Communication Issues in Production and Operations with Skilled Trades

An Essay by
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The purpose of entitling this series of essays "Maintenance is from Mercury, Management is from Pluto," is not meant as a condemnation of the efforts of either the maintenance skilled workers or company management, but to provide insight into the challenges of communication between maintenance and management. They key is that the difference and challenge in communication goes back centuries into history with a radical change occurring since 1911.

Through ancient times, into the Middle Ages then right up to the 1900's, craftsmen dominated the manufacturing of goods. Through apprenticeships and craft 'secrets,' craftsmen maintained a level of power over manufacturing products and providing services with Master Craftsmen being held in high esteem.

In 1824, John Hall of the Harpers Ferry Armory had developed processes to ensure that identical, interchangeable parts could be machined using specialized machines for cutting, drilling, shaping and smoothing of components. In his studies, he had determined the proper speed and feed rates, developed specialized production machines and had unskilled operators making parts. The principles determined at Harpers Ferry would lead to future mass production success and the work involved in scientific management.

In the late 1800's and early 1900's, Frederick Taylor, a college dropout, a Quaker and former machinist, presented a method he referred to as 'Scientific Management.' In 1911, Taylor published his work, "The Principles of Scientific Management," in which he presents how his concepts would greatly improve productivity. He introduced the concepts of time and motion studies, monetary motivation and how to convert skilled crafts into a series of simplified jobs that could be performed by unskilled workers.

A significant part of his motivation appears to have been a level of animosity towards skilled workers as naturally 'lazy' but motivated by monetary considerations. He saw managers as the answer to reducing craft power and increasing productivity, as he generally felt that managers were of a higher class:

> *The English and American peoples are the greatest sportsmen in the world. Whenever an American workman plays baseball, or an English workman plays cricket, it is safe to say that he strains every nerve to secure victory for his side. He does his very best to make the largest possible number of runs. The universal sentiment is so strong that any man who fails to give out all there is in him in sport is branded a 'quitter,' and treated with contempt by those who are around him.*

> *When the same workman returns to work on the following day, instead of using every effort to turn out the largest possible amount of work, in a majority of cases this man deliberately plans to do as little as he safely can – to turn out far less work than he is well able to do – in many instances to do not more than one-third to one-half of a proper day's work. And in fact if he were to do his best to turn out his largest possible day's work, he would be abused by his fellow-workers for so doing, even more than if he had*

proved himself a 'quitter' in sport.   Under working, that is, deliberately working slowly so as to avoid doing a full day's work, 'soldiering,' as it is called in this country, 'hanging it out,' as it is called in England, 'ca canae,' as it is called in Scotland, is almost universal in industrial establishments, and prevails also to a large extent in the building trades; and the writer asserts without fear of contradiction that this constitutes the greatest evil with which the working-people of both England and America are now afflicted.[1]

He continued: "The majority of these men believe that the fundamental interests of employees and employers are necessarily antagonistic. Scientific management, on the contrary, has for its very foundation the firm conviction that the true interests of the two are one and the same; that prosperity for the employer cannot exist through a long term of years unless it is accompanied by prosperity for the employee and vice-versa; and that it is possible to give the workman what he most wants – high wages – and the employer what he wants – a low labor cost for his manufactures."[2]

He determined that there are three basic causes for the 'soldiering' that occurs, including: 1) That a material increase in output will result in a reduction of manpower; 2) Defective systems of management require the worker to 'soldier' for his own best interest; and, 3) The inefficient 'rule of thumb' methods that craftsmen use. When looking at methods to reduce these issues and to increase productivity, Taylor felt that the craftsman, or worker, was incapable of determining the methods, himself:

Now one of the very first requirements for a man who is fit to handle pig iron as a regular occupation is that he shall be so stupid and so phlegmatic that he more nearly resembles in his mental makeup the ox than any other type. The man who is mentally alert and intelligent is for this very reason entirely unsuited to what would, for him, be the grinding monotony of work of this character. Therefore the workman who is best suited at handling pig iron is unable to understand the real science of doing this class of work.[3]

His view of the worker: "This loafing or soldiering proceeds from two causes. First, from the natural instinct and tendency of men to take it easy, which may be called natural soldiering. Second, from more intricate second thought and reasoning caused by their relations with other men, which may be called systematic soldiering."[4] Was in direct opposition to his view of the manager: "There are, of course, men of unusual energy, vitality and ambition who naturally choose the fasted gait, whose up their own standards, and who work hard, even though it may be against their best interest."[5]

Can his point of view be valid, even to this day? In one example, I worked as a floor mechanic in a large motor repair company in 1989. I prided myself in pushing how quickly I could tear down and rebuild an electric motor without error. At one point, a few of my co-workers took me to one side and provided a warning that I should slow down as I was making them look bad. I did not change my habits, of course. In 1991, I was the General Manager of a motor repair shop in Virginia. The owner and I determined that we could have greater control of our level of quality

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[1] Taylor, Frederick W., The Principles of Scientific Management, 1911.
[2] Taylor, 1911
[3] Quote from Taylor, "Wikopedia.org: Scientific Management," 2005.
[4] Taylor, 1911
[5] Taylor, 1911

and turnaround if we built our own machine shop and hired a machinist. We determined a cost that would provide a good wage to an experienced craftsman and a relatively quick payback on equipment and construction, of about two years. As a working manager, I was the primary winder, balancer and one of the mechanics; I had to rely on the workers to produce their required level of work. At 23 years old, I also felt that I should not have to babysit the workforce, of which the next youngest was twice my age. However, we discovered that we were not seeing the expected trend in payback. I discovered that the machinist was able to determine how much we charged for the machine work, through a customer friend of his, and adjusted his pace so that his actual paid wage was divided into what was charged for each piece. When confronted, he stated that he did not see why the owner should 'make such a large profit from his work.'

The second case was more of a concern for me than the first. In this case, the professional machinist was unable to comprehend that costs existed above his actual take-home wage nor did he understand that the company had to justify its investment in equipment. Once we sat down with him, discussed these issues and identified the cost of the equipment, followed by presenting the decision whether we would sell off the equipment and continue to outsource, times improved and the investment was paid back in close to half the time we expected with little oversight of the craftsman.

In general, on the other hand, while I see examples of 'soldiering' regularly, I have seen a far greater percentage of self-motivated tradesmen and workers. What is seen, in my opinion, is trained perception and signs of the capabilities of managers. In my experience, I have worked in several different styles of management, which we will discuss in a later essay.

The motivation of Taylor to develop the principles of 'Taylorism' became very important in the progression of manufacturing, world-wide. These principles include:

1. Replace rule-of-thumb work methods with methods based on a scientific study of the tasks;
2. Scientifically select, train and develop each worker rather than passively leaving them to train themselves;
3. Cooperate with the workers to ensure that the scientifically developed methods are being followed; and,
4. Divide work nearly equally between managers and workers, so that the managers apply scientific management principles to planning the work and the workers actually performing the tasks.

He envisioned improvements in production through identifying the 'best ways' to perform each task by breaking them down into smaller tasks, then performing time and motion studies. Then, by having less skilled workers applying the tasks over and over again, the volume of work can be increased and both the employer and employee can be more profitable. He applied these concepts in numerous industries and companies, including Bethlehem Steel.

In 1913, Henry Ford applied these concepts into his Highland Park plant as part of the design and implementation of his assembly line process. The impact was an improvement in the assembly of a car chassis from 12.5 hours, by one worker, to an average labor time of 93 minutes. "This technology breakthrough, coupled with concepts of scientific management, represents the classic application of labor specialization and is still common today."[6]

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[6] Chase, Aquilano and Jacobs, Production and Operations Management, Manufacturing and Services, McGraw Hill, 1998.

There was recourse to the application, or more directly, mis-application of scientific management, including a 1913 Congressional Bill to prohibit the use of time-study and incentive plans in federal government operations. Ultimately, the bill was defeated.

From 1911 to the 1940's, the primary push was to develop tools and methods to reduce the time to manufacture products. The worker and craftsman lost his power to management, who assumed control. This loss of control began taking its toll on the concept of rewarding improvements and work volume that Taylor espoused.

"In auto assembly plants, resistance to speed up has been the chief task of unions since the 1930's. It was the cause of the UAW's first great strikes against Ford and GM in the 1930's and a leading cause of the UAW's strikes against GM in the winter of 1997-1998."[7]

"About a week ago, the GM workers in the Fisher Body factories received a 10 dollar Christmas bonus from General Motors. It didn't make up for all the inequalities the men had to endure… favoritism, unsafe working environment, piecework and the line speedup, minimal wages and benefits to name a few from the long list of indignity and disrespect."[8]

In the meantime, a series of studies performed at Western Electric, in Cicero, Illinois, known as the Hawthorne Studies (1923-1933) identified how work groups provide mutual support and resistance conerning management to unreasonably increase output. "These studies, conducted in the 1920's started as a straightforward attempt to determine the relationship between work environment and productivity. The results of the research led researchers to feel that they were dealing with socio-psychological factors that were not explained by classic theory which stressed the formal organization and formal leadership. The Hawthorne Studies helped us to see that an organization is more than a formal arrangement of functions but is also a social system."[9]

Traditional Assumptions:

⇒ People try to satisfy one class of need at work: Economic need;
⇒ No conflict exists between individual and organizational objectives;
⇒ People act rationally to maximize rewards; and,
⇒ We act individually to satisfy individual needs.

Human Relations Assumptions:

☑ Organizations are social systems, not just technical economic systems;
☑ We are motivated by many needs;
☑ We are not always logical;
☑ We are interdependent; Our behavior is often shaped by the social context;
☑ Informal work group is a major factor in determining attitudes and performance of individual workers;
☑ Management is only one factor affecting behavior; the informal group often has a stronger impact;
☑ Job roles are more complex than job descriptions would suggest; People act in many ways not covered by job descriptions;
☑ There is no automatic correlation between individual and organizational needs;

[7] Head, Simon, The New Ruthless Economy, Oxford University Press, 2003.
[8] "General Motors Flint Michigan GM-UAW Sit-Down Strike Journal 1937," www.flintsitdown.com
[9] "Background of Organizational Behavior," web.cba.new.edu/~ewertheim/introd/history.htm, 2005

- ☑ Communication channels cover both logical/economic aspects of an organization and feelings of people;
- ☑ Teamwork is essential for cooperation and sound technical decisions;
- ☑ Leadership should be modified to include concepts of human relations;
- ☑ Job satisfaction will lead to higher job productivity; and,
- ☑ Management requires effective social skills, not just technical skills.

While these factors are recognized with basic psychology, from the Hawthorne perspective, many textbooks focus only on the era of their publication and the views of the authors. For instance, in a 1979 management textbook:

> *Scientific management experts advised managers to treat people strictly as individuals and to offer individual piece-rate incentive pay to encourage each employee to produce to his or her maximum. Managers in the 1920s and 1930s were aware that many (if not most) workers limited their personal efforts in order to maintain their membership in an informal social structure. At some point, for virtually everyone except the individualistic 'rate busters,' the desire for communication, support, and friendship with associates on the job and during working hours becomes more important than the little bit of extra money that might be earned.*
>
> *…For young, unmarried female clerical workers in an insurance company office, for example, physical conditions and management policy must be adjusted to recognize the affiliation need. They may come to work mainly to fill the social gap that exists after high school graduation if they do not go to college or marry quickly.*[10]

Issues and problems were not as different then from now. For instance, in the first paragraphs of Taylor's 'Principles of Scientific Management:' "We can see our forests vanishing, our water-powers going to waste, our soil being carried by floods into the sea, and the end of our coal and our iron is in sight. But it is our larger wastes of human effort, which go on every day through such of our acts as are blundering, ill-directed or inefficient, and which Mr. Roosevelt refers to as a lack of 'national efficiency,' are less visible/less tangible, and are but vaguely appreciated."[11]

"The search for better, for more competent men, from the presidents of our great companies down to our household servants, was never more vigorous than it is now. And more than ever before is the demand for competent men in excess of the supply."[12]

Taylor saw the solution for the reduction in competent manpower to be a system of Scientific Management. He even saw the use of these systems throughout all aspects of business and home life: "It is hoped, however, that it will be clear to other readers that the same principles can be applied with equal force to all social activities: to the management of our homes; the management of our farms; the management of the business of our tradesmen, large and small; of our churches, our philanthropic institutions, our universities and our governmental departments."[13]

At the time, applying concepts of scientific management to business and service was difficult, especially in the area of timing and efficiency. Processes were attempted and failed until the

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[10] Webber, Ross A., <u>Management: Basic Elements of Managing Organizations</u>, Wharton School, University of Pennsylvania, 1979
[11] Taylor, 1911
[12] Taylor, 1911
[13] Taylor, 1911

advent of the business computer and related software. With the addition of monitoring software and computer capabilities, managers have been more able to watch the abilities of their personnel, and upper managers that of middle managers. Systems have also been put into place for service industries. The objectives are multi-fold, with the commonization of processes and the ability to utilize less skilled manpower in place of their skilled predecessors.

Table 1: Operations and Management Timeline

Year	Implemented By	Description
1910's	Frederick Taylor (USA)	Scientific Management, time-study, motion study and work study
	Frank and Lillian Gilbreth (USA)	Industrial psychology and motion studies
	Henry Ford and Henry Gantt (USA)	Assembly line and activity scheduling charts
	F W Harris (USA)	EOQ applied to inventory control
1930's	Shewhart, Dodge and Romig (USA)	Quality Control, sampling inspection and statistical tables for quality control
	Elton Mayo (USA) and Tippett (UK)	Hawthorne studies of worker motivation, activity sampling for work analysis
1940's	Dantzig (USA) Operation Research Groups (UK)	Multidisciplinary team approaches to complex system problems (simplex method of linear programming)
1950's-1960's	US and Western Europe	Operation Research Tools, simulation, waiting-line theory, decision theory, mathematical programming, PERT, CPM
1970's	Computer Manufacturers (USA)	Computers in business, shop scheduling, inventory control, forecasting, project management, MRP
	McDonalds Restaurants (USA)	Service quality and productivity, mass production in the service industry
1980's	Harvard Business School (USA)	Manufacturers strategy paradigm, manufacturing as a competitive weapon
	Tai-Ichi Ohno (Japan) Demming and Juran (USA)	KANBAN, Poka-Yokes, CIM, FMS, CAD/CAM, Robots, JIT, TQC, and factory automation
	Goldratt (Israel)	Bottleneck analysis, OPT, Theory of Contraints, Synchronous Manufacturing
1990's	NIST, ASQC (USA), ISO (Europe)	TQM, Baldridge Quality Award, ISO 9000, Quality function deployment, value and concurrent engineering, continuous improvement paradigm
	Michael Hammer	Business process re-engineering and radical change paradigm
	US Government, Netscape and Microsoft	Electronic Enterprise, Internet, World-Wide-Web
	SAP (Germany) Oracle (USA)	Supply Chain Management, SAP/R3, Client/Server software

Starting in about World War II, maintenance and reliability becomes an increasing concern as manufacturing systems become more complicated. The Operations and Maintenance (O&M) concepts begin to blend in the early 1980's as TPM becomes part of the O&M dialog.

Table 2: Maintenance and Reliability History

Year	Description
< 1950	Reactive maintenance and basic cleaning and lubrication, some scheduled maintenance (periodic)
1950's	Preventive Maintenance, Periodic maintenance and parts replacements
1960's	FAA and United Airlines begin research into new maintenance concepts
1970's	Reliability Centered Maintenance and the concepts of Condition-Based Mainenance, early availability of field testing technologies
1980's	Field testing technologies become readily available, maintenance software/ CMMS programs, Reliability Engineering
1990's	EAM/CMMS, advanced condition-based monitoring, vendors become experts

The communication issues between management and maintenance become more difficult as the complexity of maintenance tasks and the skill level of maintenance personnel increases with technology and computer-based systems. A definitive divergence in maintenance and management language becomes noticeable.

Figure 1: Cost Impact of Maintenance $/hp/yr
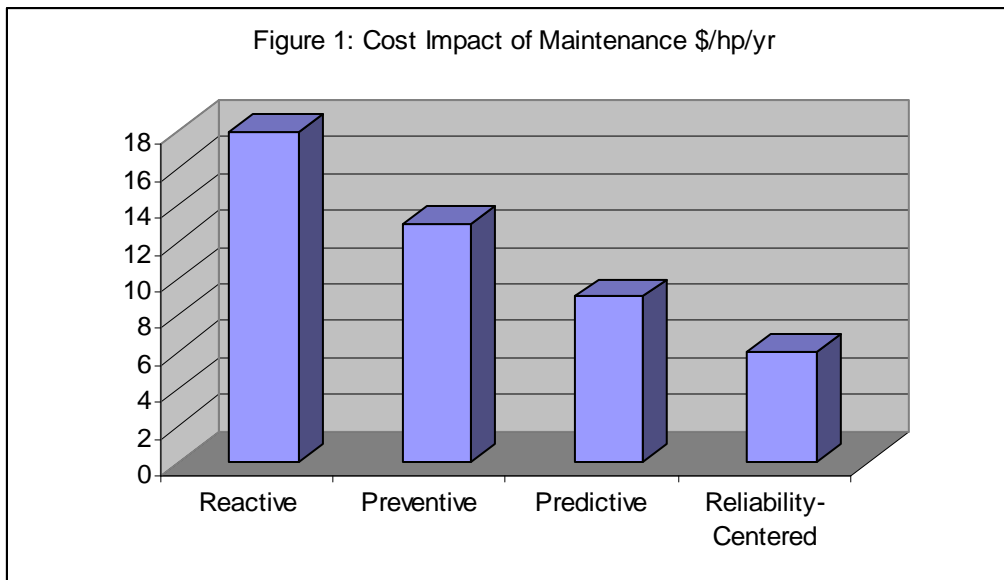
Prior to the 1950's, maintenance was primarily a reactive issue with components being repaired upon failure, cleaned regularly or lubricated periodically. Following World-War II, planned and preventive maintenance became more dominant as industrial and manufacturing systems became more complex. In the 1970's, the US Air Force funded Nowlan and Heap to develop the manual Reliability-Centered Maintenance. In the 1980's, maintenance became entangled with business operating and inventory management software. The science of Reliability Engineering continues to grow through the early 2000's.

Software and computers have had a greater impact on manufacturing and reliability than any other one leap. This comes from several standpoints.

For the skilled maintenance/predictive maintenance technician, software provides a simpler means to evaluate and trend condition of equipment, should an instrument vendor provide an

'expert' software system. It also allows for systems of continuous monitoring that are, in the early 2000's, becoming more prevalent. Maintenance planners can monitor the effectiveness of maintenance groups or personnel and properly implemented CMMS systems can allow for the detection of repetitive failures, equipment histories and other benefits.

Computers and software also allow managers to monitor the condition of different aspects of a corporation, groups or individuals. It has allowed for 'lean' processes within business offices, services and maintenance, and the view of corporate conditions real-time.

"Here the computer rivals the industrial assembly line itself as an agent of surveillance and control. Managers can peer into subordinates' computers with their own, time an employee's work to the nearest second, record and time workers' telephone calls; mark to the nearest second their every movement – to the toilet, the water fountain, or the lunch room. Graphs, statistical tables, pie charts – the latter illuminated with colored segments of green, yellow and red – all can analyze from every conceivable angle the performance of an employee or group of employees over a period of hours, days, weeks or years, with up-to-the-minute analysis."[14]

Additional changes to management have occurred as technology has increased over the past century. One of the most important started with the implementation of the foreman as management's monitor on the production line or in maintenance. As software entered the field, management has moved out of the field and more into the office, possibly not even in the same facility, state or country. This disconnect from the 'front line' provides the reason for the title of this essay series as maintenance is close to the front line while management may be a distance away (maintenance is from Mercury, management is from Pluto).

When I first entered the field of maintenance, I started as an electric motor repair journeyman and was quickly promoted to supervisory positions. I made it a point to learn all parts of the trades that I was responsible for. In the early 1990's, for instance, I made it a point of learning, in addition to rewinding and mechanical work, machining, vibration, balancing, infrared, ultrasonics and other machinery test methods (including of course, alignment, etc.). This allowed me, as a supervisor, then later as senior management, to understand the issues of my personnel and the skill to discuss opportunities with our clients. As I moved up the ladder, I worked with sales staff and marketing, as I had some level of responsibility in those areas.

As computer systems entered into the picture, I began to learn how they could assist me by both maintaining customer information and scheduling. As my career continued, with the tools available, I was able to monitor all aspects of those that worked for me, provide solutions to my clients and customers that were affordable and realistic and actually perform the work and training, as necessary. Having an understanding of the areas that I was responsible for, and tools to monitor success, made it easier to delegate authority and empower the manpower I had available.

In many of the sites I visit, however, I have noticed an increasing number of managers that either do not understand the processes that they are responsible for, or have not visited the sites that they are responsible for. Instead, they rely upon the software information that is provided.

The gulf between the maintenance and reliability professional and management becomes greater.

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[14] Head, Simon, 2003

In conclusion, as pointed out in the first essay, "Business Management of Reliability and Maintainability," there is still more to the rift between maintenance and reliability. In this essay, we explored the difference between Scientific Management and its successors and the concepts of reliability and maintenance. We then, briefly, introduced the impact that software has had on reliability and maintenance and the gulf between maintenance and management. The purpose has been to continue to identify the cause of this separation of philosophies.

In the next essay, we will continue to explore the software and skilled workforce issue in more depth. Following this discussion, we will begin to explore how to repair the rift, allowing for better communication and significant impact on the effectiveness of your reliability program.

About the Author

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