

## DEVELOPMENT OF AN EFFECTIVE MAINTENANCE WORKMAN SKILLS IMPROVEMENT PROGRAM

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**Abstract**— Maintenance Skills Training for industry is become an important concern because the cost of machine breakdown due to loss of production is high in large scale industries which are using highly productive machines. In many areas of the country, companies are competing for skilled maintenance personnel. The companies needed skilled maintenance person for performing maintenance jobs in a effective way so that availability of machine should be more .Current paper deals with need of training for maintenance personnel, methods for developing effective workforce & also the training formats for checking their performance.

**Keywords**— Maintenance skills, Training, Effective workforce, Training formats.

### I.INTRODUCTION

The term training [1] refers to the acquisition of knowledge, skills, and competencies as a result of the teaching of vocational or practical skills and knowledge that relate to specific useful competencies. It forms the core of apprenticeships and provides the backbone of content at institutes of technology (also known as technical colleges or polytechnics). In addition to the basic training required for a trade, occupation or profession there is also need to continue training beyond initial qualifications: to maintain, upgrade and update skills throughout working life. Various companies [2] may refer to this sort of training as professional development. The development and implementation of a maintenance skills training program must be part of a well-developed strategy as it not only to enhance the efficiency of maintenance person but also helps to identify skilled workman.

### II.OBJECTIVE

Our objective is to clarifying the steps for helping industries to prepare & develop an effective training program. First, we must understand that every plant is different in equipment, personnel, social climate, and skill levels. We must also assume nothing.

### MAINTENANCE SKILLS FACTS [3]

Let us face the facts about Maintenance Skills:

1. Most companies do not have fully skilled maintenance personnel.

2. You cannot fire everyone that is incompetent.
3. Hiring skilled maintenance personnel is difficult.
4. Most repetitious equipment problems that cost companies billions of dollars a year are a direct result of skill deficiencies.
5. A person that feels competent is a better worker and is motivated easier.
6. Often maintenance personnel are disciplined because of skill deficiency, not because of a lack of concern or commitment.
7. People become frustrated or stressed when they do not know the proper way to do a specific task.
8. Companies spend millions of dollars a year on maintenance training without regard to the results expected from it or without a way of measuring results.

### III. STEPS TO A SUCCESSFUL TRAINING PROGRAM

These are the steps to a successful training program [4]:

1. Obtain commitment from plant, production and maintenance management. They must all understand that this process does not provide overnight results. They must also understand that they will have to contribute to the success of the program, such as:

Plant Manager: Money spent on the training program (overtime - possibly, labor cost, developmental cost, instructor cost, material cost).

Production Manager: Longer down time to repair machines properly.

Maintenance Manager: Trying to juggle breakdowns, scheduling work and training with personnel.

They must also understand the rewards of the program:

Plant Manager: Decreased downtime, decreased maintenance cost, increased employee morale.

Production Manager: Increased production uptime and equipment efficiency.

Maintenance Manager: Reduced breakdowns, less panic, less stress, better employee morale.

2. Establish baselines in order to track if the training is successful or not. A baseline must come from an area that has been tracked for a period of at least 12 months in order to be proven as a valid method of tracking progress. The baseline you use should be tracked on a chart and be explained to all maintenance personnel. A change is normally not seen for at least 6 months. The different area baselines that could be established are:

- Maintenance overtime
- Maintenance parts and supply cost
- Downtime or Uptime
- Tracking maintenance hours on preventive maintenance, scheduled maintenance, breakdown maintenance

3. Perform a literacy assessment [5] - The literacy level of your maintenance personnel must be determined in order to insure everyone will at least be able to read and comprehend the training program.

Many maintenance managers don't care if someone can read, write or perform math very well along as they can do their job. We must look beyond personnel doing their jobs well today. If someone has a literacy issue and we don't help that person resolve it, then they will be headed for failure later in life. As technology changes so will the demands of everyone to read, write and perform mathematics in a maintenance environment.

4. Perform a FOG index [6] - This is one of many ways to determine the reading level of the material a person is reading in order to perform their job. Typically this involves taking samples of the reading material in a specific job and identifying the number of multiple syllable words in a sentence and the length of sentences. This information is needed in order to identify the literacy requirements of a maintenance person's job.

5. Perform a job task analysis [6] - This identifies exactly what is the skill and knowledge for a specific skill area. The task analysis is performed with the use of the maintenance personnel and validated by management.

6. Develop a skills assessment [7] - A skills assessment should be based on the critical task in a task analysis. Each skill area should have three components:

- Written: This identifies the knowledge required for a specific skill.
- Identification: This area assesses knowledge in specific skill areas.
- Performance: This area assesses the critical skills required.

7. Perform a skills assessment [7] - The skills assessment should be performed by assessors who are certified in order to

insure validity of the results. We should have to take help of an outside agency or a local technical school administrator for the assessment. This insures that the assessor does not have preconceived notions about what someone knows.

8. Identify the curriculum [7] - Management and trainer should determine the training curriculum based on the results of the assessment. For this look at the average scores of the individuals in each area and begin training in the areas with the lowest averages first.

9. Review the assessment results [7] - A third party should review the assessment results with each individual privately and confidentially. This person should focus on the strengths a person has and then the areas they need to improve in.

10. Provide the maintenance personnel with the training plan [8] - This plan should include the following:

- Training Curriculum.
- Training hours.
- Roles and responsibilities of each person.
- How the training will be delivered. i.e., 10% classroom, 90% hands on etc.

11. Training should be developed on the task analysis and be competency based.

12. Anyone not meeting a competency should be given remedial training.

13. Personnel should be held accountable to use their developed learned skills to the competency identified

#### **TRAINING FORMATS / METHODS TO GET THE TRAINING AS PER NEED.**

1. Technical Schools and Colleges [9]: Technical Schools and Colleges are good resources to provide the maintenance skills training required. A company must insure that a school or college provides them with the training they need and how they want the training provided. Technical Schools and Colleges many times have funding available either from their state agency or through government grants. The key to success in this program is that the company must be fully responsible and accountable for the training. Do not expect the school or college to be fully responsible for the success or failure of a maintenance training program.

Two real life examples are shown below:

Company A: Company A asked their local Technical College to provide them with a maintenance training program. The Technical College agreed that they could provide the

maintenance skills training and that their state agency would fund the program. Everything looked great to the plant manager. The only requirement from him was to provide the time for his maintenance personnel to attend the training programs. The Technical College began training and thought everything was going well until the plant manager decided he wanted to attend a training session. He attended the final class on Dial Indicator Coupling Alignment. The next week the plant manager noticed two mechanics aligning an electric motor and saw they were not performing the alignment as they were trained. He became very upset and canceled the training program with the Technical College citing they did not train his personnel adequately. The actual problem found later was that the college trained the mechanics on a procedure that the plant did not have the tools to perform properly. The maintenance supervisor also told his mechanics when they returned from class to forget what they learned in class and just perform the coupling alignment as he had shown them. This is a typical situation that happens many times. A company must be involved in the development of a maintenance training program and become involved in how a subject is taught, what is taught, and make sure it is taught to the requirements of their equipment.

Company B: Mr. X was asked by a company to provide maintenance training to their mechanics. Mr. X asked the company exactly what was the expected outcome of a maintenance training program. They stated they wanted a training program to upgrade the skill level of their personnel. Following this guidance Mr. X first obtained the commitment of management to proceed with the training development and implementation. Next, he had his staff perform a job task analysis. A maintenance assessment was performed to assess the knowledge and skill level of the maintenance mechanics. The results of the skills assessment was then reviewed with management and a training curriculum was developed based on the needs identified. Next, the assessment results were reviewed with each mechanic stating their strengths and areas needing improvement. The training established was based on the curriculum and the training was performance based with the plant's equipment and problems in mind. The company frequently reviewed with Mr X the task and competencies each person would be trained in, how the training would be given and any specific equipment the company wanted to emphasize in this training. This training program grew as more and more companies heard about the program. This is a successful program because not only was the Technical Institute committed to providing quality training, but also the companies were involved in the training at all times. From this example we learned that by developing and implementing training properly we can be successful.

2. Contract Training: Hiring a training firm to provide a company with the maintenance skills training. When

reviewing a company to provide maintenance skills training, ask for references and visit a plant where the training has been in place for at least a year. Once you are satisfied with the references of this firm then give a proposal explaining:

- How the training would be developed?
- What training format they would use? {i.e., Hands on (performance based), Classroom, etc.}
- How will they determine the skill and knowledge level of the maintenance person?
- What are their roles and responsibilities in the upgrading of the skill level in this training program?
- How will they deal with personnel that have learning problems?

A company that is dedicated to maintenance skills training should be able to resolve all of the above issues, as they will have the experience and knowledge to implement a very successful training program. Many times a training firm is overlooked because of cost, but the cost of having training implemented is much more costly than paying someone to do it right the first time. The main advantage of a training firm is that they must be successful or they will not be in business very long whereas a college or school does not have to be concerned with this issue. Think of building your own house from the ground up. The smart person hires the most reputable contractor to handle the entire job, and then follows the progress all the way through. Most people and companies do not possess the skills to implement their own programs.

3. Vendor Training: There are two types of vendor training. One involves the use of a local vendor to provide free seminars on their product line. This type training can be good for product review and understanding but will not work when looking at upgrading the skill level of your maintenance personnel. This type training is needed because there are products that can be used by maintenance personnel that if they are not utilized properly, serious problems may result. The second type vendor training is provided by equipment manufacturers. This type training is very important to the successful maintenance of any new equipment. The concerns are that the maintenance personnel being trained may not have the prerequisite skills to understand the training provided to them. If you plan to use equipment vendor training then someone must identify the prerequisite skills needed to understand how to troubleshoot and maintain a piece of equipment. Next, an equipment vendor must provide the course outline and objectives. This insures that the training will be professional and not something an instructor gives from memory.

4. Workshops: Workshops are good training sources when they are tailored to meet a company's needs. Tailoring a

workshop to a specific plant insures that attendees will have a better chance of gaining knowledge and skill from the workshop. Workshops that are not tailored can still be useful if the objectives meet the attendee's needs. A person must have the prerequisite knowledge and skill for a specific workshop in order to increase their knowledge and skill in a specific area.

5. Other Methods: There are many other methods a company may use which will provide a successful training program. Some of these methods are peer coaches / training, in-house training, self instructional, etc. A combination of these programs works very well depending upon a company's specific needs. The thing to remember is that every plant and situation may be different and require a tailored program to meet their needs.

#### **HOW TO KNOW IF YOU'RE CHOOSING THE RIGHT TRAINING AT RIGHT TIME FOR YOUR COMPANY'S NEEDS [10]**

**1. Training expenses:** Employee training programs cost money that employers might be reluctant to spend-especially in tough economic times. Often times giving serious consideration to an employee training program is delayed until an incident occurs that highlights the need for a change in the status quo. The truth is that money spent on training employees well can benefit a company in many ways for years. The benefits come in the form of increased efficiency and productivity; less downtime or complete breakdown of systems; less reliance on high priced outside consultants to resolve issues, as well a decrease in insurance liabilities due to accidents on the job, along with their potential for OSHA (Occupational Safety and Health Administration) penalties. Additionally, employers need to factor into their long range planning that a large segment of the experienced industrial workforce will be retiring within the next five years. (Some estimates go as high as 50% of the entire industrial workforce nationwide.) That means fewer employees will be available with the skills and knowledge in place to maintain, repair and operate industrial systems. Clearly, the time has come for companies to commit to dedicating resources to train current and future maintenance, repair and operations employees. What kinds of training do employees need to do their job well? The types of training that each employee will require, is dependent upon the nature and scope of their areas of responsibility. For example: an employee that services air conditioning systems would benefit from training about electrical safety, electrical circuitry, grounding and bonding, and many additional subjects, beyond becoming thoroughly knowledgeable about the specific topics of air conditioning systems, refrigerants, EPA requirements and certification requirements. A company's generalized maintenance and

repair technician would benefit from training about any system present in the facility that they may be responsible for.

#### **2. How often do employees need training?**

Technologies of all types are evolving at increasingly accelerated rates. You cannot assume that employees can or will be able to adapt the information or knowledge they have about a specific technology, and be able to properly operate, maintain or repair newer technologies that may have been integrated into their workplace. It might be valuable to look into training that might be offered by the manufacturer of a system or mechanism that has been added to your workplace.

In addition to mechanical or technological changes, code cycle changes are another important marker indicating when employees might be requiring training. Again, the employer is obligated to ensure that the work environment is as safe as possible and that the physical environment and work practices conducted therein are in compliance with the latest code requirements and mandates. New employees should be screened for safe work practice adherence. Don't assume that a new hire comes from an environment where there was an adequate safety culture in place. If a new employee is found to have a lesser understanding or awareness of best safe work practices for their areas of responsibility, they are a good candidate for training.

#### **3. What are the options for types of training?**

There are many types of training options with varying degrees of effectiveness and engagement of the student in the learning process. They range from interactive compact discs and online courses to full classroom instruction with hands-on training aids. Training can be offered through the manufacturers of the products or systems that you have in house; they can be conducted by trade associations; technical training can also be found at local educational institutions and it is offered by commercial training companies.

#### **4. How to determine what type of training will be best for my company? (What is the best training value?)**

Before a company goes shopping for training, they need to determine what they hope to accomplish with that training. Having a clear understanding of what your training needs are is a key factor in determining the adequacy of the type of training that you are considering. For a lot of companies, the decision about what type of training they should utilize for their staff development is based upon cost considerations. It is also important to consider the quality and depth of the learning experience that various types of training deliver. Truly effective learning and retention-(which is especially important when the training is to be applied to mission-critical outcomes), should cover all of the levels of learning as described in Bloom's Taxonomy of Learning Domains. It means that a truly effective learning experience should leave a student with the following:

- I understand the subject matter. (A cognitive learning experience)
- I understand the value of knowing about the subject matter and how it will improve job performance. (An affective learning experience)
- I have a level of mastery of the practical application of the subject matter-I can do it. (A psychomotor learning experience)

A classic study originally published in 1956, outlining the effectiveness of learning techniques.

How do you measure the effectiveness of training? In order to measure whether training was effective, it is helpful to have a set of criteria by which you can gauge the student's training experience. The following evaluation model was developed by educational expert Donald L. Kirkpatrick. It includes four stages: reaction evaluation, learning evaluation, behaviour evaluation and results evaluation.

(i) Reaction evaluation is how the students felt, and their personal reactions to the training or learning experience, for example:

- Did the trainees like and enjoy the training?
- Did they consider the training relevant?
- Was it a good use of their time?
- Did they like the venue, the style, timing, domestics, etc?
- Level of participation.
- Ease and comfort of experience.
- Level of effort required to make the most of the learning.
- Perceived practicability and potential for applying the learning.

(ii) Learning evaluation is the measurement of the increase in knowledge or intellectual capability from before to after the learning experience:

- Did the trainees learn what was intended to be taught?
- Did the trainee experience what was intended for them to experience?
- What is the extent of advancement or change in the trainees after the training, in the direction or area that was intended?

(iii) Behaviour evaluation is the extent to which the trainees applied the learning and changed their behaviour, and this can be determined immediately and several months after the training, depending on the situation:

- Did the trainees put their learning into effect when back on the job?
- Were the relevant skills and knowledge used?
- Was there noticeable and measurable change in the activity and performance of the trainees when back in their roles?

- Was the change in behaviour and new level of knowledge sustained?
- Would the trainee be able to transfer their learning to another person?
- Is the trainee aware of their change in behaviour, knowledge, skill level?

(iv) Results evaluation is the effect on the business or environment resulting from the improved performance of the trainee-it is the ROI, which is the acid test of training efficacy. Measurements of the efficacy of industrial trades training would typically be performance indicators, such as: higher productivity, demonstrated safe work practices, less work related injury, less system downtime, fewer numbers of complaints, less staff turnover, fewer failures, reduced waste, increased adherence to compliance issues, higher quality ratings, etc. The bottom line is that staff development and training are essential to the long term health of every company. It is important that ongoing training be considered a vital element in a company's fiscal planning. Once the decision has been made to include training into the corporate budget, make sure that you are getting your money's worth. Be prepared to measure and analyse whether or not the staff training methods utilized have actually made a difference in performance quality and ROI (Return On Investment). Don't underestimate the value of the training that you secure for your employees. Be clear about the desired outcome of the training you seek. Be very discriminating about the training provider and their methodology and reputation, and above all, remember the adage: you get what you pay for.

#### DEVELOPING AN EFFECTIVE WORKFORCE [11]

Large scale industries cut cost through headcount reduction, reducing maintenance activities and a variety of other arbitrary means. Many view headcount reduction as the only means of achieving a competitive position that would permit our industries to survive in the ever-increasing competitiveness of the world market. Unfortunately, companies cannot cost cut their way to prosperity. If cutting cost is not the answer, to only real option is to increase the productivity of our critical assets. This is certainly true of our workforce. Research has clearly show that a one percent increase in workforce productivity will produce more than ten times the financial impact as a one percent reduction in operating costs. Unfortunately, old habits are slow to die. The challenges generate by growing competition worldwide are too broad and too deep for this old approach to succeed. Instead, our survival depends on the ability to achieve and sustain maximum productivity from the entire workforce, not just a cadre of over-achievers. Achieving a universal maximum effort from our workforce will not be easy, but it is certainly not impossible. There are four essential steps required to achieve sustainable workforce performance levels:

**(i) Develop A Team Culture:**

The first step is to develop a process that will integrate your superstars into a cohesive, focused team. In addition to increasing the performance levels of the over-achievers, this integration will multiply the superstar's performance contribution, as well as provide the mentoring and training needed to raise both the skills and performance levels of the entire workforce. We learn best through imitation and without good models there is little chance that overall workforce performance will change. Integrating the superstars into the organizational team will raise the bar for the entire organization.

**(ii) Align Roles and Responsibilities:**

In too many cases, the organizational structure and staffing do not coincide. Instead of creating structures based on the functional needs for effective planning, management and execution of the work necessary to cost-effectively perform the company's mission; they are created around the cadre of superstars. While this approach may work in the short-term, it cannot sustain the performance levels essential for long-term survival. The key to workforce productivity is to ensure that each worker is in a role, for which he or she is competent, or can become competent, as well as effectively and efficiently perform his or her duties. In addition to the technical skills, each employee must want to perform his or her function and have a passion to excel.

**(iii) Clear Performance Goals:**

The workforce will function at the expectation levels established by the corporation. If mediocrity is acceptable, that is exactly the level of performance that the workforce will produce. Every employee will respond to a realistic challenge, management must establish performance goals that will stretch performance levels of the entire workforce and each of its individuals. Universal Accountability Management must uniformly hold the workforce accountable for its actions. This does not mean punishing employees for mistakes or falling back to the well-established mentality of fixing blame whenever things go wrong. Instead, the workforce must understand that management is serious about achieving established performance levels and will not tolerate behaviour that is not supportive or is contrary to them. Relying on superstars or cost reductions for long-term survival has not and cannot work. Organization decision-makers must find a way to raise the performance level for all of their workers, from the boardroom to the shopfloor. To do so mean thinking holistically and systematically about the structure and processes that affect your ability to compete in the marketplace and ensuring that all restrictions or impediments to excellent performance are eliminated. Let your workforce do its job. They might surprise you.

**(iv) Motivation:**

There is a widely held misconception that the only factor that motivates the workforce is money. Too many corporate managers, at all levels, fail to understand that many other methods are more effective in motivating their workforce. The key to motivation is getting employees to want to do a good job. In this light, motivation is something that must come from within an employee, but the supervisor must create an environment that encourages motivation on the part of employees.

**(v) Recognizing Needs:**

Every supervisor knows that some people are easier to motivate than others are. Why is this true? Are some people simply born more motivated than others are? No person is exactly like another. Each individual has a unique personality and makeup. Because people are different, different factors are required to motivate different people. Not all employees expect or want the same things from their jobs. People work for different reasons. Some work because they have to work; they need money to pay bills. Others work because they want something to occupy their time. Others work so they can have a career and its related satisfactions. Because they work for different reasons, different factors are required to motivate employees. To understand the behaviour of an employee, the supervisor should always remember that people do things for a reason. The reason may be imaginary, inaccurate, distorted, or unjustified, but it is real to the individual. Identifying the reason is necessary before the supervisor can understand the employee's behaviour. Too often, the supervisor disregards an employee's reason for certain behaviour as being unrealistic or based on inaccurate information. Such a supervisor responds to the employee's reason by saying, "I don't care what he thinks that is not the way it is." Supervisors of this kind will probably never understand why employees behave as they do. Another consideration in understanding the behaviour of employees is the concept of the self-fulfilling prophecy, known as the Pygmalion effect. This concept refers to the tendency of an employee to live up to the supervisor's expectations. In other words, if the supervisor expects an employee to succeed, the employee usually will succeed. If he expects them to fail, failure usually follows. The Pygmalion effect [12] is alive and well in most plants. When asked the question, most supervisors and managers will acknowledge that they trust that small percentage of their workforce will effectively perform any task assigned to them. Further, they will state that a larger percentage is not trusted to perform even the simplest task without close, direct supervision. They exhibit these beliefs their interactions with the workforce and each employee clearly understands where he or she fits into the supervisor's confidence and expectations of them as individuals and employees. The "superstars" respond by working miracles and the "dummies" continue to plod along. Obviously, this is no way to run a business, but it has become

the status quo. They make little, if any effort, to help under-achievers become productive workers.

(vi). Reinforcement

The workforce will repeat reinforced behaviour more often than behaviour than those that are not. For instance, given a pay increase when their performance is high, employees are likely to continue to strive for high performance in hopes of getting another pay raise.

There are four types of reinforcement: positive, negative, extinction, and punishment. Positive reinforcement involves providing a positive consequence because of desired behaviour. The majority of plant and corporate managers follow the traditional motivation theory that assumes money is the only motivator of people. Under this assumption, financial rewards are directly related to performance in the belief that employees will work harder and produce more if these rewards are great enough. However, money is not the only motivator. In fact, money can be a negative motivator. For example, many of the incentive bonus plans for production workers based on total units produce within a specific time (i.e. day, week or month). Since there is nothing in the incentive that addresses product quality, production or maintenance costs, the typical result of these bonus plans is an increase in scrap and total production cost. Negative reinforcement involves giving a person the opportunity to avoid a negative consequence by exhibiting a desired behaviour. Both positive and negative can be use to increase the frequency of favourable behaviour. Punishment involves providing a negative consequence because of undesirable behaviour. Both extinction and punishment are used to decrease the frequency of undesirable behaviour.

### CONCLUSIONS

A company that seeks a successful maintenance training program must be committed and understand that to develop and implement a program takes time and money, but the rewards are far beyond the cost associated to them. Always remember a principal of Adult Learning, a person must see or do something 7 to 21 times in order to retain the information. Maintenance person skill improvement is one of the important steps for any industry to survive in this competitive environment. With some exceptions, employees are not self-motivated. The management philosophy and methods adopted by plants and individual supervisors determine whether the workforce will constantly and consistently strive for effective day-to-day performance or continue to plod along as they always have. It is not about monetary incentives. In many cases, a simple, sincere pat on the back or a handshake with a heartfelt “well-done” will accomplish more positive benefits than we think. It is not the monetary value, but the sincere recognition of one’s supervisor of a job well done that has lasting, positive motivation. Try it!

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