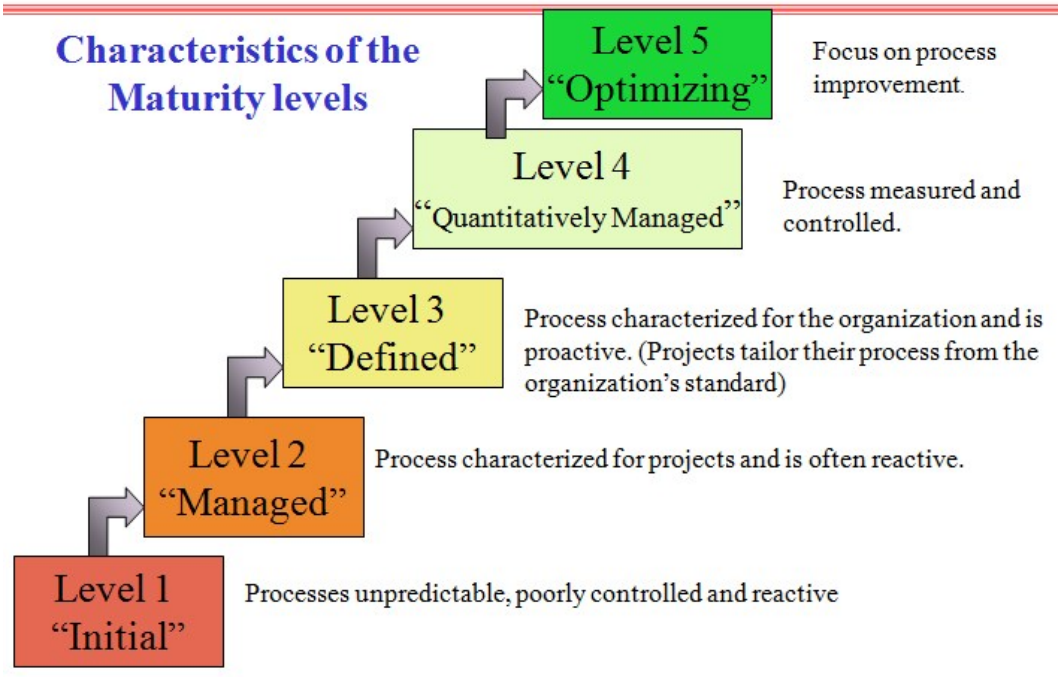


Figure 2. CMMI Maturity Levels (Godfrey, 2004)

Capability Maturity Model Integration for Services (CMMI-SVC) is an extension of the traditional CMMI. It is nearing completion, scheduled for release mid-March 2009 (CMMI for Services, 2009). Historically, CMMI was created to improve the results for software and systems development, and therefore has been difficult to customize and flex to meet the needs of a service organization such as a Primary Support Center. CMMI for Services is the first iteration by the authors of CMMI trying to resolve this deficiency in CMMI.

Considering the maturity of CMMI-SVC, even in a draft format, one cannot ignore the possible impact a CMMI could have for organizations supporting services. CMMI-SVC and ITIL have a similar structure and process. Also, their purpose is the same, to identify the required change to the IT infrastructure to resolve or remove the root cause of the problem.

CMMI-SVC does not break each aspect down into isolated events or actions but the end goal is the same to improve the service delivered to the customer. It validates the model presented in this paper by addressing the same aspects of process requirements.

METHODOLOGY

The methods used to complete this research project have been broken down into three distinct phases. The phases are: develop Problem Management model, refine and test the validity of the Problem Management model, and survey of Higher Education Institutions. After developing and refining the model, a short survey was built and sent out to Higher Education institutions in the Survey of Higher Education Institutions phase. These phases are discussed below.

Phase 1: Develop Problem Management Model

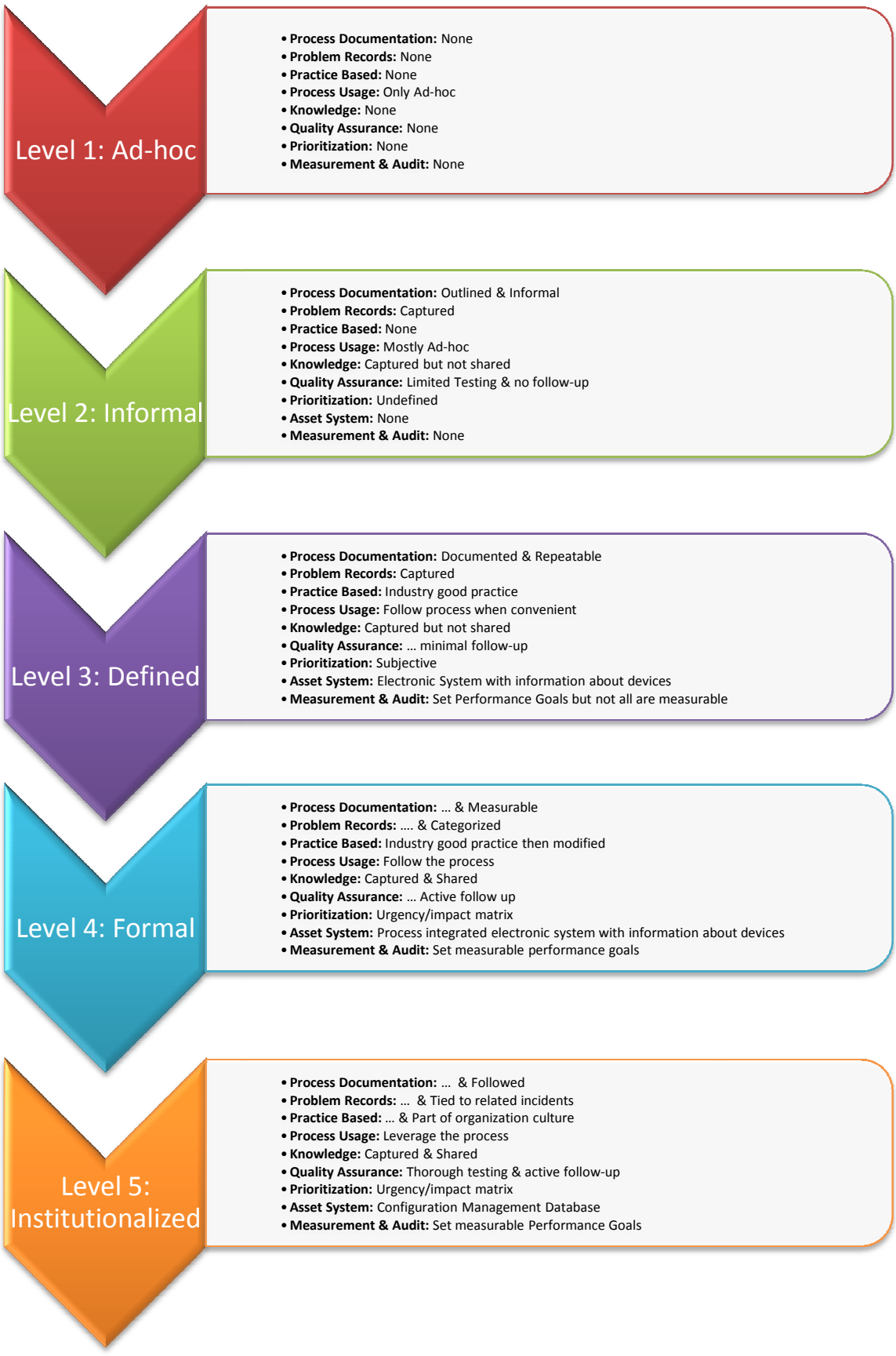
The ITIL framework's non-prescriptive nature, while providing flexibility to customize the process for the organization, does not lead the Help Desk manager to know what the next logical step would be to continue to improve the process.

To develop a Problem Management Maturity (PMM) model, the ITIL Problem Management process portions of the ITIL v2 Service Support book (Office of Government Commerce, 2004) and ITIL v3 Service Operations book (Office of Government Commerce, 2007) were reviewed thoroughly. The foundational and key components for a successful Problem Management process were extracted from the text by reviewing the sections of the Problem Management chapter. The foundational and key components were then used to ascertain the related portions of the process, and then tied together in the model. This resulted in a list of ten criteria for Problem Management (See Appendix A). The CMMI model provided the basis for the stage model format.

Problem Management Maturity Model

Figure 3 is a stage model representing maturity of a Problem Management Process based on the list of criteria developed from reviewing ITIL Problem Management materials. The criteria were placed into five distinct levels of development. Each level builds on the previous level by either adding to the criteria or replacing an undesirable criterion state with a more desirable state. These scale questions address the qualities of a "mature" Problem Management process. A more mature process was defined as one which meets a greater number of criteria such as being well documented, consistently repeatable, measurable, and reliably implemented.

Figure 3. Problem Management Maturity Model


Level 1: Ad-hoc
• Process Documentation: None
• Problem Records: None
• Practice Based: None
• Process Usage: Only Ad-hoc
• Knowledge: None
• Quality Assurance: None
• Prioritization: None
• Measurement & Audit: None
Level 2: Informal
• Process Documentation: Outlined & Informal
• Problem Records: Captured
• Practice Based: None
• Process Usage: Mostly Ad-hoc
• Knowledge: Captured but not shared
• Quality Assurance: Limited Testing & no follow-up
• Prioritization: Undefined
• Asset System: None
• Measurement & Audit: None
Level 3: Defined
• Process Documentation: Documented & Repeatable
• Problem Records: Captured
• Practice Based: Industry good practice
• Process Usage: Follow process when convenient
• Knowledge: Captured but not shared
• Quality Assurance: … minimal follow-up
• Prioritization: Subjective
• Asset System: Electronic System with information about devices
• Measurement & Audit: Set Performance Goals but not all are measurable
Level 4: Formal
• Process Documentation: … & Measurable
• Problem Records: …. & Categorized
• Practice Based: Industry good practice then modified
• Process Usage: Follow the process
• Knowledge: Captured & Shared
• Quality Assurance: … Active follow up
• Prioritization: Urgency/impact matrix
• Asset System: Process integrated electronic system with information about devices
• Measurement & Audit: Set measurable performance goals
Level 5: Institutionalized
• Process Documentation: … & Followed
• Problem Records: … & Tied to related incidents
• Practice Based: … & Part of organization culture
• Process Usage: Leverage the process
• Knowledge: Captured & Shared
• Quality Assurance: Thorough testing & active follow-up
• Prioritization: Urgency/impact matrix
• Asset System: Configuration Management Database
• Measurement & Audit: Set measurable Performance Goals

Phase 2: Refine and Test the Validity of the Problem Management Model

With the end result in mind, the model needed to be as clear and concise as possible. The list of criteria was peer reviewed by two members of the Help Desk Institute staff. Each person's frank and helpful comments were used to refine and enhance the model. In addition, the Help Desk manager at Boise State University and the Lead Technical Support Specialist reviewed the list of criteria in an effort to validate it against members of the target audience. The result was an updated model comprised of ten criteria categories with several statements to match to an organization.

The model of ten criteria categories was converted into a survey. The survey was tested and reviewed by the Help Desk staff at Boise State University. Their input and points of confusion were used to clarify and refine the questions. The end result was a highly readable survey with little need for interpretation by the survey participants.

Phase 3: Survey of Higher Education Institutions

The survey based on the PMM Model was delivered to the Help Desk managers of seventy-eight higher education. A complete list of institutions is available in Appendix C. The institutions are located throughout the entire USA with one located in Canada. The schools were pulled from members of the Help Desk Institute (HDI) Higher Education Forum (HEF), a list of Western Athletic Conference members, and Boise State University peer institutions.

The research began with a survey using the scale questions outlined in Appendix A. The survey also included questions to collect background information about the institution and query the perceived effectiveness of the Problem Management process.

The results were compared with the PMM model. The comparison to the scale allowed the classification of the Problem Management maturity at each school.

It was suggested that the time expected to complete the survey (about 20 minutes) would limit the return from the group survey. In an effort to provide the best data set possible, an incentive was offered to encourage participants to complete the survey. The incentive was $25, $15, or $10 gift certificates for Starbuck or iTunes. A window of opportunity was available to complete the survey to be eligible to enter the drawing for the gift certificates. Winners were selected at random from the pool of people that submitted their information for the drawing.

Limitations of Methodology

The members of the HDI HEF have demonstrated a desire to pursue improved ITSM practices for their organization by becoming members of the HDI organization. This may not equate to implementation based experience of Problem Management practices. However, the desire to work towards improved ITSM practices may lead to a more knowledgeable outlook on the subject.

An online survey delivered via email is a common method for organizations to gather information. Some of the recipients of this survey may receive many requests to take online surveys from other organizations or people per month. Therefore, the time available to respond to a survey, while being limited already, was even further divided. Another factor to consider is the topic and email soliciting participation did not capture the recipients' attention; and thereby, was never regarded as something the recipient should complete.

RESULTS

The results section first discusses the survey response, including information about the population and response rate. Second, PMM Model was used to categorize the results. Third, respondent maturity is evaluated. Finally, several potential mitigating factors are discussed.

Response Information

The survey was sent to 78 managers of the institution's Primary Support Center. The 78 managers included institutions from across the USA and one university from Canada. Twenty-five completed responses were returned, equating to a 32% return rate. Tables 3 and 4 provide an overview the demographics for the respondents.

Table 3. Population Information on Institution Type and HDI Membership

Institution Type and HDI Members	
7 Private	18 public
16 responses from the 27 Help Desk Institute Higher Education Forum Members	

Table 4. Number of Institutions for Student Population

Institution Size	Number of Institutions	Student Population	Full Time Equivalent Average	Full Time Equivalent Range
Small	6	<8999	2431	793 - 4448
Medium	9	>9000	2759	1248 - 8860
Large	9	>20,000	5823	1362 - 19663

Results Comparison to the PMM Model

Categorical and Overall Maturity Results

Table 5 illustrates the overall categorical Maturity Chart mode scores on a 5 point scale for all the responses. The most common responses were ones and twos on the five point scale for process maturity (higher scores represent greater levels of maturity). The overall average score for all but two categories was below the Level 3 (Defined) PMM model level. In addition, the mode category score for Utilization of Configuration Management Database and Measuring Problem Management and Reporting were at Level 1 (Ad-hoc). The mode information shows that most of the respondents experienced immature portions of the Problem Management process. Moreover, there are four criteria categories with a standard deviation larger than 1.25, demonstrating a highly inconsistent maturity per category among the surveyed organizations.

Table 5. PMM Model Categorical Scores for the Results

PMM Model Criteria Categories	Mean	Mode	Standard Deviation
Quality Assurance for the Results	3.2	3	1.04
Incident Management	3.12	3	1.17
Results of Problem Management	2.92	3	1.47
Prioritization of Problem Record	2.84	3	1.28
Problem Management Process Design	2.44	1	1.45
Problem Records	2.4	1	1.41
Problem Management Process	2.24	1	1.27
Utilization of Configuration Management Database	1.44	1	1.08
Measuring Problem Management and Reporting	1.16	1	0.55

The mean values for the categorical scores in combination with standard deviation start to paint a picture of the Problem Management process maturity. Twenty-three of the responses reported a Level 1 (Ad-hoc) maturity level for the criterion Measuring Problem Management and Reporting. This factor is supported by the low mean score with a small standard deviation. Level 1 (Ad-hoc) maturity is the most common mode score for more than half of the criteria categories, which further illustrates overall maturity level of the institutions surveyed.

Table 6 lists the twenty-five respondents' overall scores on a five point scale for the maturity model. Eleven of twenty-five respondents have a mode score of 1 which denotes the relative immaturity of their Problem Management process. The respondents with the highest overall score tend to have the largest standard deviations which exhibit a

high variance on the maturity level for the different criteria of Problem Management. A large variation in the maturity for the different criteria indicates a process that could benefit from process improvement.

Table 6. Overall Result Scores for Respondents

Respondent Number	Mean	Mode	Standard Deviation
1	2.78	3	1.30
2	3.00	3	1.12
3	3.56	4	1.59
4	3.44	4	1.51
5	2.67	1	1.58
6	1.89	2	0.78
7	1.56	1	0.73
8	2.56	2	1.33
9	1.56	1	0.88
10	1.44	1	1.33
11	1.44	1	0.73
12	1.78	1	0.97
13	1.56	1	0.73
14	3.67	4	0.71
15	3.11	5	1.62
16	2.67	3	1.22
17	1.44	1	0.73
18	3.56	4	1.59
19	2.00	1	1.41
20	2.89	4	1.54
21	1.33	1	0.71
22	1.89	1	0.93
23	2.67	3	1.32
24	3.11	3	0.93
25	2.89	1	1.69

Comparison of Incident and Problem Management Results

Other avenues of classifying the data were pursued. One method to consider is an Analysis of Variance (ANOVA). This type of analysis allows one to determine “whether two samples differ significantly with respect to some property” (Hoel, 1966, p.262). The

analysis used here focused on the simplest form of an ANOVA; in which, "observations are classified into groups on the basis of a single property" (Hoel, 1966, p. 263). The ANOVA calculation is "testing a null hypothesis that several population means are equal" (Daniel & Terrell, 1983, p.250).

Table 7 shows the results of the test of the null hypothesis that the maturity of an organization's Incident Management process is equal to the maturity for the Problem Management process. The F critical value is 4.043 and F is 8.118 (See Table 7). With an F value larger than the value for F critical (i.e. F crit in Table 7), the null hypothesis that Incident Management maturity is equal to the Problem Management maturity for an organization must be rejected (Daniel & Terrell, 1983; Hoel, 1966). The analysis results in the conclusion that the groups are significantly different when comparing Incident and Problem Management maturity.

Table 7. Analysis of Variance for Incident Management and Problem Management Maturity

SUMMARY

Groups	Count	Sum	Average	Variance
Incident Process	25	78	3.12	1.36
PMM Model Score	25	58.222	2.329	0.567

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	7.823	1	7.823	8.118	0.006	4.043
Within Groups	46.257	48	0.964			
Total	54.080	49				

Maturity Level Results

Table 8 uses the maturity model scores to classify the respondents into maturity levels. The maturity scores resulted in eleven organizations at Level 1 (Ad-hoc), ten at Level 2 (Informal), and four at Level 3 (defined). Various factors that influence Problem

Management maturity were then included in Table 8. The other factors in table 8 are consistently different based on the Problem Management maturity groupings. The organizations with Level 3 (Defined) Problem Management maturity also have mature Incident Management processes and receive more incidents monthly at their Primary Support Center. It is also consistent that the same organizations have the highest number of open and closed Problem Records. The previous Analysis of Variance conclusion that the groups are significantly different when comparing Incident and Problem Management maturity prohibits us from generalizing a theory based on maturity.

Table 8. Maturity Groupings with Other Factors

Maturity Factors	**Maturity Level**		
	Ad-hoc Level 1	**Informal Level 2**	**Defined Level 3**
Maturity Model Total Score	12 thru 18	23 thru 27	30 thru 33
Number of Cases	11	10	4
Incident Process Maturity	2.55	3.40	4.00
Average Number of Incidents	2.82	3.40	4.25
Average Number Problem Records Open	1.71	2.10	4.00
Problem Records Closed	1.71	2.89	4.00
Pursued Problem Management Opportunities	1.38	2.63	2.25
Time for Problem Management Monthly	2.13	2.78	3.00
Primary Support Center Staff that Enter (Creation) Problem Records	1.89	2.40	3.33
Primary Support Center Staff involved Problem Record resolution	1.50	2.50	2.33

Figure 4 shows the pre-self assessment question and PMM Model self assessment results. The survey question, "Do you feel that your problem management needs to be improved?" was asked before the Problem Management self assessment portion of the survey. These subjective assessments agreed well with the PMM model results. The results of the pre-self assessment question revealed that all the organizations were at the lower three of the five maturity levels, which agrees with the results from the PMM Model. Using the dividing points 1.5 and 2.5 to break the PMM Model results into the defined levels, the same number of respondents selected a maturity Level 1 (Ad-hoc). Three organizations slid down into the maturity Level 2 (Informal). Thirteen aligned to maturity level 3 while pre-self assessment had sixteen at a maturity level of three.

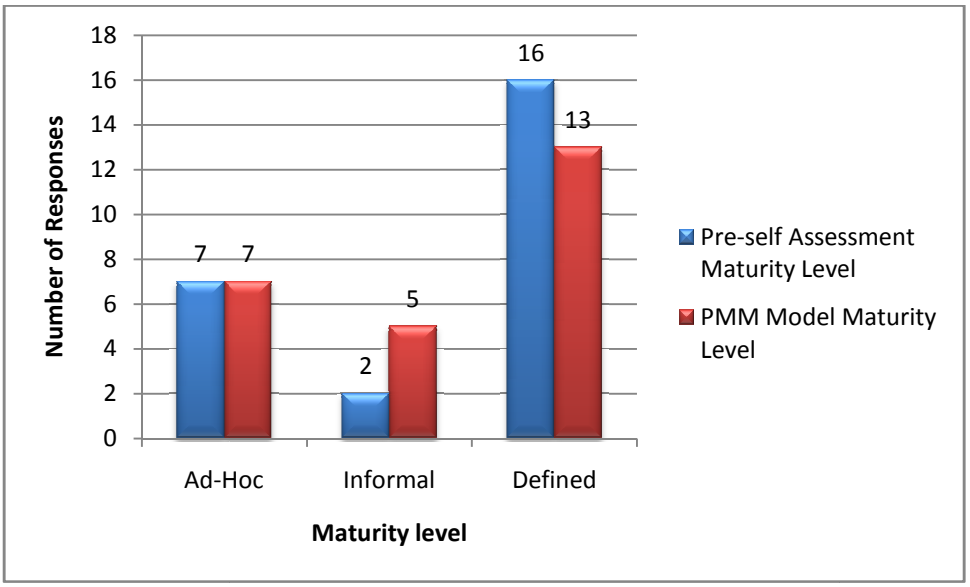


Figure 4. Maturity Self Assessment

Mitigating Factors

Several factors were considered that might influence the maturity of Problem Management for those organizations. The factors are size, institution type, and support

organization type. It was found, however, that none of these mitigating factors influenced the Problem Management maturity level.

Size

A hypothesis about Problem Management in Higher Education was that an organization's size affects the maturity of the Problem Management process. It was believed that larger organizations would tend toward into a more structured environment and therefore develop a more mature Problem Management process.

The Integrated Postsecondary Education Data System (IPEDS) database (http://nces.ed.gov/IPEDS/) was used to gather data student population and Full-time equivalent staff by assigned position criteria. Additionally, the survey gathered information about the number of full-time, part-time and student employees for the Primary Support Center. This information was compiled to build an overall Full-time equivalent (FTE) count for the Primary Support Center. The respondent could have selected answers as shown in Table 9 below.

The Total FTE count was calculated using the formula in Equation 1 a calculation of total FTE count.

Table 9. Example Response to Number of Employees by Type

Respondent	Full-Time (X)	Part-Time (Y)	Student Employee (Z)
ABC	5 to 19 full time	less than 5 part time	5 to 19 student employees

$$Total\ FTE\ Count = X + \{Y * 0.5\} + \{Z\ * 0.33\} \quad (1)$$

Where X = Average of the Full Time Range, Y = Average of the Part-Time Range, Z = Average of the Student Employee Range (Fitzgerald, 2008). Using the information from the example response in Table 9 becomes:

$$Total\ FTE\ Count = \frac{5+19}{2} + \left\{\frac{5+0}{2} * 0.5\right\} + \left\{\frac{5+19}{2} * 0.33\right\} \quad (2)$$

This example results in the following calculation:

$$Total\ FTE\ Count = 12 + 1.25 + 3.96 = 17.21 \approx 17\ FTE \quad (3)$$

The information on Student Population, Full-Time Equivalent, and Primary Support Center Full-Time Equivalent was used to divide respondents into small, medium, and large categories. The divisions are as outlined in Table 10.

Table 10. Size Divisions per Criteria

Size	Student Population	Full Time Equivalent	Primary Support Center Full Time Equivalent
Small	<8999	<1999	<11
Medium	>9000	>2000	>12
Large	>20,000	>4000	>30

Tables 11, 12 and 13 show the ANOVA calculations based on size types: Student Population, Full-Time Equivalent, and Primary Support Center Full-Time Equivalent. None of the results produced a value for F that was equal to or larger than the F crit for the results. Therefore, the ANOVA analysis showed that size is not a determining factor for Problem Management maturity.

Table 11. Problem Process Maturity versus Student Population

SUMMARY

Groups	Count	Sum	Average	Variance
Small	7	119	17	29.66667
Medium	9	194	21.55556	43.02778
Large	9	211	23.44444	51.52778

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	168.5156	2	84.25778	1.983715	0.16141	3.443357
Within Groups	934.4444	22	42.47475			
Total	1102.96	24				

Table 12. Problem Process Maturity versus Full Time Equivalent

SUMMARY

Groups	Count	Sum	Average	Variance
Small	10	198	19.8	49.06667
Medium	8	176	22	59.14286
Large	7	150	21.42857	37.28571

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	23.64571	2	11.82286	0.240989	0.787898	3.443357
Within Groups	1079.314	22	49.05974			
Total	1102.96	24				

Table 13. Problem Process Maturity versus Primary Support Center FTE

SUMMARY

Groups	Count	Sum	Average	Variance
Small	8	165	20.625	34.83929
Medium	9	175	19.44444	43.52778
Large	8	184	23	65.14286

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	54.86278	2	27.43139	0.575796	0.570506	3.443357
Within Groups	1048.097	22	47.64078			
Total	1102.96	24				

Support Structure Type

Table 14 presents the ANOVA analysis on the criterion type of support organization. The results were grouped into the categories Centralized, Decentralized, or Federated (See Glossary for definitions). It was theorized that the support organization type might identify a group of institutions with a more mature Problem Management process. Again, the results of the calculations failed to show any significant difference in PMM scores among these types of support organizations.

Table 14. Analysis of Variance on Support Organization Type

SUMMARY

Groups	Count	Sum	Average	Variance
Centralized	5	114	22.8	31.2
Decentralized	7	138	19.71429	31.90476
Federated	13	272	20.92308	63.24359

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	27.808351	2	13.9041	0.28451	0.75510	3.44335
Within Groups	1075.1516	22	48.8705			
Total	1102.96	24				

Institution Type

Table 15 displays the ANOVA analysis on the institution type. There were two possible types: public and private. The table shows that this was not a source of variance for the group because the F value is not equal to or larger than the F crit value. Once more, the results must be considered as one group with respect to institution type.

Table 15. Analysis of Variance on Institution Type

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Public	18	394	21.88889	41.75163
Private	7	130	18.57143	56.28571

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	55.467937	1	55.46794	1.217921	0.281182	4.279344
Within Groups	1047.4921	23	45.54313			
Total	1102.96	24				

DISCUSSION

The development of a high level maturity scale for Problem Management was a primary goal of this research. The author of this work posits that this scale would be a valuable measuring tool for organizations' building improved Problem Management processes. According to Deming's Plan-Do-Check-Act (PDCA) model, the last two steps (Check-Act) require one to verify the process outcomes which occurred as planned in the beginning of the process and then, act on the information gained (Deming, 1994; Scherkenbach, 1992). If the PMM model and Deming's PDCA model were combined, one could build a Problem Management process via an iterative approach using the maturity scale to check the results of the process and then act to improve the process. These concepts are the basis for the processes outlined in the fifth ITILv3 book, Continual Service Improvement.

Another benefit of the PMM model is to identify areas that could possibly have the largest process improvement impact for their organization. With the area(s) for process improvement identified, the organization can focus effort on how to improve the process instead of debating what to improve

Figure 5 is a histogram of the entire PMM Model response set from all 25 respondents. The high frequency of Level 1 (Ad-hoc) responses indicates that there are many respondents which have hardly taken a first step toward improving their Problem Management process. It also illustrates the overall Problem Management maturity for most organizations is still an emerging and developing topic. Over 52 percent of the

responses fall within the maturity levels of one and two. Also, the figure reveals a gap, by the increased frequency, between Level 2 (Informal) and Level 3 (Defined) responses. This gap suggests that the organizations that have implemented portions of Problem Management over which they can better control. It is illustrated by the 35 percent increase between levels two and three.

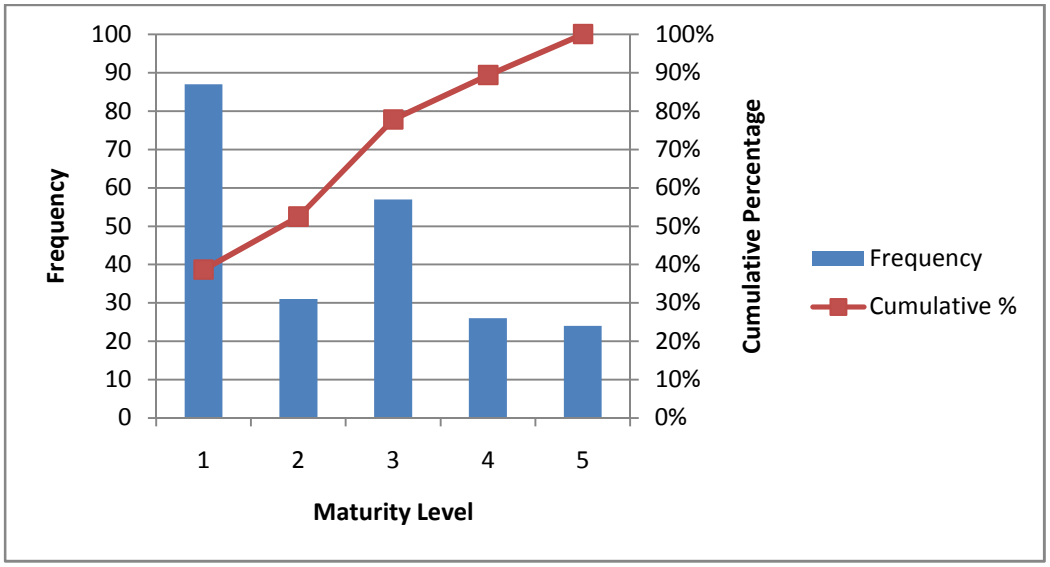


Figure 5. Histogram of the Entire PMM Model Response Set

For example, Table 16 shows the relative immaturity of configuration management within the Problem Management process. Configuration management is used to show the interconnected relationships between systems and the information about the individual components that make up the entire system. Problem Management uses configuration information to assist with root cause analysis. The results of this study show a low maturity with a significant range of variation. The criterion, Utilization of Configuration Management Database, is one of the most difficult items to implement. The maturity scores and variation demonstrate that fact.

Table 16. Utilization of CMDB Overall Maturity Results

PMM Model Criteria Category	Mean	Standard Deviation
Utilization of Configuration Management Database	1.44	1.08

It is important to remember that configuration information is only a small portion of the Problem Management process. Asset Management or a CMDB is possible to implement without purchasing or developing software (Using Excel with manually updated changes), but such solutions do not scale for use at the larger institutions. A little creativity and careful selection of process actions can produce a quality Problem Management process without additional tools. Therefore, an organization could improve to a certain level of maturity through the expenditure of time to develop, implement, and improve the Problem Management process.

Typically, the Primary Support Center is the central source for Incident Management. Processes like Problem Management are more difficult to develop without a wider adoption throughout the organization. This notion is supported by a response to the statement that Problem Management has been an effective use of time for the Primary Support Center. The respondent stated, “The primary support desk cannot solve these issues alone and needs input from the other IT teams” (Survey, 2008). The high level of variance between Incident Management and Problem Management maturity seems to support this supposition.

Table 17 contains the results for the agree/disagree questions in the survey for the following factors:

- Does the staff in the Primary Support Center view the Problem Management process outcomes (i.e. work-arounds, requests for change) as fruitful?
- Has a Problem Management process added value to your organization?
- Do you agree or disagree with the following statement? Problem Management has been an effective use of time for the Primary Support Center.

As an organization's process becomes more mature; they continue to better understand the value proposition provided from Problem Management as they can benefit in their own organization. This factor is demonstrated in Table 17 by the reduction of disagree or neutral responses to the questions listed above.

Table 17. Analysis of Agree - Disagree Responses

	Maturity Level	**Ad-hoc**	**Informal**	**Defined**
	Maturity Model Total Score	12 thru 18	23 thru 27	30 thru 33
	Number of Cases	11	10	4
Does the staff in the Primary Support Center view the Problem Management process outcomes (i.e. work-arounds, requests for change) as fruitful?	Strongly Disagree or Disagree	3	0	0
	Neutral	7	2	1
	Strongly Agree or Agree	1	8	3
Has a Problem Management process added value to your organization?	Strongly Disagree or Disagree	2	0	0
	Neutral	8	3	0
	Strongly Agree or Agree	1	7	4
Problem Management has been an effective use of time for the Primary Support Center.	Strongly Disagree or Disagree	2	0	0
	Neutral	5	2	0
	Strongly Agree or Agree	4	8	4

In response to the question, “Does the staff in the Primary Support Center view the Problem Management process outcomes (i.e. work-arounds, requests for change) as fruitful?” one respondent wrote,

“The Help Desk and Desktop Services teams do see the outcomes as useful. However, many of the problems lie in Systems, Operations, and Networking.

Members of those teams do not see the process outcomes as necessary and often do not provide the follow-thru needed to thoroughly close a Problem ticket." This is an interesting response because the groups with direct customer contact grasp the value of Problem Management. Problem Management is much more than fixing the root cause of an issue with a technology. A key facet of Problem Management is capturing knowledge. It is clear from the statement above that the Systems, Operations, and Networking teams may not fully understand the impact of following the process. Captured knowledge can be used to allow faster resolution of incidents which leads to more time to work on other tasks or projects.

One survey response was an admonition that tracking problem tickets is a significant success for the organization. The respondent went on to write, "These are as useful for the technical staff and the university community as the Problems reported as seen by our users in the self-service support portal," which is a great demonstration of using process to explain IT's value to the customer. This organization has created a layer of transparency to allow the users to easily see if they may be affected by a known error in their computing environment.

Figure 6 outlines the results for the staff's involvement in Problem Management. The respondents' staff used about 12% to 50% of the opportunities to interact with the process. Even the most mature organizations underutilize the staff interaction with the process. Yet again, the data shows that Problem Management processes are immature and not properly utilized.

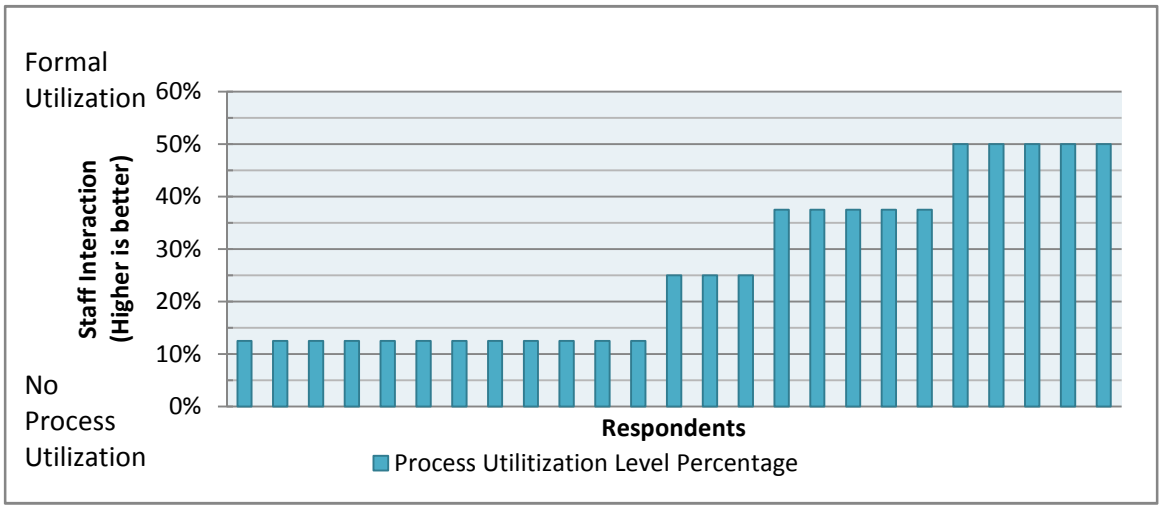


Figure 6. Staff Involvement with Problem Management

The information provided by the survey results provides a high level view into Problem Management. It can be surmised that Problem Management has not gained a significant foothold in Higher Education Information Technology organizations. The lack of variance in any of the common criteria for categorizing institutions and the immature results for Problem Management processes leads one toward the belief that Problem Management is at best an isolated event to certain IT organizations.

LIMITATIONS

The results from the survey pointed out three possible condition combinations (i.e. states) to add to the model:

- Problem records are captured and tied to related Incidents but not categorized
- Organizational Problem Management process has not been developed
- The work-arounds and requests for change receive limited testing and active follow-up is performed with Problem Management reporting measurements.

The added state for Problem Records of *captured and tied to related Incidents but not categorized* is unusual. The state is not an inconceivable combination of activities for problem record. It seems to be an unlikely occurrence from the author's point of view but it was brought into focus by the survey results.

The added state for *Organizational Problem Management of the process has not been developed* was an oversight in the model development. All the other stages for Organizational Problem Management required the organization to have a documented process. There was no option in the model to report that there was no process.

The added state for work-arounds and requests for change of *received limited testing and active follow-up was performed* with Problem Management reporting and measurements was added to the model. It was a logical iteration that was missed during the model design phase. Upon review of the results, it became apparent that it was a logical state to perform quality assurance on problem resolutions. The combination of

limited testing and active follow-up could provide the most value with the least amount of investment.

The criterion for Adoption of Problem Management proved to be answered inconsistently. The method used to solicit the information about the staff's involvement with Problem Management combines three interrelated topics. It was intended that the respondent would logically pick one answer from each of the three aspects because some of the options were mutually exclusive. Unfortunately, the survey did not enforce the mutual exclusivity so the resulting data did not map to the model. Therefore, this study cannot confirm the validity of the Adoption of Problem Management portion of the PMM Model.

The model brought forward in this study provides a solid quick assessment tool. The overview nature of the model does not provide process implementation details. It could be used to start development on a shell or skeletal process but one will have to use other sources to complete the development. The PMM Model's purpose is as an assessment tool.

APPLICATION TO PRACTICE

This maturity model can be used by organizations to set realistic goals for building and improving a Problem Management process. It can be used as a checklist of items necessary to include in the process. It would be quite difficult to build and introduce a process that works at an Institutional level. An organization can use the PMM model to validate the process maturity during development which would then allow that organization to introduce a successful process.

Combining the PMM model maturity scale and the PDCA model yields an especially compelling tool to help an organization successfully add a continual service improvement process for Problem Management for their organizational structure. It introduces a couple of topics at an individual process level which can then be tackled successfully. Being able to successfully introduce a process to an organization and then improve the process will further expand the returns on the investment.

Real World Applications for the PMM Model

Change Management Introduction

One respondent provided a real world tale about how they were driven to a process based approach for their support organization.

> "Our networking group decided to do an upgrade to an electrical panel, but neglected to tell anyone that the network would be down on a Saturday morning very early since it was only going to take half an hour to complete. The upgrade did not go as planned and power to the platform was out for more than 6 hours.

> Because no one knew about the upgrade, no one notified the academic side of the house that there might be issues. Online exams had been scheduled and could not be canceled. All servers were down and the server group had no way of providing service. This led to the creation of our change management committee. All RFC must now be reviewed and approved before any changes can be acted on."

While it does not directly relay information about Problem Management at the organization, it does demonstrate the need to manage IT from the customer's point of view and expectations.

Application of Problem Management at Boise State

The researcher was charged with developing a Problem Management process while working for Boise State University. The initial task was to recommend a process to the User Services Manager. The recommendation was then up for review and discussion. It proved to be a challenge to use the existing tools and Incident process to introduce a Problem Management process.

It became apparent to the researcher that change must be managed: not change in technology, but change in human processes. The effort to develop the new process was as much about building the new tool for the department as it was about managing people and their expectations and disagreements with the new process.

A process was developed with two key aspects in mind. The first aspect was selecting the best combination of process and what could be introduced as new requirements without overwhelming the staff. Another key driver was the fact that only

minimal changes could be requested to existing systems and no money was available to purchase new systems to support the new process.

An iterative approach was selected to implement the new Problem Management process. This approached allowed the introduction of a process that had key important components but still needed further improvements to become a robust mature process. The key process requirements were selected to develop the structure of the process. The following key process actions were selected for inclusion in the initial Problem Management process:

- Problem Identified
- Open Problem Ticket
- Document Known Error
- Set Priority and Make Assignment
- Diagnose the Issue
- Escalate Based on Categorization and Prioritization
- Develop Workaround
- Submit a Request for Change
- Close Problem Ticket

Boise State University has recently introduced a new knowledge base for its IT staff to use. A core value of Problem Management was providing information for the staff to use during Incident Management, so creation of new articles in the knowledge base was specifically highlighted during the process development.

Table 18 provides a view into the maturity of Problem Management process that was developed through the process outlined above. The low maturity scores of one or two point out the portions of the process where detail was specifically left out to allow the department to succeed at introducing the new process. For example, the process the researcher introduced did not provide a methodology for prioritizing Problem Records beyond the Lead Technical Support Specialists and Help Desk Manager will evaluate each Problem Record to prioritize it. Boise State has an average PMM Model score of 2.22 which would place us in the Level 2 (Informal) stage for the model.

Table 18. Overall Categorical Scores versus Boise State University's Scores

PMM Model Criteria Categories	Overall Average	Boise State
Quality Assurance for the Results	3.2	2
Incident Management	3.12	3
Results of Problem Management	2.92	3
Prioritization of Problem Record	2.84	1
Problem Management Process Design	2.44	4
Problem Records	2.4	3
Problem Management Process	2.24	2
Utilization of Configuration Management Database	1.44	1
Measuring Problem Management and Reporting	1.16	1
Average Maturity Score	2.42	2.22

The researcher has since been tasked to improve Boise State's Problem Management process. Several aspects of the process do need significant improvement.

Management has identified measureable and meaningful goals as a key aspect to add to the enhanced process. There are several aspects under consideration for the goals:

- What are reasonable time frames to identify reasonable workarounds or request for change?
- How do we measure goals for the individual, department, or IT organization?
- How do we measure time allocated to staff for Problem Management?

The PMM model was used to select the correct actions for the Problem Management process. The current process is at a Level 2 (Informal) maturity using the PMM model, so a significant improvement can be seen by moving to a Level 3 (Defined) maturity. Time is needed to build a set of goals for Problem Management that match the department's goals, which can be measured and provide meaning. One example of a goal could be that User Services identifies two problems per month. This is a measurable goal, but the significance of this goal is highly dependent on the department's or organization's goals. In this case, Boise State wants to drive usage of the Problem Management process so the goal has meaning. This goal may no longer of consequence in a year, but an iterative approach via the PDCA process would allow Boise State to update or remove the goal at any time according to the business needs.

FUTURE RESEARCH

The scope of the survey conducted for this research was limited to the validation of the PMM Model. The next step is to move to a wider survey to gather more data about Problem Management. The additional data could be used to identify trends for Problem Management; further study could go even deeper to assess the usefulness of Problem Management.

The maturity results are for only North American universities. It could be interesting to broaden the study to an international scope to gain a better view of Problem Management in Higher Education. Another avenue to consider is researching Problem Management in business and government which could result in a comparison between the three organization types.

There are a limited number of studies on individual ITIL processes. ITIL has a number of different processes none of which have been studied with any depth. The methods used to research Problem Management could be applied to any other ITIL process.

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APPENDIX A

Criteria for Quality Problem Management

Each criterion is based on the ITIL Problem Management process framework. The list of qualities for each criterion is in order of worst to best. The most well aligned Problem Management process will use the last quality on each criterion. These criteria were summarized to build the PMM Model.

A. Incident Management Process

    I. An Incident Management process is not documented.

    II. An Incident Management process is outlined and the process is informally followed.

    III. An Incident Management process is fully documented and repeatable.

    IV. An Incident Management process is fully documented, repeatable, and measurable.

    V. An Incident Management process is fully documented, repeatable, measurable, and consistently followed

B. Problem Management Process

    I. A Problem Management process is not documented.

    II. A Problem Management process is outlined and the process is informally followed.

    III. A Problem Management process is fully documented and repeatable.

    IV. A Problem Management process is fully documented, repeatable, and measurable

    V. A Problem Management process is fully documented, repeatable, measurable, and consistently followed

C. Problem Records

I. Problem records are not captured

II. Problem records are captured but not tied to related Incidents.

III. Problem records are captured and tied to related Incidents but not categorized

IV. Problem records are captured and categorized (using the same scheme as Incident Management) but not tied to related Incident

V. Problem records are captured and categorized (using the same scheme as Incident Management) and tied to one or more related Incident(s)

D. Problem Management Process Design

I. Organizational PRM process has not been developed

II. Organizational Problem Management process was designed independently of industry good practice.

III. Organizational Problem Management process is purely based on industry good practice and has not been modified to your organization.

IV. Organizational Problem Management process is based on industry good practice and has been modified to match your organization's own practice model.

V. Organizational Problem Management process is best practice and it has become part of the organizational culture.

E. Adoption of Problem Management

I. The staff only performs ad-hoc Problem Management and in reaction to multiple related incidents (Problem Management happens when you have a problem that can't wait).

II. The staff informally performs Problem Management by reacting to incidents and suggesting possible problem records. Mostly ad-hoc Problem Management occurs with very little review of priority or urgency of the problem (we try but don't get to it).

III. The staff actively completes the Problem Management process by reactively dealing with problems and occasionally suggesting problems. The staff has scheduled time for root cause analysis and producing work-arounds and requests for change (RFCs), which is often consumed by processing incidents. The problems are processed after setting priority and urgency to determine order.

IV. The staff actively completes the Problem Management process by reactively dealing with problems and proactively suggesting problems. The staff have scheduled and dedicated time for root cause analysis and producing work-arounds and requests for change (RFCs) outside of Incident Management process. The problems are processed after setting priority and urgency to determine order.

F. Results of Problem Management

I. Problem Management process produces no documented solutions or workarounds (Support Staff resolve the cause with no communication or documentation about the resolution.)

II. Problem Management process produces documented solutions in the form of a Request for Change (RFC), or workarounds that may not be shared with other staff.

III. Problem Management process produces documented solutions in the form of a Request for Change (RFC) and workarounds are shared via a knowledgebase.

G. Quality Assurance for the results

I. The work-arounds and RFCs are not tested and no follow-up on the solution is performed (Follow-up would include monitoring for re-occurrence and reduction of related incidents).

II. The work-arounds and RFCs receive limited testing and no follow-up on the solution is performed.

III. The work-arounds and RFCs receive limited testing and minimal follow-up on the solution is performed.

IV. The work-arounds and RFCs receive limited testing and active follow-up is performed with PRM reporting measurements.

V. The work-arounds and RFCs are thoroughly tested on multiple cases and active follow-up is performed with Problem Management reporting measurements.

H. Prioritization of Problem Records

    I. The Problem Management process has no prioritization criteria.

    II. The Problem Management process prioritizes by undefined criteria.

    III. The Problem Management process defines priority by subjective urgency and impact to the business operation.

    IV. The Problem Management process defines priority by an urgency/impact matrix according to predefined levels set by the business

I. Utilization of Configuration Management Database (CMDB)

    I. Problem Records do not have an electronic system with information about devices to support them.

    II. Problem Records and an electronic system with information about devices (e.g. Asset Management or Asset Inventory) are not integrated. Asset information must manually be retrieved from a separate system for input to the Problem record.

    III. Problem Records and an electronic system with information about devices (e.g. Asset Management or Asset Inventory) are integrated. Asset information is tied to and used to resolve problem records.

    IV. Problem Records and Configuration Management processes are integrated via a CMDB

J. Measuring Problem Management and Reporting

    I. Nothing is measured or reported about the Problem Management process.

II. Problem Management has set performance goals (such as percent of or number of problems removed from the environment each month, percent of or number of problems converted to known errors, Average age of a high priority problem, Percent of problems addressed reactively versus proactively). Information about the Problem Management process is reported to management but not all performance goals are measurable.

III. Problem Management has set performance goals, which are all measurable. Information about the Problem Management process is reported to management.

IV. Problem Management has set performance goals, which are all measurable. Information about the Problem Management process is reported to management. Audits on the process are performed to verify aspects of the process such as conformance to the process, problems have been correctly identified and recorded, problems have been corrected, and reports have been produced and contain meaningful information.

APPENDIX B

PMM Model Results

Table B1. PMM Model Results with Calculations

Respondent	A	B	C	D	F	G	H	I	J	**Mean**	**Median**	**Mode**	**Standard Deviation**
1	3	2	3	4	5	3	3	1	1	2.78	3	3	1.30
2	3	3	2	4	5	3	3	3	1	3.00	3	3	1.12
3	4	3	4	5	5	4	5	1	1	3.56	4	4	1.59
4	4	4	4	4	5	5	3	1	1	3.44	4	4	1.51
5	2	1	5	1	3	5	3	3	1	2.67	3	1	1.58
6	2	2	1	2	3	3	2	1	1	1.89	2	2	0.78
7	2	2	1	2	1	3	1	1	1	1.56	1	1	0.73
8	4	2	3	2	5	3	2	1	1	2.56	2	2	1.33
9	2	1	1	1	1	3	3	1	1	1.56	1	1	0.88
10	5	1	1	1	1	1	1	1	1	1.44	1	1	1.33
11	1	1	2	1	3	1	2	1	1	1.44	1	1	0.73
12	3	1	1	1	3	3	2	1	1	1.78	1	1	0.97
13	2	1	2	1	1	3	2	1	1	1.56	1	1	0.73
14	4	3	4	4	5	3	3	4	3	3.67	4	4	0.71
15	5	5	3	2	3	3	5	1	1	3.11	3	5	1.62
16	3	3	3	2	3	5	3	1	1	2.67	3	3	1.22
17	2	1	1	1	1	3	2	1	1	1.44	1	1	0.73
18	4	5	4	4	3	5	5	1	1	3.56	4	4	1.59
19	5	1	1	1	3	3	2	1	1	2.00	1	1	1.41
20	4	4	1	4	3	3	5	1	1	2.89	3	4	1.54
21	1	1	1	1	1	3	2	1	1	1.33	1	1	0.71
22	3	2	2	1	3	3	1	1	1	1.89	2	1	0.93
23	3	2	5	4	3	2	3	1	1	2.67	3	3	1.32
24	3	3	4	4	3	4	3	1	3	3.11	3	3	0.93
25	4	2	1	4	1	3	5	5	1	2.89	3	1	1.69
Mean	3.12	2.24	2.4	2.44	2.92	3.2	2.84	1.44	1.16	2.42	2.32	2.24	
Median	3	2	2	2	3	3	3	1	1	2.67	3	2	
Mode	3	1	1	1	3	3	3	1	1	2.67	3	1	
Standard Deviation	1.17	1.27	1.41	1.45	1.47	1.04	1.28	1.08	0.55				

APPENDIX C

List of Surveyed Organizations

This list was built from taking the list of Western Athletic Conference Schools and searching for Help Desk Manager or Service Desk Manager (Example Google Search: site:boisestate.edu Help Desk manager).

HDI HEF Members	**WAC (Full and Affiliate Members)**	**Boise State University Peer Institutions**
Abilene Christian University	*Full Members*	Portland State University
Baylor University	Boise State University	Cleveland State University
Boise State University	Fresno State University	Eastern Washington University
Brigham Young University	University of Hawaii at Mānoa	George Mason University
Calvin College CIT Dept	University of Idaho	Northern Arizona University
Central New Mexico Community College	Louisiana Tech University	University Of Alaska Anchorage
Colorado Mountain College	University of Nevada, Reno	University of Northern Colorado
Fairleigh Dickinson University	New Mexico State University	University Of Cincinnati-Main Campus
Georgia Southern University	San José State University	University Of Louisville
Hobart and William Smith Colleges	Utah State University	University Of Nebraska-Omaha
Indiana University	*Affiliate Members*	University Of Nevada-Las Vegas
Johns Hopkins Bloomberg School of Public Health	Sacramento State	University Of Northern Colorado
McGill University	Cal State Fullerton	University Of Texas-El Paso
New York University	Southern Utah	Wayne State University
Saint Joseph's University	Northern Arizona	Weber State University
Southern Methodist University	San Diego	Wichita State University
Texas Christian University		
Texas Tech University		
University of Akron		
University of California, Davis		
University of Dayton		
University of Oklahoma		
University of Saskatchewan		
University of South Carolina		
University of Utah		
University of Wyoming		
Western Carolina University		

GLOSSARY

Centralized. A centralized support organization will contain a majority of the institutions' support activities, particularly those regarding decision-making. Little IT support occurs outside of the central support organization's purview.

Customer. Any person, either internal (institution employee) or external, who is supported by your support center.

Decentralized. A decentralized support organization will disperse the support activities throughout the institution. Several similar support organization structures will exist throughout the institution with very little coordination occurring between them. Core services (such as the network or phone infrastructures) could be managed by a single entity across the entire institution.

Federated. A federated support organization will have a central core support organization, but units or departments across the institution may also have support offices that have some level of autonomy. A key advantage for this model is that support is provided by people tied to the unit or department. The United States of America is an example of a federated organization.

Incident. Any reduction or interruption to the standard operation of a service, which can result in a decrease in the quality of the service.

Major Incident. An incident with a high impact, or potentially high impact, which requires a response that is above and beyond that given to normal incidents. Typically, these incidents require cross-company coordination, management escalation, the mobilization of additional resources, and increased communications.

Problem. Unknown underlying cause of one or more Incident.

Support Organization. Encompasses one or more support centers as well as other departments involved in a support organization.

Support Center. Most specific level where support is delivered. There may be one or more of these within a support organization. Example names for a support center could be Help Desk, Service Desk, User Services, or Customer Support.