During these difficult economic times, no one understands the challenge in meeting maintenance/repair objectives better than the facility manager in the public sector arena. Facilities management departments are being task with reducing budgets and still support the building needs of governmental programs.

Past practices for the facility manager was either discontinuing nonessential services or increasing the deferred maintenance budget. Costs saving ideas came from energy saving projects or reducing frequently in operational services, i.e. cutting the lawn twice a month versus once week or empty trash cans every other day, etc. These actions can reduce operating cost, but at the expense of accepting lower customer and employee expectations.

This article/program proposes to consider an area not often examined; work productivity. A manager could achieve dramatic productivity by implementing work measurement to manage and control maintenance. Using work measurement method is the main focus of Industrial Engineering since its inception as a separately recognized engineering discipline.

History

The root of industrial engineering was formed during the Industrial Revolution beginning in the early eighteen century in England. Many new inventions, such as the spinning jenny, spinning loom, power loom, and steam engine were applied to factories using a large workforce.

With the founding of factories, several individuals began introducing new ideas and concepts concerning the management of machines and people. These individuals were closely involved because they created new inventions and started factories.

Sir Richard Arkwright, the inventor of the spinning frame, is credited with developing and administering the first factory discipline. In the late seventeenth century, James Watts and Matthew Bouton, foundry managers, initiate manufacturing cost accounting and control systems to improve efficiency and increase output.

Early development to study and improve work management progressed independently by these early individuals. No attempts were made to create a formal body of knowledge about these new management concepts.

The Industrial Revolution came into its own in the United States in the second half of the nineteenth century. The assembly line, mass production, and the division of labor made it possible to manufacture products more efficiently and at lower costs. As a result of new technology, new ways of using labor and to amplify mass production and increase demand for goods, was primary in the U.S. economy.

During this period, the individual efforts in many countries began to emerge as a body of management knowledge. This emergence was led by a number of people from the United States. This included such notables as Fredrick Taylor, Henry Gantt, Frank and Lillian Gilbreth, and Henri Fayol.

Taylor’s contribution was in the field of methods improvements, while Gantt worked in developing management principles and procedures. The Gilbreths did work in time motion studies, and Fayol wrote on organizational principles.

These early pioneers combined their management theories and concepts that later became the basic
principles in the scientific approach to production management. Industrial engineering grew out of these scientific ideas of organization, methods, and work measurements.

Around the 1930’s, industrial engineering was became recognized as a profession entirely associated with the manufacturing industry, particularly in production. These concepts were never thought useful in other professions, such as facilities management.

After World War II, progressive thinking plant managers began to apply industrial engineering principles to aid them with the management of their responsibilities. Although the profession had existed for a number of years, it was not until 1955 that a definition of industrial engineering was created and endorsed by the American Institute of Industrial Engineers; their name was changed to the Institute of Industrial Engineers (IIE) in 1981. IIE’s definition of industrial engineering:

*Industrial engineering is concerned with the design, improvement and installation of integrated systems of people, material, information, equipment and energy. It draws upon specialized knowledge and skills in the mathematical, physical and social sciences, together with the principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from such systems.*

As you see, the definition/concept of industrial engineering is valid and applicable to any business environment looking to improve the organization’s efficiency and effectiveness, including facility management’s job.

**Applying Industrial Engineering to Facilities Management Services**

To effectively apply industrial engineering principles to the facilities management environment, it is important for a facility manager to understand the differences between manufacturing (production) activities and operational activities in a facilities management department.

Production activities are highly standardized and respective events. The respective action makes them predictable by the use of statistical analysis techniques.

With a few exceptions, facilities management is a service provider organization. One of the difficulties in applying industrial engineering to facilities management is the problem of quantifying the service output. Industrial engineering analyzes production of work units. A work unit is defined as any amount of work, or the results of such works, that are convenient to use as an integer when quantifying the work.

In manufacturing, the work output is a high volume and short work cycle. Maintenance/repair work by its nature is a low volume and long work cycle. These differences have made it difficult with early attempts to measure maintenance work. The facility manager will need to be knowledgeable with the services they provide with the understanding the objective to develop a work unit hierarchy for the facilities management tasks.

Work unit criteria should be defined by the objectives for research and be able to produce good, quantifiable information. The work units’ criteria should include the following:

- Clear hierarchy of countable, transformable units of quantification for an objective to the workload.
- Allow for meaningful workload forecast, in terms related to the needed resources or convertible to such terms.
- At least one or more levels, the work unit should demonstrate a firm relationship to required resources to be established: at these levels a work count, the number of times a work unit to be performed, should be a meaningful number with respect to required resources.
By developing and defining the work unit hierarchy for facilities management tasks, industrial engineering concepts can be utilized. In order to use industrial engineering concepts to improve efficiencies, you must be aware of the primary elements: the type of task and parameters; the service-service subject matter, and human challenges relative to the organization.

Few facilities management organizations have an industrial engineer available to them to develop and study the work unit activities. This assignment is generally initiated by management and delegated to subordinate staff that know and responsible for the work.

We will be focusing on those industrial engineering principles that can be most used to improve the facilities management maintenance and repair operations.

**Methods Engineering**

As far as we are concerned, one of the major objectives for a facility manager is to increase efficiency of their department's functions. As the saying goes “do more with less.” Sometimes you max out resources and never feel you are winning the maintenance war; facility managers start becoming accountants and begin looking at savings as budget cuts or eliminating/scaling back services.

In some cases it’s appropriate to reevaluate the type of service levels that facilities management provides, but we should ask what our core duties to the organization are and what our customers’ need are in order to meet their department objectives.

It is possible to tackle the “do more with less” paradigm in terms other than money. We will be discussing methods that will aid in improving efficiency of one of the critical portions of any organizational budget, work units (labor).

Method engineering is a subspecialty of industrial engineering concerned with human integration in industrial production processes; in our discussion of the facility management service provider, methods engineering requires the collection of analysis techniques that focus attention on improving the effectiveness of people and the work environment.

Data analysis enables the facilities manager to make decisions about several things, including: purpose of the operation, material/supplies characteristics, working conditions, material/inventory handling, work place layout, and resource allocation. Knowing the specifics (who, what, when, where, why, and how) of providing services assists in the development of an optimum service delivery method.

The major techniques used in method engineering are work sampling, work measurement, work simplification value engineering, process charting, operational analysis and time motion. Although all techniques are used in manufacturing, we will explain the first three techniques that closely correspond to facilities management functions.

**Work Sampling**

Work sampling is a statistical approach technique to measure work activity as related to delays consisting of intermittent observation of actual work and delays. Also referred to as activity sampling, frequency study; and ratio delay study.

A work sampling program will only measure the productive efforts (sometimes ingalled wrench time) of an employee group. It also measures nonproductive time. Comparison of both productive and nonproductive times helps facility manager improve productivity.

Work sampling is the most economic way to obtain detailed information on the productivity of people.
Work sampling itself does not improve operations, but provide management a tool on the facts to which action can be taken and decisions made resulting in improved operations.

Work sampling should not be used to measure the performance or deficiencies of individual worker. Work sampling should be used to measure the effectiveness of the entire maintenance management program.

Work Measurement

Work measurement is the process of establishing the time that a given task would take when performed by a qualified worker working at a defined level of performance.

There are various ways in which work may be measured and a variety of techniques have been established. Generally, there are four methods used to establish standards of maintenance/repair work measurement:

1. **Measurement by management**: the responsible supervisor receives the completed work orders and through the supervisor’s understanding the scope of work, experiences, and judgment determine the estimate time for the work. This method is not constructive because it takes time away from primary duties and supervisor judgment could be difficult to validate.

2. **Historical records**: this requires statistical analysis of historical time data on complete work orders to attain an average that can be considered an appropriate standard. These standards should be updated regularly once a year to ensure reliable data.

3. **Work Sampling**: Work sampling is done daily to determine productivity of each worker, average for each shop, and any trends in productivity. When using work sampling, it is necessary that the personnel being studied are performance rated and some type of work count is maintained.

4. **Using standard time data**: This method established and predetermined time standards to develop elemental standards time data and estimates. These standards take into account an average time for a qualified craftsman working at a normal pace, under capable supervisor, and experiencing normal working delays to complete a defined amount of work of a specified quality. There are several successful standards available; Department of Navy, Bureau of Yards and Docks has maintained the *Engineered Performance Standards* and RS Means have published a number of facilities related handbooks.

Work Simplification

Work simplification is a method of examining particular tasks (work units) step by step, breaking a job down into segments. Each task would be looked at systematically with a common sense approach into the way the job is done. The objective is to reduce the number of steps taken with a goal of reducing time and costs in completing the task, while meeting the organization’s mission.

The focal point of a work simplification program for the facilities management environment is getting supervision and craft levels to work together towards a continental improvement. They must channel their efforts toward four possible results:

1. What can be eliminated?
2. What can be combined?
3. Should the sequences of work be changed?
4. What can be simplified?

Meaningful and earnest examination of an organizational operation process and application of these questions to the work can improve efficiency and lower cost.
Modern Industrial Engineering Theories

The principles discussed were in the terms of data collection and statistical analysis. We'll discuss in this part concepts introduced in the 1970 & 1980's for improvements not using statistical data as the only tool.

In 1954, Robert N. McMurry wrote in the Harvard Business Review, "In practice, of course, the engineering approach which so effective with things is almost invariably the wrong one to use with people." We believe Mr. McMurry was talking about future elements the industrial engineer would utilize, a person's soft skills or "EQ" (Emotional Intelligence Quotient).

In the early 1970’s, foreign auto manufacturers became global leaders, which many remain today. Foreign manufacturers’ success came from using new industrial engineering concepts. Not only did they apply statistical data, but they also transformed the production team attitudes.

Dr. W. Edmond Deming, a statistician by trade, applied his ideas to the Japanese auto industry to improve quality and efficiency. He is regarded as having the major impact upon Japanese manufacturing and helping Japan evolve on into a global power. Despite being considered something of a hero in Japan, his concepts were just beginning to win widespread recognition in the U.S. at the time of his death in 1993.

Dr. Deming explained that current management style, at that time, needed to undergo transformation. The transformation required a view from the outside, because the system could not understand itself. He called the transformation a system of profound knowledge. This view was to provide a map of theory by which to understand the organization in which we work.

Dr. Deming advocated that all managers (management) needed to have the System of Profound Knowledge, consisting of four parts:

1. Appreciation of a system: understanding the overall process involving suppliers, producers, and customers (or recipients) of goods and services.
2. Knowledge of variation: the range and cause of variation in quality, and use of statistical sampling in measurements.
3. Theory of knowledge: the concept explaining knowledge and the limits of what can be known.

Dr. Deming further explained that no one needed to be well versed in any or all parts in order to understand and apply these ideas. Dr. Deming further developed his 14 points for management in industry, education, and government which follows as application of this outside knowledge, for transformation from the present style of Western management to one of optimization.

Lean Management

In the fall 1988, John Krafcik coined the term Lean in an article published in the Sloan Management Review. Lean principles originated from the Japanese auto industry upon the work of earlier leaders such as Fredrick Taylor and Henry Ford and learning from their mistakes.

Lean management, referred to as "Lean", is a production practice or process where operating resources are only used to create value to the customer by looking at the services provided from the customer’s perspective. Value is defined as any action or process that a customer would be willing to pay for. Basically, Lean is centered on preserving value with less work.

Lean focuses upon improving the “flow” or smoothness of work, thereby steadily eliminating waste, mura and using pull systems (the term kanban) to level out the work load (Heijunka). Lean can be referred to as a fitness program for your company. Just as a diet and exercise regime improve ones body, Lean is a way
of getting your organization fit for life, by focusing on your customers’ values. As waste is eliminated, quality improves while production time and cost are reduced. Lean is a long-term management decision philosophy.

Lean is a variation on the concept of efficiency based on optimizing work flow; a recurring theme in human history toward increasing efficiency, decreasing waste and using empirical methods to decide what matters, rather than uncritically accepting pre-existing ideas.

Just as a diet and exercise regime improve ones body, Lean is a way of getting your organization fit for life, by focusing on your customers’ values.

Conclusion

Resources in the public sector have always been relatively scarce in the sense that there is rarely, if ever, enough to go around satisfy all the needs. The public sector facility manager will have to squeeze dollars from all aspect of the facilities department’s resources, the largest is staff productively.

A facility management organization that can involve its staff to improve productivity and eliminate wastes will have the greatest impact on the public sector organization, by doing more with less.

*It is not enough to do your best; you must know what to do, and then do your best.*

*Dr. W. Edmund Deming*