

Worker Utilization Assessment through Random Sampling of Non-Repetitive Tasks for Scheduled Maintenance at a Power Generation Facility



Introduction

A major manufacturer of power generation equipment had concerns regarding the staffing levels for Project Managers, Field Engineers, and Technical Specialists assigned to scheduled outages for preventive maintenance. Individuals assigned to these projects were typically required to work twelve hour days, seven days a week. Under these circumstances the personal fatigue and delay for humans drastically increases. Management was interested in determining the percent utilization, or busy time, of these individuals to ensure that they were not being overworked.

Additionally, management asked PMC to identify potential efficiency improvements. By streamlining the process, lead times can be drastically shortened.

Development of Labor Standards

Work sampling was the preferred method for determining operator utilization. With work sampling, an entire crew can be studied by one analyst. Also, there is much less clerical work required when performing work sampling. In addition to this, work sampling lends itself to the study of non-repetitive tasks.

There are several conditions which must be met in order for a work sampling study to be accurate. First, the sample size must be sufficiently large enough and the sampling period should be an accurate representation of typical conditions. It is critical that the observations for each day occur at random; a macro was written in Microsoft Excel to accomplish this.

The next element required for performing a work sampling study is to identify all of the activities the subjects perform. Table 1 below represents the activities which were defined and the associated code. Finally, a brief description of the activity is provided.

Table 1
Codes, activities and their description

Code	Activity	Description
1	Idle	No productive work is being performed
2	Break	Taking a scheduled break
3	Busy - at Trailer	Performing productive work at trailer
4	Busy - at Deck	Performing productive work at the deck
5	Busy - Admin job	Project related administrative work
6	Busy	Miscellaneous productive work
7	As Needed	Available for undefined activities
8	As Needed	Available for undefined activities
9	Meeting	Participating in a scheduled meeting
10	Could not find	Not able to make visual contact

Analysis of Worker Utilization

Figure 1 below illustrates the percent of busy time verses the percent of idle time for the Field Engineer assigned to day shift. Figure 2 provides a more detailed depiction of how the Field Engineer spent their time by presenting each of the activities and their respective percentages in a Pareto chart.

FIGURE 1
Field Engineer Utilization- Days

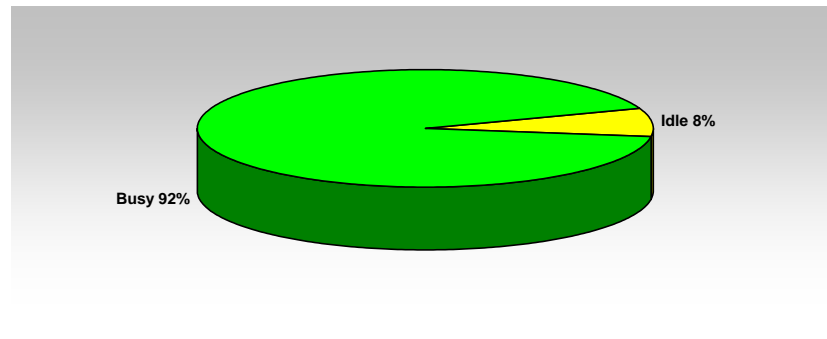
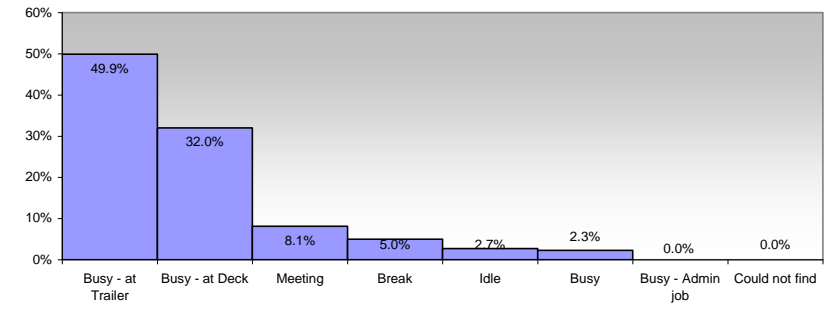


FIGURE 2
Field Engineer Activity Proportions- Days



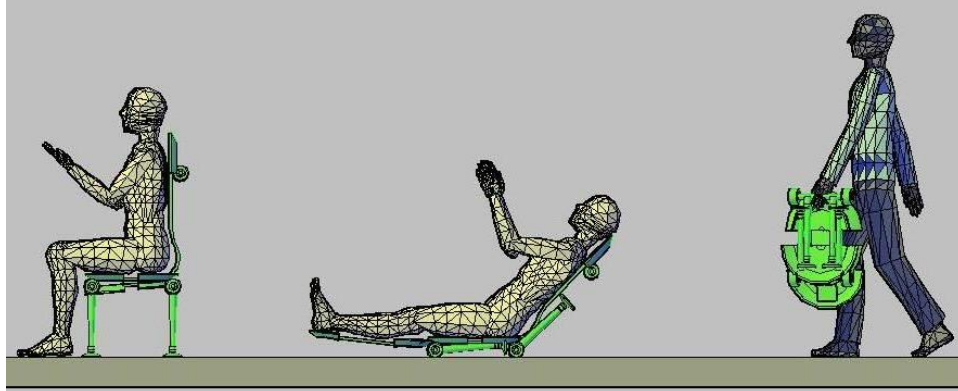
In manufacturing, a five to ten percent allowance for personal fatigue and delay is standard. Due to the exhausting work schedule, management set a target of twenty percent for personal fatigue and delay. As such, the Field Engineer shown in the example above was twelve percent higher than the desired factor. The Technical Specialists studied were also shown to be well above the twenty percent factor. As such, management assigned some of the Field Engineer's tasks to the Technical Specialists and increased the number of Technical Specialists by one per project. This brought the utilization for each classification to a low level of seventy five percent and a high level of eighty two percent.

Efficiency Improvements

The first opportunity for an efficiency improvement deals with the handling of nuts or bolts that are removed and cleaned. These parts are precision manufactured and are very expensive to replace. To improve this process, a cart was designed to place the parts onto immediately upon removal from the unit. This cart serves to store and handle the parts until they are to be reinstalled. This eliminates much of the double handling that was present. The concept design for the cart is illustrated below.



There are multiple instances in which work is performed in an ergonomically unfriendly manner. Tasks such as filing blades are often performed while lying on the ground. This practice increases personal fatigue and is inefficient. The solution to this inefficiency was to design a portable ergonomic chair. The chair will fold for easy shipping and flexibility at the site. It will also adjust to different heights and angles to compensate for the different applications. This will improve working conditions for the millwrights and thus improved morale. The time required to perform tasks will decrease as the millwrights can quickly roll around the components in the work zone. The concept design for the ergo friendly chair is illustrated below.



Conclusion

Upon completion of this study, management had a clear understanding of the staffing level required to support a scheduled maintenance project on a gas turbine. This helped to reduce safety risks and ensure project deadlines were met. Also, several opportunities for efficiency improvements have been developed and the designs were provided.