THE STUDY OF THE KEY COMPONENTS OF A WORK ORDER PROCESS WITHIN A HOSPITAL ENVIRONMENT

by

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A RESEARCH PAPER
SUBMITTED TO COMPLETE THE
PLAN B REQUIREMENTS IN
150-790
FIELD PROJECT IN MANAGEMENT TECHNOLOGY

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December, 2000

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ABSTRACT

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The Study of the Key Components of a Work Order Process within a Hospital Environment
(Title)

Management Technology Tom Lacksonen December/2000 62
(Graduate Major) (Research Advisor) (Month/Year) (No. of Pages)

American Psychological Association (APA) Publication Manual .
(Name of Style Manual Used in this Study)

The purpose of this study is to evaluate the key components of a functional work order process for facilities managers and to determine how it can improve the workflow within a hospital's facilities department.

A comprehensive review of literature was done to research maintenance procedures and systems used in hospital facilities. Secondly, to understand how a work order process creates opportunities to improve workflow, an evaluation of the key components of a process was conducted, along with a review of processes and procedures currently in place.

Additional data for the study was gathered through the use of several survey techniques and through a quantitative evaluation (process charts, efficiency calculations, etc.) reviewed in the literature review.

Acknowledgments

I am deeply indebted to those individuals who supported me throughout this arduous and time consuming process, including all of my advisors, beginning with Elbert Sorrell, Zeke Smolarek, Martha Wilson and ending with the strong support of Tom Lacksonen without whom this paper may have not been completed.

Special thanks to my family (Roderic, and Kendall) and my parents Marvell and Clella Porter, and my sister Dianna Allen. Thank you is also extended to Felicia Hurst who was there from the very beginning through it all.

Acknowledgement should also be given to the American Hospital Association resource center (Chicago, Illinois), and the International Facility Management Association's research library services (Houston, Texas) for their list of resources.

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CHAPTER ONE

STATEMENT OF THE PROBLEM

Introduction

"The practice of coordinating the physical workplace with the people and the work of the organization, integrating the principal of business administration, architectural and behavioral and engineering sciences," provides a broad description of facilities management, as defined by the International Facility Management Association, (Research Report #18, Benchmark III, 1998 p. 5).

This study focuses on facilities and building maintenance organizations within the service industry, specifically hospitals. However, the definition cited above encompasses facilities of all types. To most people, a hospital evokes dramatic images of bustling emergency rooms where the customers (the patients) of the hospital are pushed through corridors on stretchers awaiting the arrival of the doctors and nurses.

However, behind the scenes the pace tends to be less hectic and the emphasis becomes controlling downtime of equipment, environmentally controlling patient rooms and providing a safe working environment. The people that are accountable for behind the scenes of "the plant/facilities operations" are not the doctors and nurses but the facilities manager and maintenance personnel working within a facilities or plant maintenance

department. Furthermore the customers are generally the doctors, nurses, and patients.

The tasks of the facilities manager can be quite overwhelming for several reasons as follows: According to statistics compiled by the International Facility Management Association (IFMA), a hospital can range in size from 500,000 square feet to well over one million square feet. The size coupled with hours of operation (13-16 hours), and the number of occupants (500-1000) can dramatically affect a manager's ability to plan and schedule maintenance work (Benchmarks III, 1998, pp. 10, 14, 15).

The interfacing of the facilities manager with the maintenance department is critical. The Manager delegates the day-to-day (hands-on) operations to the maintenance personnel as suggested by Birchak (1998). "The facilities manager can be thought of as the head coach of the facilities team and holds members responsible for results. The head coach leads the development of the overall plan and strategies" (Birchak, 1998, p.1).

The maintenance personnel in turn, ensures all building systems remain operational. More specifically they bear direct responsibility for the preventative, remedial upkeep and repair of the facility and its components, for example, HVAC, electrical, plumbing, elevators, carpentry and painting work. Refer to Figure 1.1 for additional information.

A key component or element of this interfacing between manager and maintenance is effective planning. Planning involves developing procedures and protocol and documenting how the work is to be accomplished. Without planning the environment can become chaotic much like the hospital emergency room described above. Palmer (1996) has noted that, "Planning helps both the quality and productivity of maintenance. Quality is directly affected because the workspace, instructions, parts, tools and crafts are all correctly identified and ready before the job starts. Quality is indirectly affected by the boost in productivity because the workforce can spend more time on difficult jobs and pro-active work" (Palmer, 1996, p.19).

Palmer (1996) further stated that "planning affects productivity by reducing delays. … Simply implementing a fundamental planning and scheduling system should improve productivity to about 45 percent" (Palmer, 1996, p.19). The ultimate purpose of planning then must be to organize maintenance resources in advance so that when the work is done it can be carried out more effectively.

It should be noted that 25 to 35 percent productivity is typical of traditional type maintenance organizations with set-up, travel time and breaks, etc. being taken into consideration. Generally

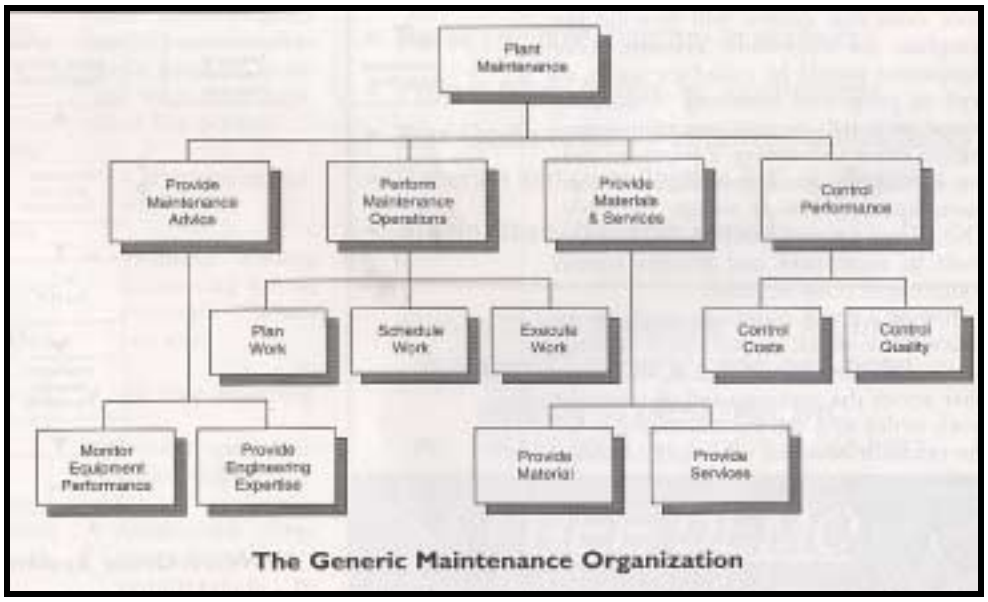


Figure1.1 An Organization Hierarchy (Brewster, 1998, p. 45).

speaking every facilities maintenance department has in-place goals and objectives by which it functions. Typically, these goals and objectives are dictated by life safety, health, and environmental regulations and issues within the service industry. Hospitals unlike other service industries must also meet strict requirements and standards established by the JCAHO (Joint Commission on Accreditation of Health Care Organizations) a process which occurs every three years and measures compliance in areas for example of:

- safety issues
- security

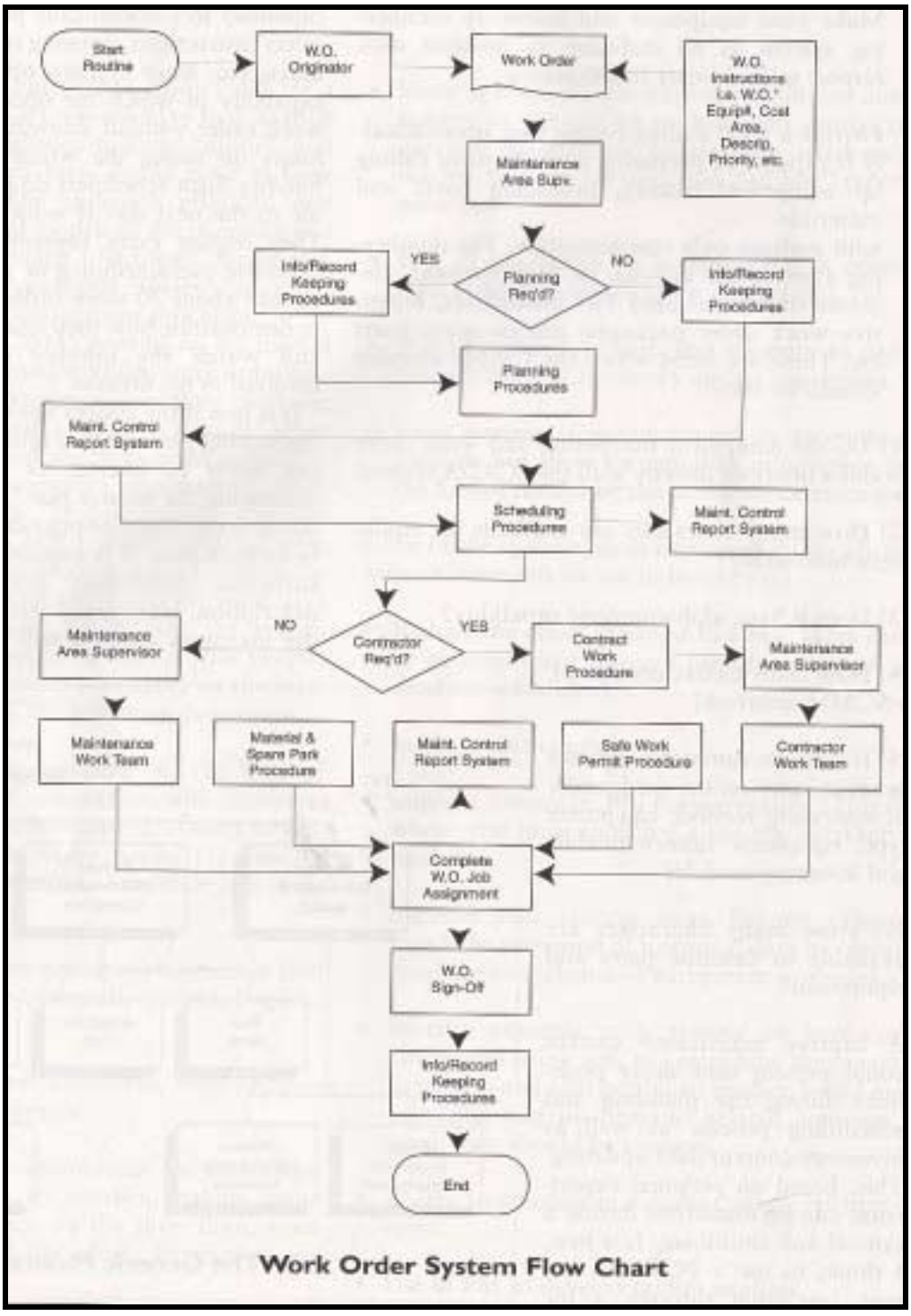


Figure1.2 A Typical Work Order Process Flow Chart (Brewster, 1998, p. 46).

- preventative maintenance
- emergency preparedness and competency of management, staff and vendors to name a few.

Background

Well-maintained facilities and equipment are the outcomes or outputs of a facilities departments goals and objectives. While tracking man-hours and dollars spent on maintenance to achieve the goals becomes the inputs. According to Tomlinson (1993), man- hours spent in maintenance is usually associated with four (4) key elements that are present within any facilities department and generally make-up what is termed the maintenance program as follows:

- Emergencies: Defined as immediate repairs needed as a result of failure or stoppage of critical equipment during scheduled operating period. Imminent danger to personnel and extensive further equipment damages as well as substantial production losses of equipment if not repaired immediately.
- Routine Maintenance (Repetitive Work): Janitorial work, buildings and grounds work highly repetitive work.

- Scheduled Maintenance: Extensive major repairs such as rebuilds, overhauls or major component replacement requiring advanced planning, lead time to assemble materials, scheduling of equipment shutdowns to ensure availability of maintenance resources including labor, materials, tools and shop facilities.
- Preventative Maintenance: Any action which can reduce premature failure and extend the life of the equipment. It includes equipment inspection, testing to avoid premature failure and lubrication, cleaning, adjusting, and minor component replacement to extend equipment life (p. 187).

With the type of work defined, the next step must be to take a look at how the work to be done gets identified and requirements are determined relating to man- hours. Heintzelman (1976) reported that there are several methods of identifying work as follows:

1. Complaints from people using the facilities.
2. Emergency service calls.
3. Facilities manager inspection tours.
4. Manufacturers and safety standards dictate periodic inspections (i.e.: elevators).

(Heintzelman, 1976)

With all of the work that must be done coupled with the overall objectives of the facilities/maintenance department, there needs to be a

communication tool in place that directs the maintenance personnel to perform the day to day hands-on work.

Maintenance communication gets accomplished in the form of a work order. The work order request can be verbal, handwritten or a computerized document. "A work order or work order system is defined as, a communication system by which maintenance work is requested, identified, classified, planned, scheduled, assigned and controlled". (Tomlinson,1993, p. 193).

As mentioned earlier, the most important part of maintenance is planning. In order to plan, the information must be communicated clearly from the requestor (or originator of the work). Westerkamp (1993) pointed out that "A work order must state clearly what is needed and when. ..., [Furthermore], "it is here at this first communication step that the success or failure of a maintenance task can be assured. ... [He goes on to say], "with good information, the work can be accomplished quickly, downtime reduced and costs minimized (Westerkamp, 1993). Without it, the right job might not even get done, let alone efficiently". A common theme that was present throughout the researchers survey data dealt with expectations of Managers and customers.

Amongst the many players (i.e.: facility managers, customers, etc.) there were at least perceived differences of response time to work orders and what was considered timely.

The other factor worth noting was the inability amongst some of the respondents to prioritize their work effectively which was perceived to have an effect upon workflow, which can be defined as controlling the work. The time it takes to do the work and how much it costs (either labor hours or materials) to accomplish is defined as productivity.

The problems that currently exist have manifested themselves within facilities maintenance departments as dissatisfied customers, low productivity amongst maintenance personnel, reactive rather than pro-active approach to facilities needs and unpredictable workloads. The term workload is defined as the essential work to be performed by maintenance,

"The most notable problem in many maintenance organizations is the absence of a simple straight forward maintenance management system. Normally, labor performance is quite good, but utilization (the amount of time productively occupied) is terribly low. The discrepancy points to poor planning, scheduling, and control systems as well as to insufficient supervision.

"Hospitals by nature are chaotic and high energy places, however to stay competitive within the industry this can not be the vision seen by potential customers."

[As mentioned previously those charged with maintaining a balance between the chaotic and routine day-to-day operations are the facility

managers and the maintenance personnel. They do so by making sure the maintenance program is well defined and shared with all affected parties.]

"The failure of many maintenance programs can be traced to inadequate definition and a failure to educate those who must carry them out and use the services. If your aspirations are an effective maintenance organization, keep in mind that most fail to do so because they were introduced onto an environment in which the program they were expected to perform was ill defined. The adequacy of program definition can be determined by examining its conceptualization, the way maintenance services are handled from request to completion". (Tomlinson, 1993, p. 117).

In summary maintenance must have clear objectives and communication tools in-place to carry them out if they are to maintain control and consistency in their work.

Statement of the Problem

Facilities Managers are finding it difficult to control their workloads and effectively assign maintenance workers to complete their work tasks.

Purpose of Study

The purpose of this study is to evaluate the key components of a functional work order process typically used by facilities managers and to

determine how the process can improve the workflow within a hospital's facilities department.

Hospitals would serve as a good benchmark for the industry as it relates to a work order process system. This researcher interviewed several Hospital Facilities Managers in the course of preparing the study, their maintenance programs (specifically work order processes) fell into three categories: 1) no program in place, 2) infancy or start-up stage, 3) programs were fully operational, but not perceived as effective. All of which suggest, to this researcher, a need for further study.

The results of this study will provide maintenance with the guidelines they need to organize themselves, define their program to fit their needs and control the work they perform.

Objectives

- Assess present or current maintenance procedures and systems used in hospital facilities departments.
- Identify key components of an existing functional and operational work order process, within a facilities or maintenance department.
- Develop a system to evaluate or determine the effects of a functional work order process upon the productivity of workers.
- Determine if a functional work order process improves accountability and credibility between maintenance and it's

internal customers, defined as doctors, employees, maintenance workers, nurses and patients.

Rationale for Study

It is necessary for those involved in a work order process to be aware of constraints such as organizational culture (i.e.: trade affiliations, unions) and environment, available technology (i.e.: tracking methods), skill levels of maintenance crews and finally resource limitations. If one or all of these constraints exist they could adversely affect the workflow or work order process. This study will provide management with the tools to evaluate and understand the effect these constraints impose upon the work order process.

- Unfortunately there is very little quantitative data showing how facility departments actually save money for the organization. Most companies do not have adequate tracking tools or record keeping capabilities to record qualitative data. If such data was available it could be used to measure performance by comparing man- hours used, labor cost accrued, material cost accumulated and total costs committed. The focus of these costs relates to equipment, buildings or facilities maintained, activities performed or jobs completed. The results of this research will provide information which will indicate that through the effective use of labor (coupled

with a work order information system in place) maintenance may expect increased efficiency and better control of costs.

- The many companies interviewed for this study were in the process of re-evaluating their current work order process. The majority of the companies felt that their current way of managing their operations was not effective or very flexible. For example, the facilities department (or maintenance) views itself as a support function to all other areas of the hospital. Therefore, in the minds of the managers and maintenance personnel a timely response to a work order can mean life or death in a hospital environment. To that end, this study will provide information which can be used to improve workflow by identifying current problems and review existing policies and procedures for their validity and effectiveness.
- In summary, if facilities managers are finding it difficult to control their workloads and effectively assign maintenance workers to complete tasks, then an organization's total productivity goals, customer service and working environment are most likely affected.

Definitions of Terms

The following definitions are listed below so that the intended interpretations can be given to various terms that are discussed in this study.

Customer: The ultimate end user could be external or internal to the organization.

Job Analysis: The study and recording of each step of a job and determining the best way to perform that job identifying the duties, tasks and learning objectives.

Maintenance: The work necessary to maintain the original anticipated useful life of a fixed asset. It is the upkeep of property and equipment.

Maintenance Work: The repair and upkeep of existing equipment, facilities, buildings or area in accordance with current design specifications to keep them in a safe and effective condition while meeting their intended purposes.

Percent Performance = $\frac{\text{Standard hours produced (credit)}}{\text{Hours worked on planned work (actual)}}$

Note: the minimum acceptable percent performance is 85% average for a weekly reporting period. The goal should always be 100%.

Planning: Determination of resources needed and the development of anticipated actions necessary to perform a scheduled major job.

Predictive Maintenance: Is the measurement of equipment under operating conditions to detect symptoms that are out of line with physical parameter and classify the causes. It includes planning and scheduling the right time and results in improved system reliability and extended useful life of assets at the most reasonable cost.

Preventative Maintenance: Any action which can avoid premature failure and extend the life of the equipment. It includes equipment inspections and testing to avoid premature failure, lubrication, cleaning, adjusting and minor component replacement to extend equipment life.

Pro-Active: Includes root cause analyses or repair jobs and corrective maintenance to fix small problems before they get out of hand.

Productivity: Expressed as a percent of standard or "should take" time. Percent performance reflects the relationship of standard hours produced to hours actually worked on the job.

Repair: Is work to restore damaged or worn out property to normal operating condition. Repairs can be classified as minor or major.

Scheduling: Determination of the best time to perform a planned maintenance job, to appreciate operational needs for equipment or facilities and the best use of maintenance resources.

Workflow: Controlling the work.

Workload: Essential work to be performed by maintenance.

Work Order System: A communication tool by which maintenance work is requested, identified, classified, planned, scheduled, assigned and controlled.

Limitations

The limitations of this study were:

- This study will be limited to hospitals located in Minneapolis and St. Paul, Minnesota, generalization to other hospitals in the nation may not be appropriate.
- This study will only be concerned with the maintenance function for the hospital.
- The survey instrument used to gather data and the limited resources or sources of material available on the subject matter.

CHAPTER TWO

REVIEW OF LITERATURE

Introduction

The purpose of this literature review was to overview literature that has relevance to this study. Specifically, the review establishes the importance of having maintenance goals, planning and procedural components in-place, and provides an evaluation of their affect upon the work flow in a hospital maintenance department.

In addition this review provides an overview of the relationship between facilities management, maintenance customers and work order systems, including current uses.

As noted by Cotts and Lee (1992), "Every good facility manager is a good reactive manager because reaction is a fact of life in delivering services. Unfortunately that situation can down play planning, even though planning is the key to cost-effectiveness and the proper reaction to multiple needs... [Furthermore], a facility manager who does not have a philosophy regarding his position, his department and the facilities, cannot provide the leadership needed by the company" (Cotts and Lee, 1992, p. 7). As stated in the previous chapter, the interfacing of the facilities manager with the maintenance department is critical.

A key component or element of this interfacing between manager and maintenance is effective planning. Planning involves developing

procedures and protocol, and documenting how the work is to be accomplished. Understanding the relationships amongst the key players (facilities, maintenance and customers) is important to successful maintenance performance and overall customer satisfaction.

"Maintenance and operations must conform to overall corporate strategy and two goals. The first one, which is both strategic and operational, is to ensure that clients, customers, employees, and other constituencies are able to visit or work in a certain type of location and, along with that, a specific type of environment. At minimum, it is likely to include that the environment be safe and clean and that any real-estate and facility-related problems (e.g. maintenance and repair) are attended to promptly. If this goal is ignored, the business may have difficulty attracting and retaining employees, clients and customers, there by decreasing revenues and increasing costs. The second important goal includes target financial performance for property in terms of costs per square foot, costs per employees, costs as a percentage of revenues, costs as a percentage of total expenses, and costs in relation to prior period and budgeted costs" (Rondeau, Brown, Lapides, 1995, pp. 488-489).

Understanding the strategic goals will be beneficial as facilities managers and maintenance, struggle to organize, define and develop a plan or strategy to address workflow or control. There are several historical

factors that may attribute to the difficulty facilities managers have in controlling their workloads, and effectively assigning maintenance workers to complete their tasks. These factors are as follows:

- Manual tracking of workflow and scheduling
- Sophistication of equipment/man hours to maintain
- Age and condition of the facility (the demands given age)
- Number of facilities managed or leased
- Staffing levels
- Types of maintenance needed
- Planning/prioritizing the work/productivity/scheduling

(Information compiled from various resources; refer to the reference page and the following text).

1. Manual tracking of the workflow and scheduling: A maintenance information system is the means by which field data is converted into useful information so that maintenance can control its activities. Information to manage the maintenance function must be correctly identified. Thereafter, field data necessary to produce it must be collected and reported.

   "A work order system must exist to focus field data into a data processing scheme which, in turn, produces the required information.

The information, once obtained, must then be presented in an appropriate format to those who need it. Finally, those receiving the information utilize it to make decisions and take corrective actions."...

"The success of a maintenance program depends on key people making correct decisions". (Tomlingson, 1993, p. 55).

As discussed in Chapter One, the work to be done gets identified through several methods and sources. Once the information or field data is collected, it is then manipulated. This manipulation if done manually can be riddled with errors.

It is important to remember that the value of the decisions made from this "field data" depends on the quality, timeliness, accuracy and completeness of the information on which they are based. "Maintenance management is a data intensive activity. Many maintenance departments handle work orders in the tens of thousands per year, issue thousands of separate preventative maintenance tasks covering thousands of machines and other types of equipment, and must generate frequent reports as soon after the end of the reporting period as possible, so the data is fresh and useful. Computerized maintenance management systems (CMMS) are particularly well suited to these requirements". (Westerkamp, 1993, pp. 725-726).

Computerized Maintenance Management Systems are used by facility managers to keep accurate tabs on all expenditures and productivity (without labor-intensive manual paperwork), implement modifications where necessary, and improve effectiveness of service and maintenance practices.

2. Sophistication of equipment and man hours to maintain: In a hospital setting, maintenance personnel are not only responsible for the repair and monitoring of major building equipment, but they are also called upon to maintain patient related equipment for example beds and call buttons. Taking into account that the hospitals surveyed for this study had bed counts ranging from a high of 1,121 to a low of 105 with admissions rates respectively of 27, 567 and 8,323 in any given year. Although their can be several variables affecting occupancy rates, this data begins to show the magnitude of the responsibility for a facilities maintenance department. With hospitals first impressions can be devastating; the appearance of a facility (in the minds of potential patients) directly relate to how a facility is managed.

3. Age and condition of the facilities (the demands given the age): The book Facility Maintenance, (Brown, 1996) suggests "as the years have gone by, the scope of maintenance support needed for your facility has grown. During the years, budget allocations very likely

have not increased to meet the increasing maintenance needs driven by the every older electrical, mechanical, plumbing, and HVAC systems. As your company has grown and aged and as your building has been remodeled and renovated, requirements placed on its aging support systems have expanded. ...

The acceleration of facility deterioration has driven maintenance staff and dollars into crisis management [or reactive maintenance]. It is also true that the age of the building directly affects the cost of maintenance. As the physical facility deteriorates and the building equipment fails, more money is needed for both capital and operating costs just to maintain" (Brown, 1996, pp. 65-68).

The age of the hospitals in this study ranged from 10 years to 30 years old, as shown in Figure 2.1 of this study, subsequently maintenance costs of a 30-year old hospital can be quite substantial.

Some contributing factors to the "condition" of a facility, directly relate to hours of operation, number of occupants, and the mental state of the patient. All or one of these factors can have a resounding effect upon the wear and tear of a building, and the number of emergency calls and work order requests handled by the maintenance department.

4. Number of facilities managed or leased: The majority of the hospitals studied by this researcher were single stand alone facilities, however several resembled more of a campus setting with multiple buildings. The demographics of the hospitals include in this study were very diverse, a few are urban, while others were either suburban or rural.

   While it is not uncommon for hospital administrators to lease facilities, more often than not the facilities are owned.

   When a facility is owned verses leased the upkeep becomes the sole responsibility of the owner. If multiple buildings are involved and as discussed previously these buildings are old and possibly deteriorating, then the maintenance workload is increased, and unless it is effectively controlled may result in a dysfunctional maintenance program.

5. Staffing issues: "Maintenance is a support business and an unglamorous one at that. Nevertheless, physical plants cannot survive without good, careful, professional, timely maintenance. Maintenance does cost money and has to be carried out by trained professionals...". (Brown, 1996, pp. 92-93).

Carl Budde was one of two independent analysts who considered the physical plant staffing problem for the hospital industry. His work was published through the American Society for Hospital Engineering (ASHE).

Carl Budde (as cited in Brown, 1996, p. 96) noted "that a new five-story medical tower was designed with the latest technology from a nursing and clinical perspective, and even more sophisticated mechanical design...[but] little consideration was given to staffing skills necessary to maintain this complex". According to Brown (1996), another analyst, Bershad, found that "hospital engineers are continually under pressure to justify the number of personnel in the engineering and maintenance function. ... Bershad further suggests "that staffing and productivity go hand in hand, he advises evaluating the current staff and it's productivity as tools to justify the level of staffing".

6. Types of maintenance: Generally speaking there are (4) types of maintenance work that occur within a facility. They are:

- Emergencies
- Routine
- Scheduled
- Preventative

(Refer to definition section, this study for further explanation).

Each of the types of work is given a priority rating of 1-4, with 1 pertaining to emergencies and 4 relating to preventative maintenance work. Workload and workflow are greatly affected if too many emergencies occur throughout a given day; this is generally referred to as reactive maintenance.

Again, facilities managers can realize the benefits of a more pro-active approach and minimize confusion through the implementation of an effective work order system. Maintenance procedures are necessary if control is to be assured. Conducting an evaluation of the current practices and procedures related to these "attributing" factors, may lead to the discovery of inadequacies in the existing practices of facilities maintenance departments.

Key Components of a Work Order Process

The work order process involves the execution of a work order request, which can be a verbal, handwritten or a computerized document. The work order establishes the parameters of the job and collects data against the job.

According to Heinzelman (1996) "Basically, there are three levels or refinement in work authorization (request) systems. These are:

- Verbal
- Limited Formal
- Formal

Verbal Authorizations

Verbal methods of authorizing work to be done are at the lowest level of sophistication in a work authorization system. Verbal authorizations usually emanate from three sources: 1) a requester, 2) a maintenance

zone or craft shop foreman, or 3) a maintenance staff member. Although the use of verbal authorization may be an expeditious method of authorizing work, it has the following disadvantages:

1. There is no written record of what was done, who did it, and who authorized it.
2. Verbal instructions are prone to misinterpretation or what was requested, which can result in the wrong work being accomplished. Further, a verbal request may even be completely forgotten, which results in the work never being accomplished until a follow up inquiry is made.

Limited Formal Methods of Work Authorizations

These methods constitute the middle level of sophistication in work authorization. The two methods most frequently used are written policy instructions and standing work orders.

Written instructions provide guidelines as to who may authorize performance of work by the maintenance department or by vendors. The guidelines set forth some general rules to assure that craftsman and supervisors are not expending resources beyond a certain level without some higher level of authorization.

Standing work order systems can be applied in different ways. They do have some things in common however, no matter how they are applied.

They provide a written record of the type of work that is to be charged to the work order. They also provide a method for identifying labor hours, materials, or purchased services charged to the standing work order.

The variations in applications of standing work orders involve two methods. The first method is to use only a single work document, the standing work order. The second method consists of using a series of individual documents to authorize work against a blanket work order document.

The use of a single standing work order is obviously the simplest approach. However, this method does not provide a record document of what was done and who did the work in each instance of the performance of work against the standing work order.

The use of individual work orders against the blanket or standing order, provide a record of each work authorization.

Formal Methods of Work Authorization

Work authorization systems are classified as formal methods when there are specific defined signature levels for approving work orders. The levels are usually related to the organizational hierarchy and provide not-to-be exceeded authorized costs". (1976, pp. 238-241). Refer to Figure 1.1, An Organizational Hierarchy Chart and Figure 1.2, Work Order System Flowchart, for a review of typical steps involved in work order preparation.

Evaluating the Current Use of a Work Order Process

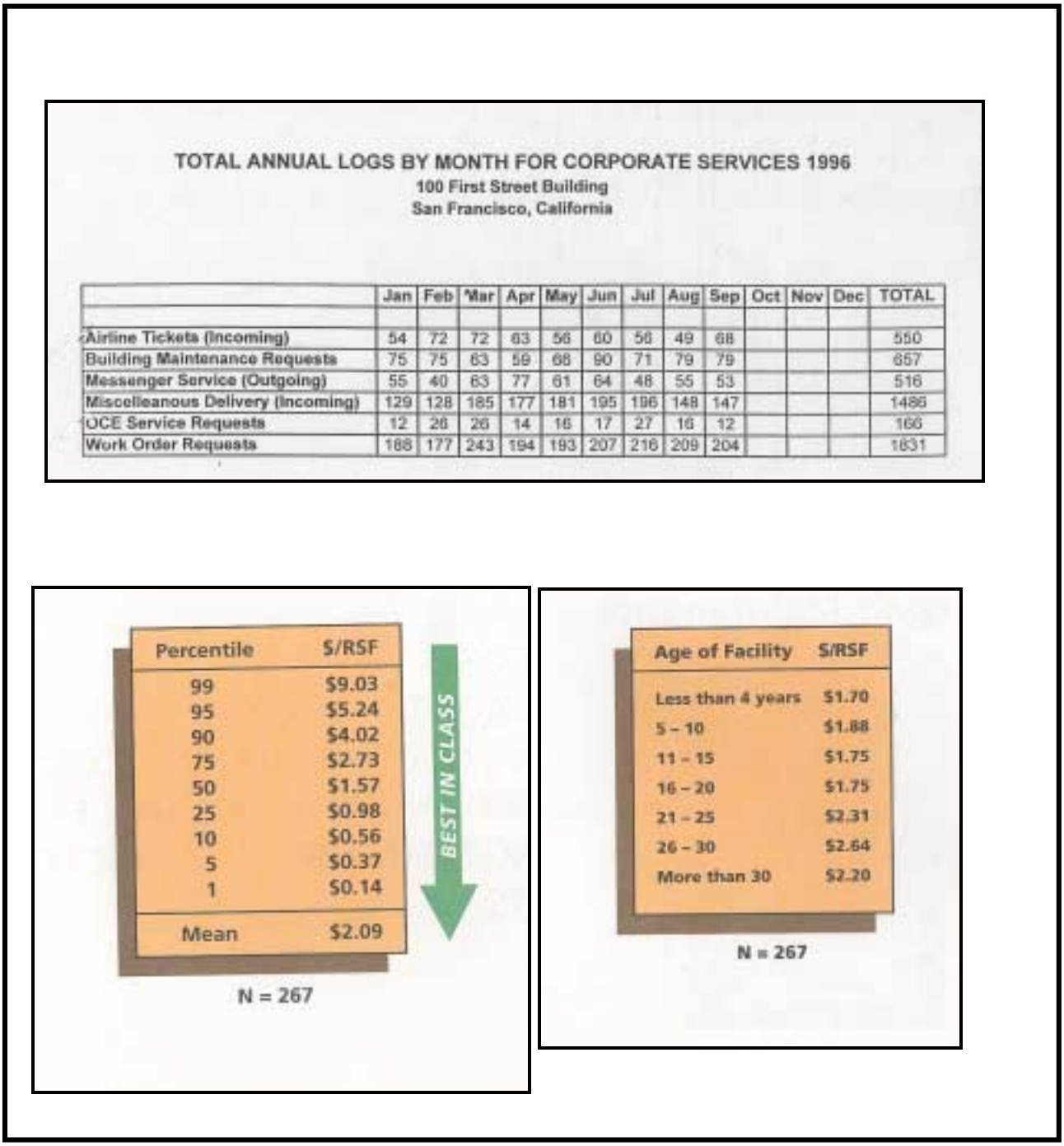
After analyzing the key components of a work order process one must develop a system to determine its effectiveness upon the maintenance program; is it effective and does it meet and satisfy customer needs?

The key to improving any process or workflow is recognizing where the system has failed and what needs to be done to change it.

Secondly, it is important to establish objectives and determine what the desired outcomes are, to know if the objectives are being met.

The objectives of the "program" are determined by proactively seeking feedback from the affected parties to ensure buy-in. In a hospital environment, the affected parties are generally, the doctors, employees, maintenance workers, nurses, and patients.

Once these objectives are properly identified, for example increasing productivity and workflow, or improving accountability and quality, these objectives should then be communicated back not only to the affected parties but to leadership to ensure alignment with the organizations vision, and that everyone's expectations are met.



TOTAL ANNUAL LOGS BY MONTH FOR CORPORATE SERVICES 1996

100 First Street Building

San Francisco, California

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Airline Tickets (Incoming)	54	72	72	63	56	60	56	49	68				550
Building Maintenance Requests	75	75	63	59	68	90	71	79	79				657
Messenger Service (Outgoing)	55	40	63	77	61	64	48	55	53				516
Miscellaneous Delivery (Incoming)	129	128	185	177	181	195	196	148	147				1486
OCE Service Requests	12	26	26	14	16	17	27	16	12				166
Work Order Requests	188	177	243	194	193	207	216	209	204				1831

Percentile	$/RSF
99	$9.03
95	$5.24
90	$4.02
75	$2.73
50	$1.57
25	$0.98
10	$0.56
5	$0.37
1	$0.14
Mean	$2.09

BEST IN CLASS

N = 267

Age of Facility	$/RSF
Less than 4 years	$1.70
5 – 10	$1.88
11 – 15	$1.75
16 – 20	$1.75
21 – 25	$2.31
26 – 30	$2.64
More than 30	$2.20

N = 267

Figure 2.1 Maintenance Costs (IFMA, 1998, pp. 10,14,15), and American Hospital Association Resource Library.

Given the number of parties involved and the multiple objectives, one may require implementation of a structured process which can be used for evaluation of the objectives. A process can be defined as a structured and repeatable method of accomplishing a desired result.

In an article written in the Facilities Engineering Journal, Jack A. Smith Jr. (1998) outlined eleven steps that can lead to a more effective process, as follows:

Step 1: Determine the process to review.

The first step is the determination of the process that needs to be reviewed for potential improvement. It can come from a variety of sources. It can either come from a systems level, i. e., a cross departmental process, or a grass roots level, as a need is determined by the actual users of a divisional or sectional process. Project management and project scheduling responsibilities associated with this review are implicitly given to a project team.

Step 2: Ensure process understanding

The process team is expected to have the "big picture" of the process, decide the priorities of agendas and to act as an arbitrator in cases where different users areas or stakeholders are not able to compromise on a solution. This is applicable if the team is an empowered team that will be performing the evaluation or if it is composed primarily of stakeholders of the process.

Step 3: Establish process measures and resource constraints.

Clarify and discuss the perceived needs with affected user areas and provide cost estimates [if applicable] of the process improvements based on user requirements. The costs will be the best estimate of the time and resources that will be required of the process under consideration.

Step 4: Determine whether the process is feasible.

Based on the results of step 3, decide whether further action should be taken or whether the process review, step 1, needs to be re-evaluated. If the process is deemed unfeasible, determine whether the correct approach to the solution of the problem has been taken.

Step 5: Collect and analyze baseline data.

The tantamount issue is the careful assessment of what is desired and whether the improvement methodology chosen is truly applicable and pertinent.

Step 6: Develop a model of improved process.

The determination of the weights that the team assigns to various attributes for differing alternatives for the process can be determined in a number of ways. The weights can be assigned by consensus of the individual weights and then they can be averaged to obtain a composite weighting for the attributes of the pertinent alternatives.

Step 7: Test the improved process.

At this point, the model of the improved process [should be] implemented on a scale that is appropriate for that particular process.

Step 8: Collect and analyze the improved process data.

The data collected will differ in nature depending on the scope of the project. The analysis of the data will also vary based on the type of data collected and the determination of the appropriate method of analysis.

Step 9: Determine whether the desired results were obtained.

The review of the process workflow will begin once a project is started. This review will use the deterministic data obtained from the process to revise the appropriate working model to reflect actual events. All instances of delays due to additions or scope change will be analyzed to determine what steps are required to prevent this from reoccurring on future projects.

Step 10: Report results and recommendations.

Prepare a report detailing the results of using the improved process model. The report will be prepared for the stake holders of the process, as well as for selected affected management as deemed appropriate for the process.

Step 11: Fully implement the improved process.

The improved process model will be implemented across the process based on the recommendations. The process [should be] monitored to

ensure it remains effective and to determine if there are other processes that are affected by the process change.

Summary of Literature

Once the maintenance program has been evaluated and the problem areas are identified, then corrective measures and policies can be developed and implemented to provide maintenance with the guidance they need to organize themselves, define their program and control the work they perform.

Furthermore, once these policies are incorporated into the "system" they can be used in employee orientation and training, and become a part of a document which can be shared with maintenance, customers and other affected personnel.

CHAPTER THREE

METHODOLOGY

The following research methods were utilized to complete this study.

Review of Literature

1. A comprehensive review of literature was performed to analyze current information related to facilities management and more specifically work order systems. Secondly, research was conducted in regard to written material necessary to meet the objectives of the study. It was accomplished through general research on:
    a. Current maintenance procedure and systems used in hospital facilities department.
    b. Identification of key components of an existing functional and operational work order process within a maintenance department.
    c. Work order systems in use and their effect upon the productivity of maintenance workers.
    d. The work order as a communications tool to improve maintenance accountability.

Finally, the periodicals and publications reviewed in Chapter 2 were written by recognized authors in the facilities/maintenance professions.

This researcher also analyzed accounts of successful and failed ventures by others in the field.

Section of Population

Facilities managers working in the hospital service industry where a work order system "approach" is utilized in their organization were contacted. The participants were selected through the use of "snowball" or referral sampling. This researcher contacted several noted hospital facilities managers who in-turn identified other individuals who they regularly network (or benchmark) with, and were thought to be informed figures in their field. Secondly, this researcher consulted the 1994 edition of Top 25 Book of Lists, which included the 25 largest Minnesota hospitals ranked by revenue. Because the study focuses only on hospitals located in the Twin Cities area, the list was pared down to 11 participants, many of whom were previously identified through referral sampling.

While a small population size may not be as generalized as a larger population, studies probing deeply into the characteristics of small populations can often provide more knowledge than a study addressing the same problem by collecting only shallow information on a larger population (Borg and Gall, 1992).

Visits to 3 of the 11 hospitals were conducted, one large hospital, one medium and one small. The visits included a tour of the hospital and direct observation of current practices.

Design of Survey Instrument

This study required the use of two survey instruments. The first instrument used to collect data was the direct observation method, events were recorded as they occurred. This researched used an "ex post facto" design approach, no attempt was made to control the variables, but simply report what was happening. Every attempt was made to minimize the influence of personal bias when the data was selected and recorded.

The second instrument utilized was telephone interviews, it was chosen because of its versatility. Information can be gathered by a few well-chosen questions, which would take much more time and effort to gather by observation. The limitation however, is the respondent's availability. To achieve an interview can sometimes result in several callbacks.

Summary of Procedures and Methods

1. Visit to industry, to evaluate an existing work order process.
2. Conducted interviews of facility managers and analyzed data collected.
3. Utilized resources found in University of Wisconsin-Stout Library through a literature review.

DATA COLLECTION

Direct Observation

This type of study was used because it could be accomplished in the 'natural" environment of a hospital setting. Non-behavioral observations were recorded and analyzed based on a plant tour, conducted to record a) physical condition of the facility, b) physical process of workflow analysis.

The recording of data focused on observations of staffing within the maintenance department and the recording of both the performance and task assignments of maintenance workers. This researcher simply reported and observed "causal inference", or how one variable affects another.

The tour of the facility was arranged through the facility manager, so that the maintenance staff was unaware, enabling the researcher to observe conditions, etc. as they occurred naturally. The tours generally took about 1-½ hours and due to this researcher's schedule, the tours were typically conducted during the weekdays centered around the lunch hour. The time of day did not pose or present a problem given the fact that lunch breaks of maintenance workers are typically staggered to maximize coverage of the hospital's physical plant.

Telephone Interviews

Telephone interviews were conducted using an interrogative style, questions were designed to be both exploratory and probing in nature.

The interview format required the use of 4 structured questions, followed by more probing open-ended questions, in order to obtain more complete data. This interview strategy provided a desirable combination of objectivity and depth, and permitted gathering valuable data (Borg and Gall, 1989).

Prior to conducting the phone interview, an opening statement was prepared in an attempt to standardize the collected data and assure that reasonably comparable data was obtained from all respondents. Borg and Gall (1989) suggested that a system be developed for coding responses and tabulating results.

The literature review provided the framework and served as a guide for developing the interview questions. Questions were developed to secure insight between relationships of variables recorded and observed, and to capture change-producing elements of the situations. Specifically, questions were developed addressing management controls in the following areas: a) organizational planning, b) standards and practices, c) accountability and performance.

In terms of organizational planning and support, emphasis was placed on questions relating to: a) management, employee and customer expectations and involvement, b) goal setting, planning and program definition.

In the area of standards and practices, questions were developed to determine the process of: a) implementing a work order process, b) determining how staff and task assignments are made, c) determining workflow and workflow controls.

Finally, in the area of accountability and performance, questions were developed to determine if there was a process of behavior feedback (which refers to the system used to provide individually balanced feedback and to maintain accountability for performance), and performance tracking.

These management controls were selected because the review of literature supported a common theme, which was inclusive of these management controls. Furthermore these management controls form the basis of an overall system designed to deliver a functional work order process through the use of consistent practices, feedback and communication and a goal of continuous improvement.

Data Analysis

The primary objective of this study was to identify the management controls in place, to observe, report and analyze the current practices to determine their shortcomings. No statistical techniques were used to analyze the data as the researcher's purpose was simply to report what currently exists.

The interview questions were analyzed using cross-case analysis methodology. Patton (1990) suggested that, if a standardized open-ended interview is used, cross-case analysis would be appropriate to group common questions or analyze different perspectives on central issues.

CHAPTER FOUR

RESULTS AND DISCUSSION

Initially, a thorough review of literature was done to research maintenance procedures and systems used in hospital facilities.

Next, to understand how a work order process creates opportunities to improve workflow surveys were conducted with all of the participants (eleven in total) and site visits were conducted with a small sample group from those surveyed as part of a focus group study.

The questions were designed to identify key components of an existing functional and operational work order process, "they focused on management controls or more specifically issues dealing with organizational planning; standards and practices; and accountability and performance measures" (Sorrell, 1995). The site visits were conducted to observe and review processes and procedures currently in-place.

Results

The primary purpose for using the observation method for this study was to identify the management controls in place, to observe, report and analyze the current practices to determine their short comings or effectiveness.

No statistical techniques were used to analyze the data, as the researchers purpose was simply to report what currently exists.

There were a total of three hospitals chosen for observation. The hospitals ranged in size from small (hospital # 1), medium (hospital #2) and large (hospital #3).

Direct Observation of Maintenance Environment

Observation at these facilities focused on staffing within the maintenance departments, types of management controls in place and performance and job tasks.

Non-behavioral of observations were recorded based on a plant-tour, conducted to record (a) record analysis (methodology, (b) physical condition of the facility, and (c) physical process of workflow.

Record Analysis (Methodology)

Through simple observation, this researcher determined what tool or method currently existed to assign work, and whether it was manual or computerized. Typically, many of the hospitals surveyed utilized a work order system. However, as observed by this researcher the level of its effectiveness and the sophistication of the process varied at each hospital, depending on how the process was managed.

Hospital 1

The work order process at its most simple form was observed at the smallest hospital, at 500,000 square feet, located in a rural area. The work order process was manual and merely used to document work to be performed. For example: the work order (a hand written document was used to record the work and when it was completed it was simply filed away.

Hospital 2

The size of the hospital was 600,000 square feet located within the inner city. At this particular hospital the work order (a computer generated document) became a scheduling and planning tool for the facilities manager. First, it was given a tracking number to establish some sort of sequence and prioritization. Next, it was assigned to a maintenance worker who completed the work and returned the work order to a manager to close out.

Hospital 3

The largest Hospital observed by the researcher was 1,000,000 square feet and it has four buildings located in a suburban area. At what appeared to be the highest functioning level, the work order (a computer generated document) was not only used as described by Hospitals 1 and 2, but it also served as a communication tool with the "customer"; it put the customer in the picture by returning a copy to the original requester after the work order was closed out.

Physical Condition and Environment

Through behavioral observation, specifically non-verbal analysis, this researcher observed the following:

Hospital 1

1) Poor work environment, very chaotic with cramped maintenance quarters
2) Poor quality tools and old equipment
3) Deteriorating infrastructure
4) Little or no use of modern technologies (computerized work order system)
5) Shortage of staff (workers), spread to thin

Hospital 2

1) Poor work environment, chaotic and isolated in the basement
2) Adequate tools
3) Aging infrastructure
4) Technology in place (computerized work order system) but not fully maximized
5) Adequate staff but noticeably under utilized, poor worker and union attitudes towards management and visa versa. There appeared to be an overall lack of communication and trust evidenced through a pattern of documented grievances.

Hospital 3

1) Highly functional maintenance work environment and very accessible from various points within the hospital

2) Good quality tools and relatively new equipment

3) Constructed within the last five years, and very state-of-the-art

4) Functioning computerized work order system in place

5) Adequate staffing, given the size of the hospital

Physical Process of Workflow

Observations of the researcher focused on the service delivery system or workflow beginning with the work order. As stated previously, every hospital (toured) utilized the work order document, but its level of integration into the day-to-day operation varied at each hospital as follows:

Hospital 1

The work order was simply used to record data; the way in which it was used appeared to have little or no affect upon workflow. The work order (task) was assigned by the manager, given to the maintenance worker for completion and then returned back to the manager, which completely left the customer out of the communication loop.

Hospital 2

At hospital 2, there appeared to be a bottleneck in the current delivery system evidenced by the number of documented customer complaints and backlog of work orders. This particular hospital was in a transition

period having recently gone from a paper work order process to a computerized system.

Hospital 3

Observations at this hospital showed the work order system to be an Integral part of the day-to-day operations. Access to historical data revealed that management had undertaken a workflow analysis, conducted a plant audit, and performed a time and motion study all aimed at revealing problems in their system. These findings were then used to improve the work order process and overall all maintenance planning and scheduling activities.

Telephone survey of Hospital Facility Managers

A telephone survey was conducted with a group of industry professionals for the purpose of securing insight between relationships of variables recorded and observed, and to capture change-producing elements of the situation.

Contact was made with 11 facility managers representing small, medium and large hospitals. There were a total of nine questions asked of each participant, involving four structured questions, three open-ended questions and two general questions pertaining to size and location. Both structured and open-ended questions addressed management controls in

the following areas: a) organizational planning, b) standards and practices, c) accountability and performance (Sorrell, 19).

In terms of organization planning and support, emphasis was placed on questions relating to: a) management, employee and customer expectations and involvement, b) goal setting program definition, c) organizational leadership and structure.

In the area of standards and practices, questions were developed to determine the process of: a) implementing a work order system, b) determining how staff and task assignments are made, c) determining and measuring workflow and workflow controls.

Finally, in the area of accountability and performance, questions were developed to determine if there was a process for measuring improvement, productivity, performance and quality.

The structured questions with corresponding results and synopsis are as follows:

1) **Is a work order process in place within your organization?**

   Results: (11 yes), 100% (with eight computerized systems and three manual)

   Synopsis: At one time or the other, every respondents process began with a paper-based system; they generally felt with the paper-based system there was constant miscommunication and lost paperwork.

2) **In your opinion, does a work order process provide you with an opportunity to improve the workflow within the facilities department?**

Results: nine (yes), (two) no

Synopsis: The majority of the respondents answered yes, indicating that as data is entered instant feedback is received. Managers felt that from this data they could observe trends, for example how long it takes to perform a particular task, thereby of pinpointing areas of inefficiency. This information could also be used to develop a continuous quality improvement process to monitor workflow.

3) **With a work order process in place has there been any noticeable changes in worker a) productivity, b) customer feedback, and c) accountability?**

Results: (seven) yes, (two) no, (two) programs recently implemented too early to tell.

Synopsis: Again, the majority answered yes to all three, particularly in the area of productivity, citing the ability to identify and address on-going problems. With a process in place respondents reported a decrease in callbacks which had a direct effect upon customer satisfaction.

In the area of accountability many of the respondents tracked

work orders to observe trends, for example re-occurring problems with an individual (productivity, etc) to identify what areas of specific training were needed. In the area of performance, respondents indicated the need to articulate clear expectations for their workers. For example, hospitals strive for a standard of 80% to 85% productivity; this productivity standard typically provides insight into how many work orders have been accomplished by a maintenance worker.

4) **If your were creating a new facilities department and had an opportunity to implement a work order process, would you utilize a computerized system?**

Results: nine (yes), (two) do not know

Synopsis: No specific reasons were given by respondents, who did not know, other than to say they needed to conduct further research.

In an attempt to capture more complete data respondents were asked several probing open-ended questions. An analysis of these questions are as follows:

1. **In your opinion, what is the biggest barrier a facility manager may encounter in implementing a work order process?**

A majority of the respondents cited the amount of data entry, getting maintenance workers to buy-in, and a lack of clear objectives and expectations from management as possible obstacles. All of the hospitals surveyed were unionized, which often adds certain organizational constraints. For example, in the majority of hospital environments crossing of the trades is considered taboo. Specific tasks are generally associated with certain trades or unions, when lines are crossed, it often times causes friction amongst the workers.

2. **What steps, if any were used to overcome these barriers?**

Nearly every respondent indicated the importance of empowering and involving staff in every aspect or step of the process, keeping leadership informed, evaluating the process for ways to improve, and providing effective training once the system is in-place.

3. **What are the advantages or disadvantages of the system you currently have in place?**

Being computerized systems (as most were), the respondents were aware of the constant changes in technology and the need to stay abreast of these changes. However, most felt the advantages for outweighed the disadvantages, citing the ability to access information many different ways, extracting data to make process improvements,

and preparing statistical analysis and customized reports for management.

Limitations of Survey

This survey was limited by the size of the survey and respondent group, and adequate time for compilation of the information to do justice to the survey.

The results of the observations and telephone survey seem to suggest that at least in a few of the facilities a certain amount of tenacity exists, or clinging to beliefs in spite of contrary evidence, "this is the way we have always done it."

Discussion

The majority of the respondents agreed while the benefits offered by a Computerized Maintenance Management System (CMMS) are impressive, no computer system can overcome an inefficient work process.

Most agreed with out the right kind of advance preparation converting to a computerized system may invite disaster; a careful examination of current work processes should be undertaken.

Additionally, review of the data resulting from the interview questions and the literature review suggested that the scope of the evaluation should include three broad areas:

1) organizational planning

2) standard and practices

3) accountability and performance

Direct observation at three of the hospitals also revealed the need for further examination of the service delivery system.

Performance measures were also cited by all those surveyed as being a key component of a functional work order system. Most noted that any worthwhile change should add value to the operation, whether in the from of reduced labor, reduced costs, less frequent repairs to specific equipment, or greater productivity.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Well-maintained facilities and equipment, and a healthy and safe working environment are the outcomes of facilities department's goals and objectives. To achieve these outcomes a maintenance department must ensure a functional work order process is in-place.

Restatement of the Problem

The purposes of this study was to evaluate the key components of a functional work order process typically used by facilities managers, and determine how the process can improve the workflow within a hospital's facilities department.

Methods and Procedure

This researcher surveyed several hospital facilities managers and conducted site visits to evaluate and observe current practices, collected data, and analyzed data.

This information along with a literature review of various sources became the foundation of the study.

Major Findings

An overview of the major findings suggests that hospital maintenance programs (specifically work order processes) fall into three categories: (1)

no program in place, (2) infancy or start-up stage, and (3) programs fully operational, but not optimized.

The findings further suggested that organizations must select appropriate methods within the context of their environment that allow them to pursue optimization of overall maintenance goals such as; controlling the work they perform, maintaining customer satisfaction, and increasing worker productivity.

Interestingly, the least effective work order process observed was hospital number 2, where communication had broken down between the facilities manager, the maintenance worker, and the customer, adversely affecting workflow.

Conversely, hospital three the most effective process was more structured, yet flexible putting decision making at the lowest possible level, and allowing an opportunity to provide feedback.

Lastly, as observed from this researchers sample group, the least effective work order system was manual and the most effective was computerized.

Conclusions

It is necessary for those involved in a work order process to be aware of constraints such as organizational culture (i.e., trade affiliations and unions), environment, skill levels of workers and finally resource limitations.

If all or one of these constraints exists, they could adversely affect the workflow.

It is up to management (leadership) to understand and evaluate their current systems and identify where or why it is not effective. However, even though the ultimate responsibility for implementation of a functional program falls to management, it is very important to empower people (the workers) so that they have a sense of control in the process.

Secondly, the key players, which include the facilities manager, maintenance worker, and the customer, must share the same vision and commitment to the process.

Typically, the communication between the key players was accomplished through a work order request. The work order request was either verbal (not very effective), hand written, or computerized.

It is usually the first step in the process that begins the workflow; from there the work was classified, prioritized, assigned, scheduled, planned, and controlled. This step should happen whether the process is manual or computerized.

As stated earlier in the quote from Westerkamp (1993, p. 75), “It is here at this first communication step that the success or failure of a maintenance task can be assured.”

Planning appeared to be another key component in the work order process. Planning involved developing procedures, protocol, and

documenting how the work was to be accomplished. This researcher's results showed the larger the facility the greater the planning emphasis. As stated earlier in this study, the majority of the hospitals surveyed were either currently evaluating (re-engineering) their current programs or had recently completed an evaluation.

Evaluation results should be converted into useful tools to improve maintenance performance or used to establish corrective actions. They should also be used by facilities managers to determine whether their maintenance objectives are being met, and to ensure continuous improvement and effective management.

In summary, in a well-designed maintenance management work process, it is necessary to change from a repair-based culture to a value-based culture. A redesigned process coupled with a (CMMS) system can yield significant quantifiable returns.

Recommendations

The results of the researcher's survey show that the key players are not always involved in the implementation or evaluation of a work order process. Often times, the right information is not collected, measured, or controlled.

Recommendations Related to This Study

Organizations establish for themselves missions, goals, and objectives. At a minimum, goals are likely to include that the environment be safe and clean, and that any maintenance or repair issues are attended to promptly.

In this context, the purpose of the objectives are to have measurable processes which verify whether the goals are being met.

It is necessary that all work order processes encompass what has been identified as management controls. Refer to Chapter 4 for specific subsections.

1. Organizational planning
2. Standards and practices
3. Accountability and performance

Basic to these management controls should be the improvement of the organization's system through the communication process. Results of this study indicate improvements can be made in the process with the appropriate communication tool in place.

Recommendations for Further Study

If a work order process is attempted (assuming there is none in place) or a current process is reengineered to ensure success, a facilities manager should first consider the following.

1. A plant management audit – Management audits provide a framework for organizations, large or small, to systematically analyze, review, and recommend improvements in performance. The result of a management audit is a work plan, which specifies the areas that need improvement, the appropriate corrective actions, and procedures for monitoring the outcome of those corrective actions.

   Some of the components include: (a) mission and philosophy, (b) organizational structure, (c) maintenance planning, (d) work and project design, (e) financial controls, (f) regulatory controls, (g) inventory and equipment management, and (h) travel and education.

   There is general agreement in the management audit field that the areas of productivity, performance, work quality, and work priority should be included in every management audit.

2. Workflow Analysis. Managers can improve performance by examining work procedures closely to determine the presence and location of bottlenecks, for example: (a) performance standards, (b) human resource management, (c) performance appraisals, and (d) time management surveys.

3. Productivity or Performance Measurement. The facility manager should benchmark other hospital facilities to gauge industry

standards and identify an appropriate productivity level or goal. An organization should then begin a productivity program starting with measurement and evaluation against the industry standard.

Various tools for productivity measurement and improvement are as follows: (a) mathematical and statistical, (b) product and process analysis, (c) ergonomics and human engineering factors, and (d) work measurement, motion and time study.

4. Focus Groups. Focus groups could be formed to evaluate the problem and brainstorm solutions; the group could be comprised of management, maintenance workers, doctors, and nurses.
5. Benchmarking. Several of the hospitals surveyed, were part of a consortium of hospitals that holds monthly meetings to network, share ideas on "best practices", discuss problems, participate in bulk purchasing from vendors and pool various other resources.
6. Customer Surveys. Customer satisfaction surveys could be developed to aid in the creation of customer oriented maintenance services, which allow the customer to be part of the process.

After the program has been in place for a period of time, a follow-up survey should be conducted to solicit feedback for continual process improvement.

7. Enhance Physical Communication Tools. Technology is constantly improving the ways and means in which we communicate. New trends and technologies in communication should be investigated further by facilities managers, with the express purpose of improving workflow.

It can be concluded that, through the implementation of a well-planned work order process, hospital facilities can control their workloads and effectively assign maintenance workers to complete tasks.

In doing so, productivity levels, quality, customer service, and the working environment that are all outcomes of a good process should improve.

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