Determining Maintenance Staffing Levels is Tricky Business

"What is the formula for determining the optimum maintenance staffing level for our plant?"
I have asked the very same question about optimum maintenance staffing levels for more than 20 years. Unfortunately, there seems to be no logical or easy answer to this seemingly straightforward question. I'm sure there are some readers out there who have mastered this mythical formula or come up with an effective method for their situation. However, I feel obligated to share my thoughts on the difficulties associated with maintenance staffing levels as we wrestle with maintenance costs, reliability improvement, and an era of maintenance skills shortages.

Plant staffing levels can be determined by a number of different methods. For example, determining the number of operators for machinery, material handling, or control stations is a relatively simple task due to the number of operating positions, job tasks, narrowly focused scope of work, and specific but limited skills and knowledge requirements. However, determining the number of maintenance mechanics or technicians is not so simple; in fact, in some plants, it is extremely complex. I have heard of formulas based on headcount per installed horsepower, mechanics per replacement cost, or technicians per square foot. Why don't these work across the board? Here are the big variables that affect maintenance staffing level decisions:

Variable #1: Scope of Work

The breadth and depth of job-performance requirements varies widely in today's industries from extremely narrow, single-task repetitive job tasks to broad multi-skill job roles. Maintenance is rarely a narrowly focused job role, either geographically in the plant or intellectually in the skills and knowledge requirements. Maintenance in general includes very broad core job skills and knowledge such as in-depth principles of mechanical, machine repair, electrical, instrumentation/controls, and machining. We must also include equipment-specific, facility-specific task skills and knowledge. Then there are advanced troubleshooting and problem-solving skills and knowledge. And we cannot ignore the specialized skills and knowledge requirements for condition monitoring and predictive maintenance. In many plants, I've heard this scope of work scenario described as "an inch wide and a mile deep for equipment operators" and "a mile wide and a mile deep for maintenance technicians."

Variable #2: Individual Competency

The second big variable for maintenance headcount is the skill set of each person: individual competency. If all maintenance people had the same level of skills and knowledge, there could be an easy answer to the question of optimum maintenance staffing levels. But there is a lack of comprehensive skills standards as applied to industrial maintenance job roles, especially in the areas of equipment-specific tasks. Today, many plants do not formally train and qualify all of the maintenance staff to address the maintenance and reliability needs of the plant's equipment and facilities. Why is it that equipment and plant operators typically receive job- and task-specific training and qualification, but the maintenance staff rarely does? There seems to be an assumed higher-level of maintenance competency than actually exists—or an oversimplification of the job roles—that gets some plants into deep trouble.

Variable #3: Equipment Reliability

Highly reliable plants and equipment can be managed with relatively fewer maintenance technicians than comparable highly reactive plants. If you have a very reliable plant and equipment, the maintenance workloads are usually very well defined in terms of scope, skills, and duration due to

planned, scheduled, and preventive/predictive maintenance. And when jobs are assigned only to qualified maintenance technicians, accurate staffing level decisions are much easier. Reactive or repair-based maintenance is highly unpredictable in terms of scope, skills and duration due to high levels of unplanned, unscheduled, reactive work loads. A variety of individual competencies also adds to the sporadic nature of equipment problems. It is almost impossible to plan anything day-to-day, let alone plan the proper staffing levels.

Variable #4: Historical information
Work orders capture a whole host of information about maintenance and repair work including problems, causes, corrective action, and labor hours worked by named technicians. Unfortunately, there is a huge void of decision-making information if the plant or facility does not use work orders or does not reinforce the need for accurate equipment and work history information: Staffing levels are arbitrary, repetitive problems are not identified, common causes are overlooked, improper actions and rework go unnoticed.

An analysis of comprehensive maintenance work order information often reveals that most of the root causes of the perceived "maintenance problems" with the plant and equipment are outside the direct control of the maintenance staff. Others who must be involved in improving "maintenance" include maintenance and repair parts procurement, inventory control, operations management and staff, process technicians, engineering, production scheduling, etc. The maintenance department alone cannot make equipment reliable.

Variable #5: Maintenance & Reliability Trends
Many business decision makers do not have enough information to truly understand maintenance and the big maintenance staffing variables I have just outlined here. Unfortunately, for decades "maintenance" has been treated as an overhead expense line item and a "non-value adding" activity in many business operations. Some business decision makers also perceive maintenance technicians as "fixers" rather than "preventers" of equipment problems.

Current information about maintenance workforce demographics, hiring trends, retirement forecasting, and knowledge retention are often overlooked, not fully understood, and/or not factored into the staffing level decisions. More and more plants will experience higher maintenance costs and higher turnover of top skilled people as the maintenance skills shortages grip our nation's business and industries, furthering the inability to determine proper maintenance staffing levels.

Real World Example
I spent time recently with a business that modifies and tunes high-performing street motorcycles using a custom-designed chassis dynamometer. One of their modifications includes changing from chain-driven to gear-driven cams and new push rods. This design eliminates high amounts of friction and improves engine torque and horsepower measured at the rear wheel. In one case, when the new cams and pushrods were installed in a customer's motorcycle, the dynamometer test revealed a sizeable loss in torque and horsepower.

The highly experienced mechanic who installed the new gear cams and push rods did not notice anything unusual during the assembly and adjustment. I noticed that he was impressively meticulous about his work. However, there was a real problem somewhere. A second highly experienced mechanic disassembled and inspected the new cams and push rods and immediately spotted a problem: The wrong push rods were installed. When the two mechanics met and discussed

the findings, they discovered that the new push rods were in the wrong package from the manufacturer. Even though the shrink-wrapped labeled package indicated otherwise, they were not the correct parts for this engine and were about 5/8" too short. Because of the push rods' design, the first mechanic was able to easily adjust the length and set the proper valve clearance. By adjusting them to their maximum limit, they flexed while running under load, limiting the valve travel and causing a reduction in torque and horsepower.

In this real world example, both mechanics were trained, experienced, and highly skilled to work on the motorcycle. But the second mechanic was factory trained and certified over the prior 10 years. Both had made this modification hundreds of times. But what was obvious to the certified mechanic was overlooked by the experienced mechanic. And while the root cause of the problem was obvious, neither mechanic had ever experienced mislabeled parts from this specific high-performance parts manufacturer.

Such subtle differences in today's mechanics' skill sets, or competencies, can create, or eliminate maintenance-induced failures and the need to rework a recently completed job. Think how much difference there is among all the maintenance technicians' skill sets and competencies in your plant or facility. Plants and equipment would be highly reliable with a relatively smaller maintenance workforce if everyone was highly skilled and knowledgeable and only assigned to jobs that they were qualified to perform—right the first time. Aircraft mechanics and top NASCAR race team mechanics do that all the time.

Bottom Line

An analysis of plant equipment, chronic and sporadic problems, and overall equipment effectiveness losses can lead to the determination of the required skill sets to achieve optimum levels of equipment performance and reliability. Until these skill sets become core competencies for maintenance staffing, it is impossible to use a formula to determine the optimum maintenance staffing levels.

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