

Cross Craft Training. Maintenance-training curriculum.

By Antonio Reis.

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The general consensus in manufacturing is that the most efficient maintenance programs focus on preventive maintenance. However because preventive maintenance programs depend much on the ability of the maintenance workers to inspect and diagnose the working condition of the manufacturing equipment and the skill level of these workers is not always adequate, there are plenty of horror stories about missing delivery dates, inexplicable equipment breakdowns and low quality attributed to failures in the maintenance function. If proper diagnostics can't be done, the program rapidly becomes a burden to the manufacturing process.

Effective inspection and diagnoses require maintenance personnel with cross craft skills and employers share most of the burden of training their craftsman in other maintenance fields.

Do you feel you need to implement a cross craft training program? How to structure such program?

Equipment and facilities maintenance are basic necessities in any manufacturing system regardless of size and complexity. One may argue that different types of equipment require different approach to maintenance in order to maximize reliability. There are abundant attempts to define common standards that would establish guidelines for the management and implementation of a maintenance curriculum that would satisfy the needs of manufacturers regardless of the industry. This is difficult since a maintenance worker able to effectively perform equipment maintenance in most industry types needs a skill set comparable to that of a Master Mechanic.

(Master Mechanic is distinguished by responsibility to perform skilled maintenance, modification and repair of mechanical facilities and machinery components requiring the skills of a machinist and welder as well as a journey mechanic. This worker requires a working knowledge of several related skill fields such as plumbing, electrical, welding and machinist work.)

The basic goal of the maintenance function is to assure the reliability of the manufacturing process. Most equipment designers and manufacturers promote reliability as a function of the equipment design. Reality shows that the matter is somewhat more complex and that reliability is a function of the operating environment. Equipment wear is present in every operating environment. The degree of wear differs depending on the on the components ability to withstand the wear and tear, corrosion, weakening etc expected during operation. A specific bearing has a very different life expectancy operating in a clean non-corrosive, non-abrasive environment versus operating on a steel mill sand return conveyer. Therefore, based on these observations, to achieve optimum

reliability, the maintenance function needs to focus on the management of the deterioration of the equipment as to maintain the said equipment within its design capabilities.

Since management of the equipment wear and tear is the primary objective of any maintenance organization, the most important skill for the organization is the ability to determine the level of wear of the equipment and correlate it with the financial implications in the manufacturing operation. This never-ending effort is the basic premise for existence of Preventive Maintenance (PM).

Preventive Maintenance is defined by some as *“The care and servicing by personnel for the purpose of maintaining equipment and facilities in satisfactory operating condition by providing for systematic inspection, detection, and correction of incipient failures either before they occur or before they develop into major defects”*. Or *“Maintenance, including tests, measurements, adjustments, and parts replacement, performed specifically to prevent faults from occurring”*. It is a fact that the quality of the PM function is directly proportional to the ability to inspect and detect either faulty equipment or symptoms that will lead to failure. To do that the inspector needs to have a broad knowledge of equipment components (bearings, linkages, motors, electric contactors, gauges, valves, solenoids etc) and measuring instruments (electrical, mechanical, gases, temperature, vibration etc.). The PM function requires maintenance workers that can cross craft over several trades.

The formal education and training of maintenance workers is mostly based on a single craft. This is understandable for economic and political reasons. A trade school can provide better services if it specializes in a specific trade, trade unions are structured to develop their membership skills in the specific trade and in general the reputation for having a skill set and specific craft culture defines a trade as well as the wages paid. A welding trade school will not distinguish from other welding schools by offering courses in electronics and the electricians union will not gain if it provides welding training to its members. So it appears that the cross craft training is mostly an “on-the-job training” phenomenon and occurs under the responsibility of the employers.

It is important that the executive management of a manufacturing organization defines a training curriculum that will best align the organization maintenance needs with the education development of its maintenance workforce. First we must characterize the complexity of the manufacturing process. We are mostly concerned with the reliability and precision requirements of the equipment in order to achieve the targeted quality and product output. As an example, the individual equipment in a refinery is not very complex but because of the large number of equipment and the inter dependency, the process is considered a complex process. [Fig 1](#) shows a graph listing various industry types by level of complexity. The ranking is based on my opinion and experiences and not on published materials. The various skill sets are arranged in order of relevance with respect to the manufacturing process level of complexity. [Fig 2](#) shows a graph listing the skill sets in terms of specialization and education requirements. In order to reach journeyman in a specific maintenance field there are to both general education and craft related skills that must be acquired. On one side we have the general education that is part of curriculum provided at public schools, junior colleges and universities and the

specific trade education that is part of curriculum provided by trade schools and other training programs such as apprentice programs. Trade schools provide both the general education and the specific trade education.

Can or should a company rely on cross-crafted workers to solve their maintenance problems instead of hiring craft masters? Depends on the type of cross training and the quality of the curriculum. I suggest that the main goal in maintenance training is that all workers achieve journeyman status in one craft. With that in mind, one should become a journeyman before venturing into cross training. Referring to [Fig 2](#) cross training must include the acquisition of skills both general education and craft related. As an example if an electrician chooses cross training in welding, he must take a similar approach as the welder apprentice. Continuation in the welding field would allow the cross training student to become a journeyman welder. The training program should be developed in steps with defined skill capability for each step and continuation of training should be optional. If this approach is taken than a company should maximize its resources and use all available skills. If such approach is not taken, an unqualified worker performs the work and the company will suffer.

Should a company dictate what crafts are worker to train on? Whenever possible the company should optimize both the needs of the maintenance function and the employee career goals. However some basic understanding needs to be established. A good cross training curriculum is designed such that the company investment return is immediate and, at least, partial solves the personnel resources of the company. In another words the electrician while training in the welding craft is a welding apprentice. At times when not required as an electrician the worker must perform as a welder's helper. Following this philosophy, cross training of a journeyman plumber in electronics to become an electronics tech will not benefit the company in any aspect. The worker needs several semesters of electrical and electronics theory among other skills that are better taken by the employee on his own time. The worker would have nothing to contribute to the maintenance function during the training and the "on-the-job" training represents an unnecessary risk for the company.

Should CCT be a mandatory requirement to work in the maintenance department? Maintenance workers must be encouraged to improve their skills. Every worker in the maintenance department must be required to reach a certain level of proficiency in a specified time limit. In my opinion every maintenance worker should become a proficient journeyman mechanic within two years of from start working in the maintenance organization.

(Mechanic's duties including but not limited to overhauling, repairing, adjusting and servicing industrial equipment, and components; diagnoses trouble and determines extent of necessary repairs; machines replacement components incidental to mechanical repairs; oversees the repair work of other mechanics, demonstrates repair and maintenance of equipment using hand tools; reports orally and in writing to superiors regarding safety and health concerns encountered while performing required duties and initiates corrective action where appropriate; maintains records of time materials, parts and tasks performed).

If a worker can't reach the above skill set within the specified time, the company should move him out of the maintenance department. However a worker that meets the basic requirements should not be forced to be cross trained in any field he is not comfortable in.

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