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APPLICATION OF THE 7- STEP PROCESS VARIABILITY REDUCTION ON THE C-17 EMPLOYEE CERTIFICATION PROCESS

A Thesis

presented

to the faculty of

California State University Dominquez Hills

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

in

Quality Assurance

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by

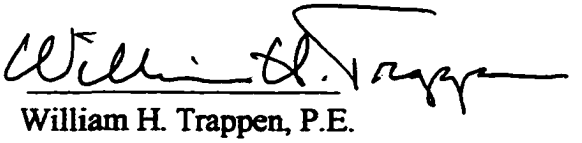
David M. Quinlan

Spring 1999

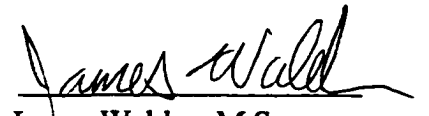
PROJECT: APPLICATION OF THE 7-STEP PROCESS VARIABILITY REDUCTION ON THE C-17 EMPLOYEE CERTIFICATION PROCESS

AUTHOR: David M. Quinlan

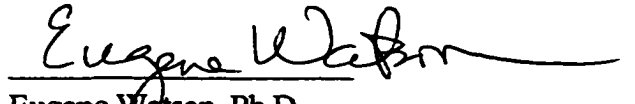
APPROVED:



William H. Trappen, P.E.
Thesis Committee Chair



James Walden, M.S.
Committee Member



Eugene Watson, Ph.D.
Committee Member

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Above all, I thank the dedication of my beliefs in continuous improvement and self-growth, which my father bestowed on me as a blessing. It has caused me to see there is no end to life's learning, but instead only a new path, which has not been explored.

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ABSTRACT

This thesis applies the 7 Step Process Variability Reduction (PVR) methodology to reduce expired employee certification. Expired employee certifications cause production delays, difficulties in scheduling training classes, and customer dissatisfaction.

The PVR process uses process flow definition, failure mode and effect analysis, key characteristic determination and statistical data analysis to identify problems and undesirable process variables. Process improvements are accomplished utilizing variability reductions, corrective and preventive actions and self directed work teams. As the result of implementing the PVR process and measuring the results of variability reduction, the outcome will be to reduce the percentage of expired employee certifications and improved the employee certification process.

CHAPTER 1

INTRODUCTION

Based on personal observation and experience, the author believes that all forms of business require an adequate skilled workforce to accomplish tasks required to produce products or services. The management of training, maintaining current skills, and meeting the advanced requirements of a continuously improving process necessitates an efficient training process. The complexity of a business governs the complexity of the training requirements. Businesses, which are subject to rigorous requirements imposed by government agencies, require efficient training programs to ensure those requirements are met. The production of aircraft is an example of this situation. The production of commercial aircraft requires compliance to laws and rules set forth by the Federal Aviation Administration (FAA). Military aircraft can also have contractual requirements set by Congress, the U.S. Air Force as well as the Defense Contract Management Command (DCMC) which is another governing agency required to ensure contractual compliance.

The C-17 Globemaster is an aircraft currently being produced by The Boeing Company for military application, but is also undergoing application to the FAA for non-military commercial use. In as much as producing aircraft is a complex process requiring numerous skills from its workforce, the training and certification of employees is a very

specialized and controlled process. The FAA and DCMC require the aircraft to be assembled and tested by individuals capable of performing specialized tasks for which they have been properly trained. (Team Leader-Learning , Training and Performance Development, March 2, 1998) The obvious result of product failure would be the loss of human lives. This factor alone mandates the requirements for an error free product performance. Beyond the need to comply with regulations, the need exists for specialized individuals to assume responsibility for the work they perform without additional verification. This is crucial in reducing costs and improving manufacturing efficiency. The C-17 program is implementing a process that reduces Quality Assurance inspectors who verify job integrity after a successful transition of allowing individual mechanics the ability to approve their own work. The obvious benefits will be lower cost and increased efficiency.

CHAPTER 2

PROCESS VARIABILITY REDUCTION (PVR)

Process Variability Reduction (PVR) (Figure 1) is created and designed as an analytical problem-solving tool which focuses on breaking a process down into several individual steps (Process Variability Reduction, 1998). The first step begins with examining the overall process and determining the repeatability of identified steps to a specific outcome, examining variance in the process and defining the current output of the process. There is a systematic approach to utilizing scientific analysis tools which helps to make logical conclusions and decisions leading to improvements. The PVR-7 step methodology is designed to improve product quality by improving the process utilized in the manufacturing cycle. This paper will show the application of PVR in the employee certification system can result in significant improvements.

The employee certification process was selected for this project due to the significant obstacles which numerous organizations face each day as a result of systems failures. System failures can result in customer dissatisfaction and a loss of confidence in a company's ability to meet contractual requirements.

The problem with the employee certification process can be best defined by studying the relationships between the manufacturing requirements for certified employees and the ability of the Training Department to meet those needs. Production management must

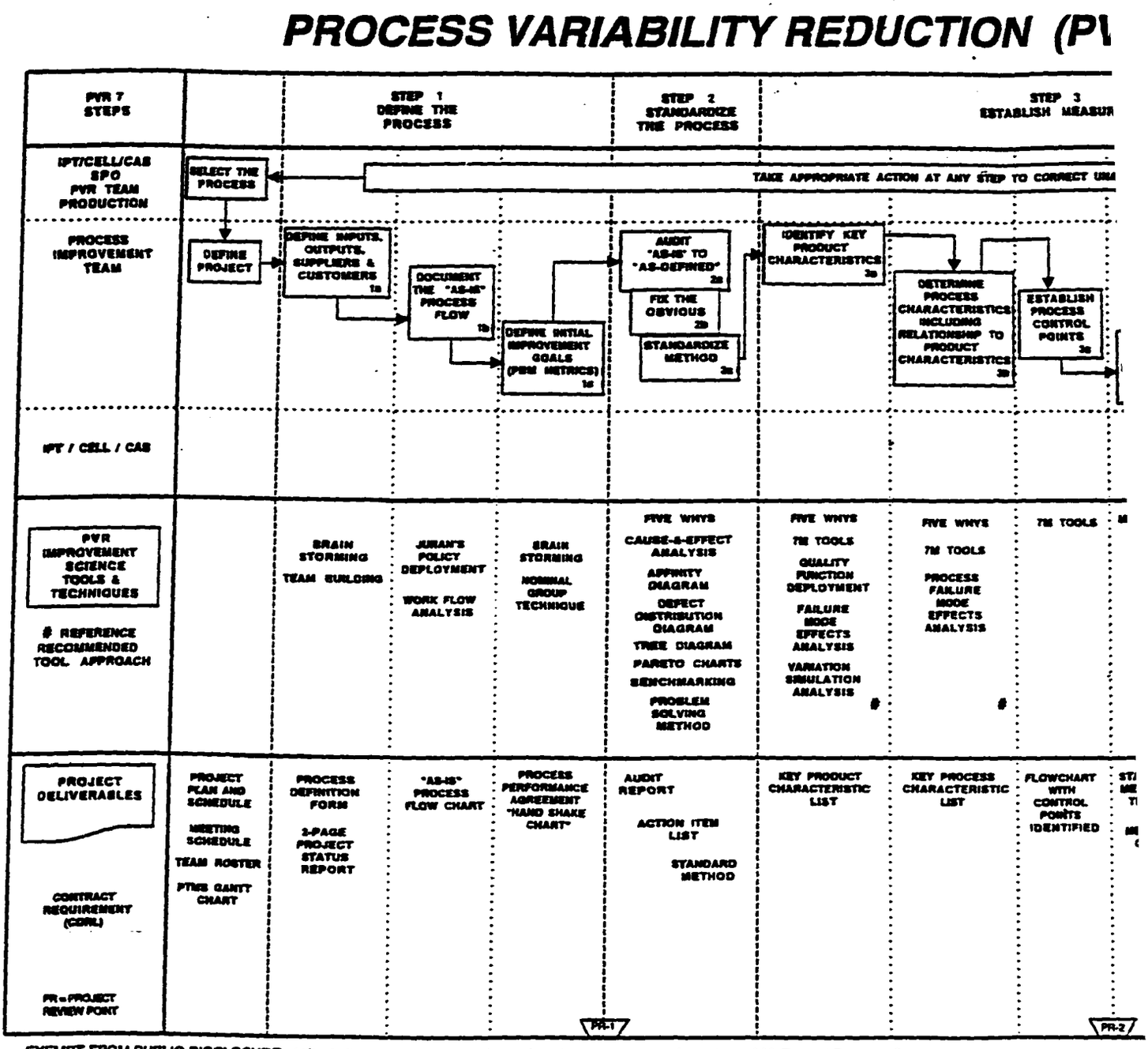
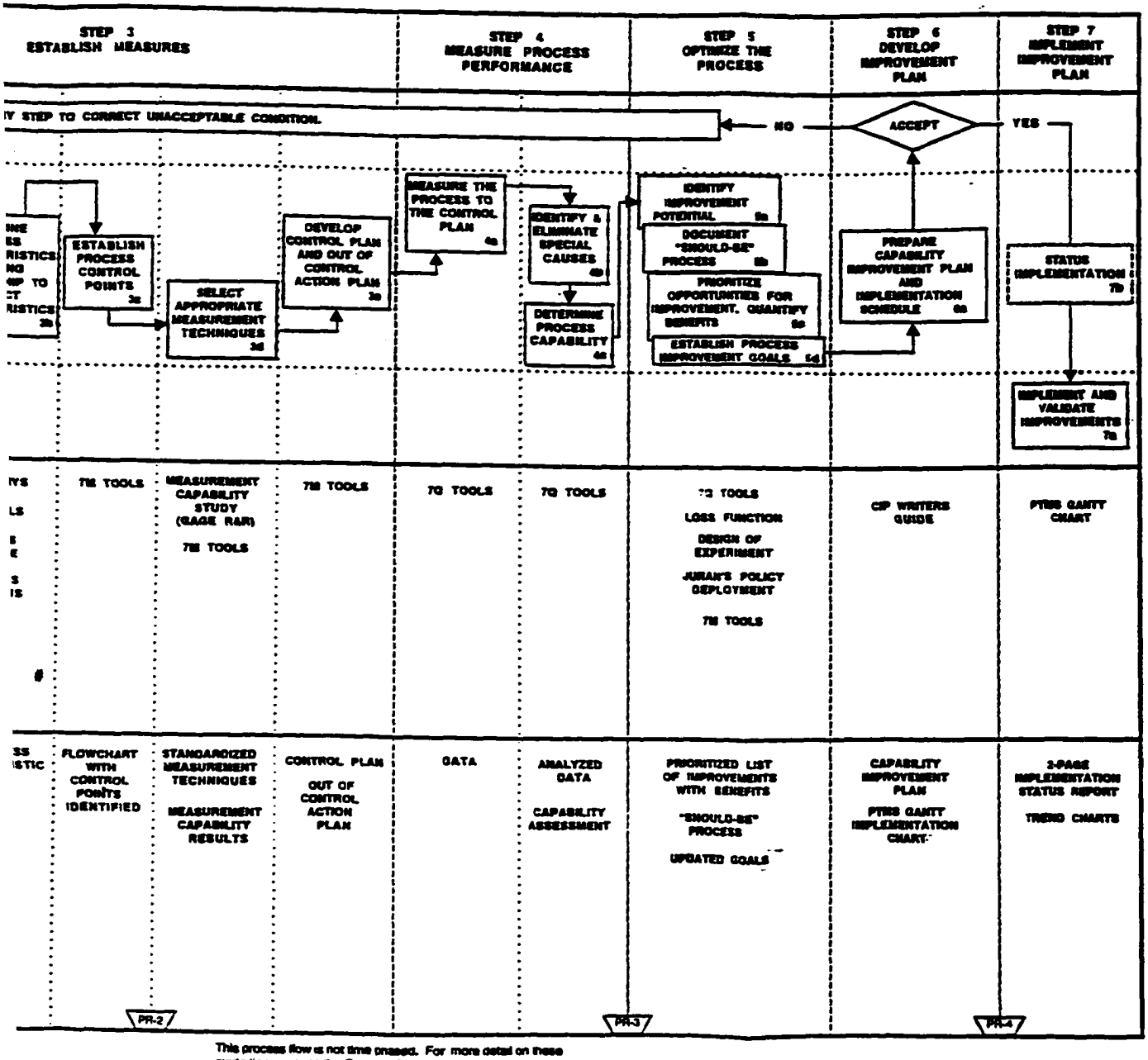


Figure 1. 7-Step Process Variability Reduction Methodology

...ION (PVR) 7 STEP METHODOLOGY

PVR PROCESS FLOW
28 APR 95



This process flow is not time phased. For more detail on these guide lines consult the Process Owner's Manual Addendum.

maintain a population of trained and certified employees to meet the needs of assembling the aircraft. Production management relies on the training department's database to notify them when an individual certifications are due to expire as well as to schedule classes and tests to update the individual. Management must also maintain information relative to changes in the workforce due to layoffs, seniority adjustments, retirements and promotions, and to notify the training department of these changes.

The responsibilities of the Training Department begin with notifying management of certification requirements and maintaining adequate instructors, training facilities and materials. This department must also meet contractual requirements by providing specific skills and certifications to the workforce. Once the process of initially establishing these requirements has been properly accomplished, the next responsibility is to maintain a certified workforce and avoid employee certification delinquencies. The Production Departments have requested earlier notification of an employee's expiring certification and a greater degree of class schedules to select from. The necessity to meet production schedules, balance overtime requirements, vacations, and budget reductions requires a different approach from the Training Department rather than the current simple training schedule now in use. The Training Department's ability to manage the complex requirements without an adequate tracking process impacted the training department's ability to schedule classes to meet the demands. (Team Leader,-Learning, Training, and Performance Development, March 2, 1998)

The potential failure of the system, which initiated the PVR project, was the possibility for employees to unknowingly perform certified operations without possessing a current certification for the process. This would be in violation of the standards and practices imposed by the companies procedures, (TA-024) which were developed to meet contractual requirements. To avoid this occurrence, a proactive approach would have to be developed. To establish control, an action was taken to suspend the electronic identification of employees with expired certification thereby preventing them from working on aircraft. This action not only caused a disruption to the assembly process, but also placed a number of skilled employees in suspension until training could be provided or until they became recertified through testing. Manual upkeep of this process was very time consuming, resulting in conflicts and confusion. Numerous reports were generated in an attempt to track certification efforts and the Training Department responded to multiple requests for class schedules in order to meet the needs of an uncertified workforce. The demands for additional support began to surface in what should have been a well-staffed organization. Indirect budgets, which were used for the training process, suffered cost overruns. A need for better control and management of the certification process became apparent to all individuals concerned.

CHAPTER 3

BACKGROUND

There are a number of training requirements given to individuals who are required to perform specific tasks in aircraft assembly. Employees are first categorized into classifications, which are defined by certain tasks of assembly. An example found on the C-17 program is the classification known as a K2J or aircraft structure mechanic. When an individual is given the proper training in various skills such as blueprint reading, general shop math, application of various measuring tools, the installation of fasteners or rivets and the ability to interpret engineering or planning specifications, he/she is then qualified to work on the aircraft. Most of the training, such as the use of measuring tools or general shop math, is a one-time application and is good for the life of the individual's career unless reason to retrain surfaces. Improvements in technology or a need to refresh an individual's skill might also require retraining. "All employees need basic skills and quality orientation. However, advanced topics differing among employee categories and functions may require additional training" (Evans and Lindsay, 1996).

The second type of training is called qualification, which requires moderate skills and is also considered to be a one-time requirement. Many inspectors are given qualifications, in as much as they do not perform the work on the aircraft but are still required to have an adequate understanding of the process in order to detect defects.

The most common training requirement is certification, which is based on a complex process where motor coordination, workmanship, or a degree of craftsmanship is required. This training also requires testing for recertification on specific intervals. There are five categories of certified operations as defined in the Boeing Employee Certification (Boeing Company, TA-024). The five categories are defined as follows:

1. Category I: Work operations, which contribute to the structural or functional integrity of the product where visual inspection may not disclose faulty workmanship;
2. Category II: Work functions classified as nondestructive testing and Manufacturing assembly which are governed by company or customer requirements;
3. Category III: Safety requirements which indicate a need to place additional controls on employee job assignments or work areas;
4. Category IV: Includes the following:
   Unique Delivery Center and Test & Evaluation –require employee certifications. Aircraft handling, aircraft functions, and support equipment-related employee certifications;
5. Category V: Work operations which require training and testing, but whose work content does not meet the criteria for categories I through IV.

There are (six) basic categories of training requirements:

The contractual U.S. Air Force requirements, (1) flight safety, (2) general safety, (3) mechanical requirements, (4) electrical requirements, (5) structures and (6) backline or subassembly requirements are usually associated with Technical Training. An example is the work that is performed on equipment furnished by the government such as the C-17's engines. Performing any work on the engines, or even operating them can be a complex process and the Air Force requires specific training be given to those individuals responsible for such activity. Flight safety requirements contain certifications such as flight control rigging where the performance of the aircraft is affected by the work being performed. This is considered to be a critical application and the contractor's responsibility to maintain. General safety requirements ensure aircraft damage does not occur due to negligence. Certification training for work in a confined workspace maintains the safety of individual employees. Fuel tanks are a good example of a confined workspace. The remaining certifications deal with specific tasks which are required to assemble the aircraft. Because the complexity of electrical installations differs from structures, they are broken down into subgroups and detailed attention is provided to ensure engineering requirements are met (Boeing Employee Certification TA-024, 1997). "Training is usually based on the skills required to do a job, and needs are identified jointly by the employee and his or her supervisor"(Evans and Lindsay, 1996).

CHAPTER 4

PROJECT SCOPE

To better understand the complexity and scope of the problem, process evaluation utilizing statistical analysis was required (Wheeler & Chambers, 1992). The first determination was to establish the number of employees requiring training at any given point in time. As of December 16, 1997 the figure on the C-17 program was 3,085. This number reflects mechanics and electricians as well as inspectors who are jointly responsible for aircraft production.

The second determination was to establish the number of certifications that expire in any given month. As a basis for determining this number, a three-month period was analyzed. In October 1997 there were 635 expired certifications. In November 1997 there were 747. In December 1997 there were 385. The average number of expired certifications based on this 3-month analysis was 589. Further investigation revealed possible reasons for this high number. The attributes discovered consisted of a combination of employees who allowed their certifications to expire due to lack of use, employees who were not properly notified, or employees who failed to attend the scheduled class due to absenteeism from sickness, vacation, etc. It was also determined that some managers,did not send their employees to training because of production schedule conditions. It seemed that managers had become reliant on the current skill level

of the employee to complete his assigned tasks and hoped that working with another employee could be a sufficient enough learning experience to get the job done. This had proven to be a significant part of the problem. "Too often, workers have learned their job from another worker who was never trained properly. They are forced to follow unintelligible instructions. They can't do their job because no one tells them how" (Deming, 1986).

The average number of certifications possessed by a single employee is 5.1, which equates to the requirement of recertification of a requirement every 2.2 months. This number is considered an averaged if training was provided to the employee at equal intervals. If the employee was able to challenge the test, which means to attempt to pass the qualifying exam without any classroom preparation, then the timeframe for qualifying is ordinarily within a few hours. Unfortunately, the majority of employees do not pass such tests without having some form of classroom refresher, which requires the employee's attendance anywhere from four to eighty hours. The average amount of time to prepare and pass the test is approximately eight hours (Wheeler & Chambers, 1992).

All of the analysis performed was done to understand the magnitude of the problem and to determine the training requirements of all employees if an effective system was in place. The analysis showed that the Technical Training department should be able to handle the requirements if properly managed. The initial focus of the problem seemed to be employees were not getting certified in a timely manner. One of the major difficulties seemed to be the lack of proper scheduling. The scope of the problem was exemplified

with an average of 120 employees each month with expired certifications. If the employees did not attend the scheduled class at the time allotted, it caused a backlog of rescheduling make-up classes that had a great impact to Technical Training. This resulted in a request for additional training by Production Department to rectify the expired certifications to enable employees to continue building the aircraft. Without the certifications, the subject employees would be unproductive, resulting in production delays. Additional training to certify employees who did not attend previously scheduled classes caused the Training Department to go over budget and also impacted instructors' training schedules. The greater the number of expired certifications, the greater the impact to production schedules, resulting in idle employees and training cost overruns.

CHAPTER 5

PRELIMINARY PROCESS ASSESSMENT

Process Definition

The first step of the PVR 7-step methodology is to define the process. This not only helps establish understanding of the entire process for the organization but also aids in evaluation when analyzing the process to define areas of improvement (Principle Industrial Engineer / PVR Trainer, January 14, 1998). The nature of employee training is co-dependent on the completion of tasks by both trainers and management. This process definition is critical to completion. Specific approaches vary by company. Boeing relies on an internal training department to meet contractual requirements. "Most large companies have an in-house training staff with state of the art facilities" (Evans and Lindsay, 1996).

To understand how the process works, it is best to start with the example of a single employee. If an employee has been assigned a specific job task, it is the responsibility of his immediate manager to review the necessary processes and skills required for the job and to make certain those requirements are fulfilled. If there are tasks which require a specific certification, the manager must ensure that the employee possesses a current certification for that specific application before he can assign the employee to perform the job.

Once the manager has completed this and defines the training requirements, he then forwards his request to his training coordinator, who in turn forwards all manager requests to the Training Department. It now becomes the responsibility of the Training Department to schedule the required classes, to select an instructor and to ensure all employees receive the necessary training to complete the course. A test is administered and if the employee passes, he is given an acceptance notice as proof until the Training Department updates the database. To make certain that the employees who are working certified operations are current with the requirements, Quality Inspectors monitor and audit the production process and will document any out of compliance conditions (Quality Manager, December 12, 1997). A discrepant condition will result in the suspension of an employee and he is no longer able to perform work on the aircraft until the proper corrective action from his manager has been taken. Maintaining employee certifications specific to his immediate job assignments ensures that the employee provides optimum performance. Not enough training results in costly mistakes on the product and too much non-specific training results in wasted resources. "The same kind of control charts used to determine whether a process is in statistical control can be used to chart a worker's performance. When the output reaches the stable state, further training will not help the worker" (Deming, 1986).

A process definition form (Figure 2) was created by technical training and used to record the process inputs and outputs, the customers and the process owners. It was used to establish the overall effectiveness of the training process. This form outlines all

PROCESS DEFINITION

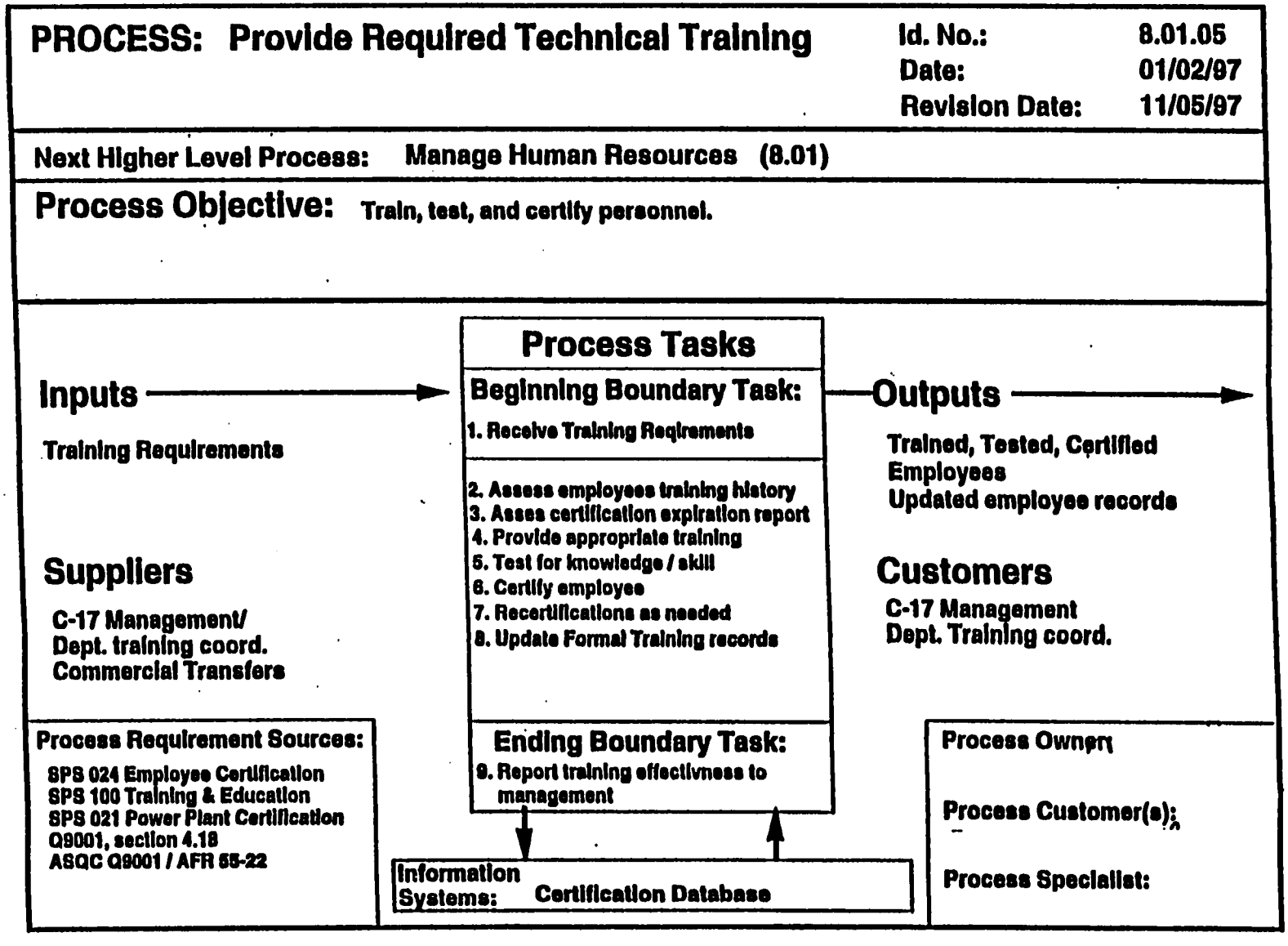


Figure 2. Process Definition Form

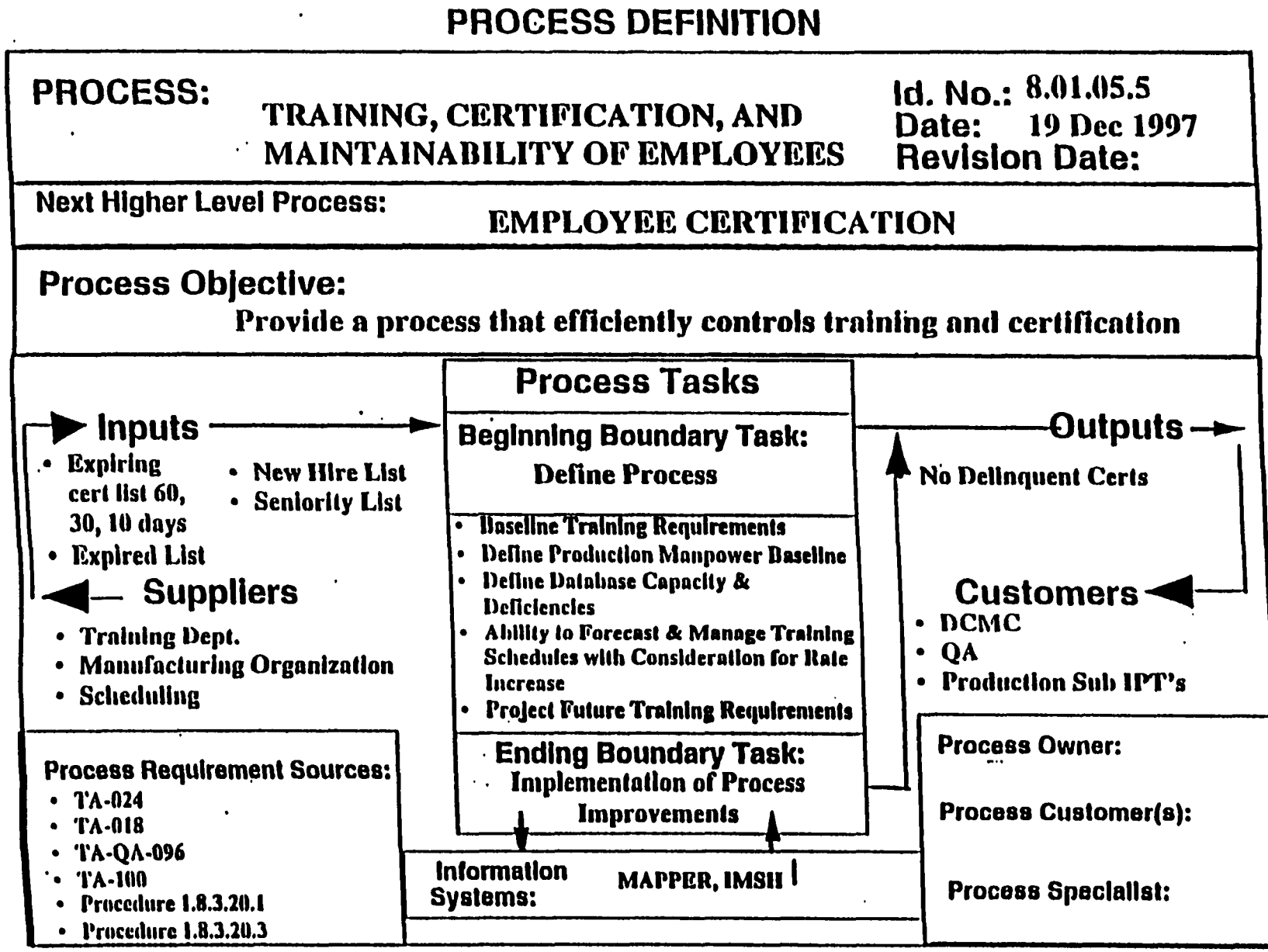


Figure 3. Process Definition Form 2

necessary requirements, documentation, information systems utilized, and boundary tasks which make up the process.

In addition, a second lower level process definition form (Figure 3) was created by technical training to define production's responsibility for maintaining an adequately trained workforce using the Training Department's resources. A process performance agreement (Figure 4) was established by technical training. The process performance agreement consists of the following components:

1. Quality: The percentage of compliance to estimated testing standards (75 percent criteria) for each certification established by the Employee Certifications and Quality Assurance.
2. Timeliness: Percentage of instances where commitment to the customer is met.
3. Efficiency: Percentage of expired certification per workforce population.
4. Cycle Time: The length of time in days from the initiation of a training request to the start of the requested class. Customer emergency training requirements are delivered as required by the customer.

A second, lower level Process Performance Agreement was created by technical training to establish production's ability to maintain certification (Figure 5). Both of these performance agreements report progress by the use of a Process Performance Metric Chart shown in (Figure 6). A minimum acceptable level was established for each metric along with an annual goal and a weighting factor which defines the level of importance. Since efficiency was measured by the percent of expired certifications in the workforce

PROCESS PERFORMANCE AGREEMENT

Process: Provide Required Technical Training

Process No.: 8.01.05
Date: 01/02/97
Revision Date: 11/05/97

Next Higher Level Process: Manage Human Resources (8.01)

Process Measurement		Minimum Acceptable Level	Annual Goal	Comparative Threshold (if required)	Weighting Factor
Category	Metric Definition				
Quality	Percentage of compliance to estimated testing standards (75% criteria) for each certification established by the EC & QC.	98%	98.5% - 97 99% - 98 100% - 99	NA	1.0
Timeliness	Percentage of times commitment to customer is met.	98%	98.5% - 97 99% - 98 100% - 99	NA	2.0
Efficiency	Percent of expired certifications per workforce population.	4%	2.5% - 97 2% - 98 1.5% - 99	NA	3.0
Cycle Time	The length of time in days from the initiation of a training request to the start of the requested class. Customer emergency training requirements are delivered as required by the customer.	14 days	10 days	NA	3.0

Process Owner | Process Specialist | Process Customer(s)

Figure 4. Process Performance Agreement

PROCESS PERFORMANCE AGREEMENT

Process: Training, Certification and Maintainability of Employees

Id. No.: 8.01.05.5
Date: 12/17/97
Revision Date: A

Next Higher Level Process: Employee Certification

Process Measurement		Minimum Acceptable Level	Annual Goal	Comparative Threshold (if required)	Weighting Factor
Category	Metric Definition				
Quality	Percent of expiring certifications updated prior to expiration date	95%	98%		3
Timeliness	# of certifications updated prior to 10 day notice	70	90	*	2
Efficiency	% of "no-shows" in class training	15%	5%	*	2
Cycle Time	% of completed certifications within 30 days	60%	80%	*	1

Process Owner | Process Specialist | Process Customer(s)

*Approved at higher level

Figure 5. Process Performance Agreement 2

PROCESS PERFORMANCE METRIC CHART

Process No.: 8.01.05
Date: 01-01-96
Rev. Date: 1-10-98

Process: Provide Required Technical Training
Next Higher Level Process: Manage Human Resources (8.01)

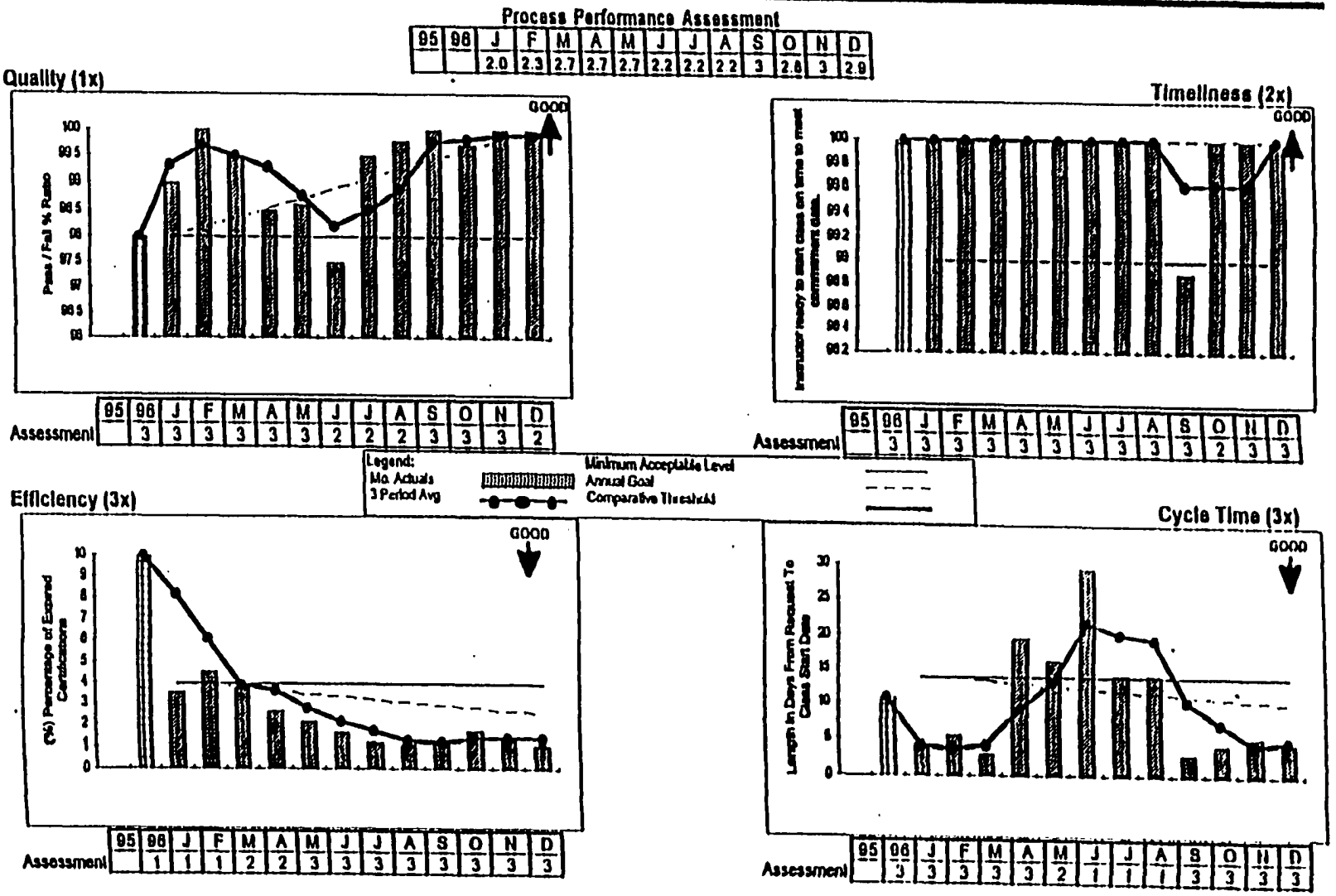


Figure 6. Process Performance Metric Chart

population and the current problem with the process is a high percentage of expired certifications, the weighting factor or importance of the problem is rated a 3. Additionally, the length of time to resolve an emergency training requirement such as an expired certification was also rated a 3. The data shows trends and performance indicators for each metric defined with a goal line which has been established to ensure compliance. There was also a 3-month average line drawn to give indications of performance trends. A minimum acceptable level line was used to indicate a process which is within the acceptable control limits enabling the chart to be utilized to make accurate decisions. The process performance metric chart shows in the quality metric employees who do complete training and pass the exams with little or no failure rates. Instructors are starting their classes on time as measured by the timeliness metric. The time required to schedule a class once requested has been averaging 5 days, which is considered good performance. Efficiency, which measures the percentage of expired certifications, is averaging 2 percent with the Process Based Management rating scale of 3. While this factor meets the established metric measurement, it does not account for the disruption created by a 2 percent workforce incapable of completing the work they have been assigned. This performance metric indicates is that training is providing the requirements to keep the workforce properly trained yet the employees are not being sent to training to increase the efficiency.

The "As-Is" process flow is a tool that documents the series of actions and decisions that take place during the process, taking the input of the process and creating the output.

Each step is described and the outcome of a decision is provided to show the cause and effect. The Training Department, Inspection Department and the Production Department all have tasks which must be accomplished to complete the training cycle. The "As-Is " process flow is described in (Figure 7) (Process Variability Reduction, 1998) and is used to evaluate any unnecessary or non-value added steps in the process. Once the data is analyzed, it will be compared against the "As-Defined" process in Chapter 5 to determine the best practice.

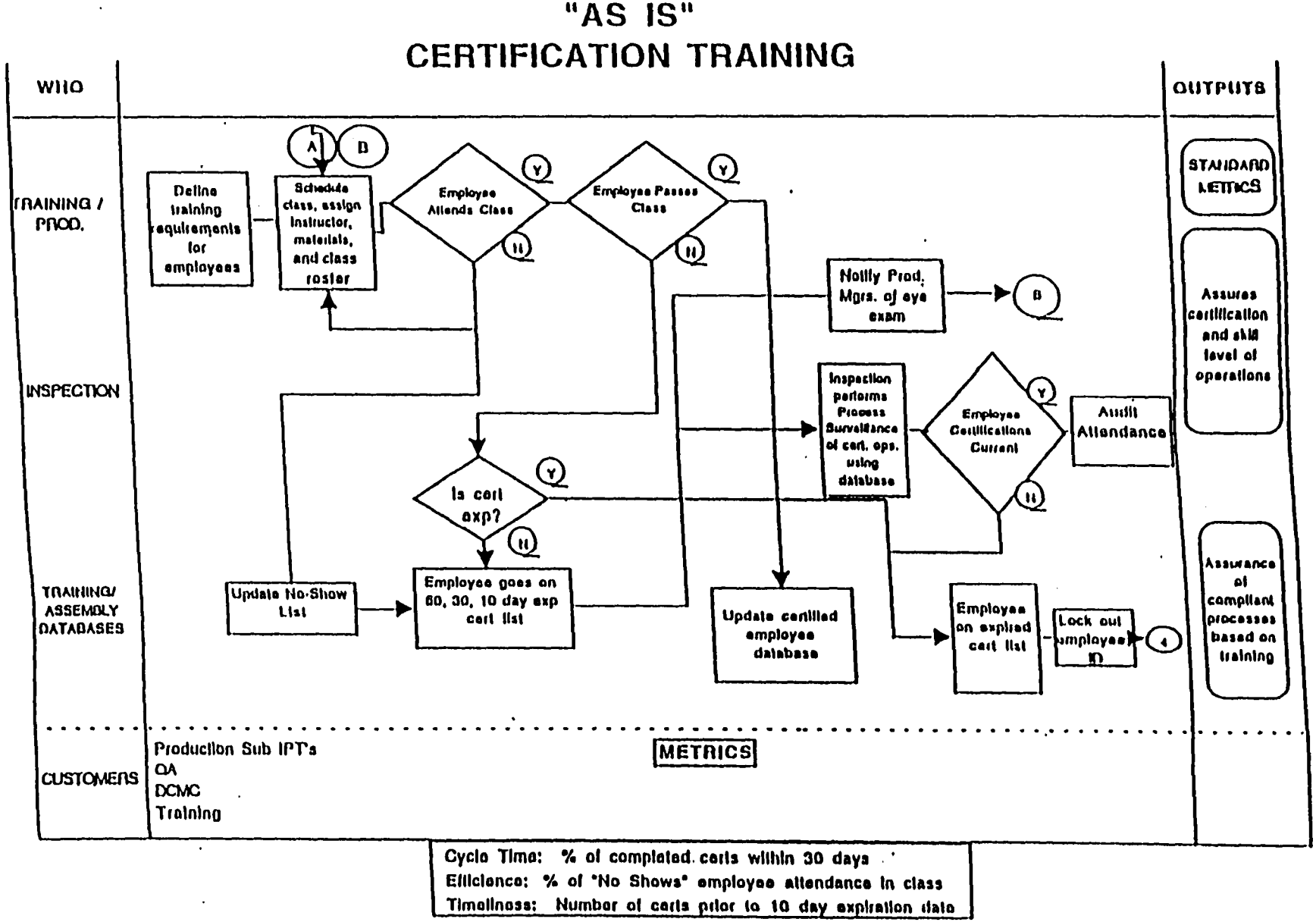


Figure 7. AS IS Process Flow Chart

CHAPTER 6

METHODOLOGY DEPLOYED TO ANALYZE AND IMPROVE PROCESSES

Process Standardization

The second phase of the 7-step methodology cycle is to standardize the process. Standardization means the process is repeatable and requires no continuous changes to obtain the desired output regardless of outside influences. The method to perform this task is to document in the "As-Is" process flow all the steps required to perform the tasks as they currently exist. An "As-Defined" (Figure 8) process flow, is then created to show the manner in which the process should work and compare the two processes (Process Variability Reduction, 1998).

A comparison of the "As-Is" process, which was the process, currently used and "As-Defined" process, which was the process that the procedure mandates, showed significant differences. The "As-Defined" process was only concerned with ensuring that employees were capable of certification. It did not take into account the possibility the employee who was not certified could still perform the work on the aircraft undetected. It did not describe the method used by manufacturing to determine when an employee's certification was about to expire and it did not include the inspectors' audit process. These items presented opportunities for improvement. Analysis of the process used to notify employees of expired certifications showed notifications were not being handled in the

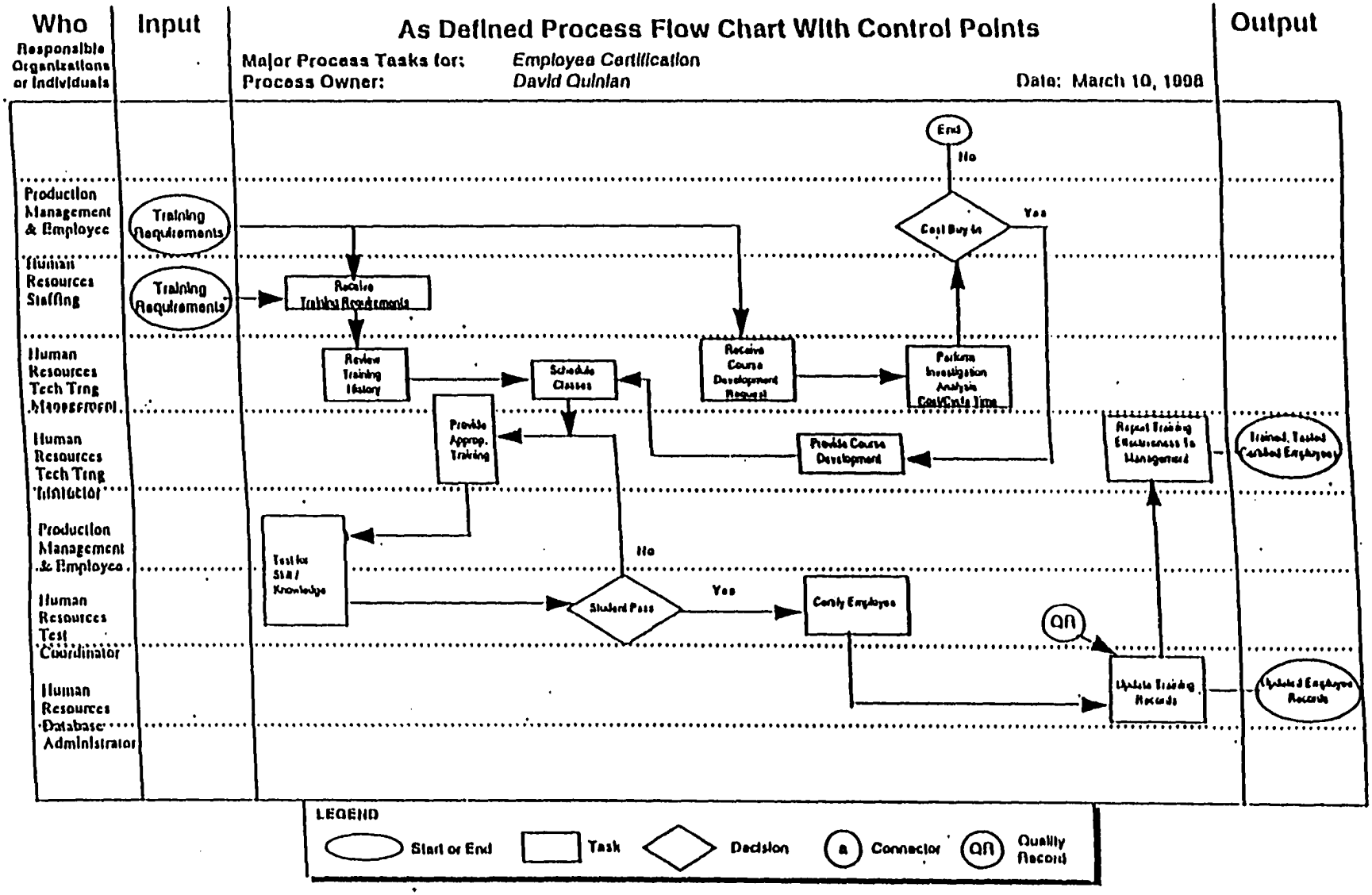


Figure 8. AS Defined Process Flow Chart

same manner by all department coordinators. To correct these discrepancies, a "Should-Be" process flow would be required.

Relationship Determination

The third step in the methodology was to determine the relationship showed how key product characteristics and key process characteristics affect the performance of the certification process. In the case of employee certifications, it was those elements or those process characteristics which affect overall training performance. The key characteristic list (Figure 9) was developed utilizing a number of interviews with mechanics, inspectors, managers, trainers, coordinators and customers. It was an attempt to gather as much input from the users of the system as possible so that a well-developed Failure Modes and Effects Analysis (FMEA)(Figure 10) diagram could be constructed (Process Variability Reduction, 1998).

The FEMA determined the severity of a problem, the likelihood of occurrence, the ability to detect an occurrence and the risk priority number, the latter being determined by multiplying the numbers from the three other categories. The outcome of the analysis revealed there was no current process for detecting failures in training coordination. It became evident that a more in-depth analysis should be performed in conjunction with the FEMA, using the same set of criteria (Figure 11)(Process Variability Reduction, 1998). This was accomplished by focusing on the problem of management's notification of the employee after proper class scheduling. The analysis provided the fact that managers were

EMPLOYEE CERTIFICATION PROCESS
KEY PRODUCT AND PROCESS CHARACTERISTICS

Key Product Characteristics at the Functional Level

Those Processes That Significantly Affect Performance

1. Employees do not attend class
2. Training database not updated
3. Employee not notified of expiring certification.

Key Process Characteristics

Process Parameters Which Cause or Create the Key Product Characteristics

1. Developing training matrix at Manager level
2. Notification to employee of expired certification
3. Notification in advance to training department of need for class
4. Sending employee for training
5. Anticipating workforce movement and planning for training
6. Keeping current with technology and change
7. Updating SF2000 to automatically notify / lock-out employees

Figure 9. Key Characteristics

FAILURE MODES & EFFECTS ANALYSIS

Process Name: Provide Required Technical Training **Process No.:** 8.01.05
Process Owner: Regan Kuhn **Date:** 10/01/97

Process Task	Potential Failure Mode(s)	Potential Effect(s) of Failure	SEV 1-10	Potential Cause(s) of Failure	OCC 1-10	Current Detection/Verification Controls	DET	RPN	Recommended Actions
Analyze backlog to determine weekly class schedule	Scheduling already trained employees	Deprives other employees of trng	6	Coord not evaluating employee trng history	5	None	N/A	30	Manually verify employees in TA-Train
[redacted]	[redacted]	Delay in new courseware delivery	6	Manager not evaluating employee trng history	5	None	N/A	30	Manually verify employees in TA-Train
[redacted]	Scheduling employees without prerequisites	Employee not trained or certified	10	Coord not evaluating employee trng history	5	None	N/A	50	Manually verify employees in TA-Train
[redacted]	[redacted]	Employee unable to perform job	10	Manager not evaluating employee trng history	5	None	N/A	50	Manually verify employees in TA-Train

Figure 10. Failure Mode and Effects Diagram

CERTIFICATION TRAINING

Failure Mode	Effect	Cause	S	O	D	RPN
Cert Training	Current Certification Not Being Kept Current	Managers not receiving	8	6	6	288
		Expired cert notice	8	6	4	192
		60, 30, 10 day report	8	6	4	192
		Mgrs. not scheduling employees	7	5	3	105
		Employee's fail to Attend class	8	6	4	192
		Employee not challenging test	6	4	3	72
Facilities, Schedules & Database	Ability To Plan For Training Requirements Ineffective	Schedule impacts	7	5	4	140
		New hires without notification	4	4	3	48
		Change in training requirements	3	2	2	12
		ATMS and training system not accurate	6	5	5	150
		No lockout of employee numbers	6	6	4	144
		No facilities or materials for proper training	5	5	2	100

S = SEVERITY IF EMPLOYEE TRAINING IS NOT COMPLETED
O = OCCURENCES THAT EMPLOYEE TRAINING DOES NOT GET COMPLETED
D = DETECTED - HOW EASY IS IT TO DETECT THAT EMPLOYEE TRAINING WAS NOT COMPLETED
RPN = RISK PRIORITY NUMBER - MULTIPLY S X O X D

Cert Training
3/10/98

Figure 11. Failure Mode and Effects Diagram 2

not receiving input they had employee certifications close to the expiration date. There was no formal system of notification of employee certification status and no checks and balances approach to validating certification at the time a manager performed job assignments. In addition, there was no provision for comparison between available classes and expiring certifications. This allowed a potential of an employee's certification expiring without any action taken if management did not manually oversee the process. There was no system in place to notify an employee not to work on certain jobs requiring a current certification. Therefore, if management inadvertently missed an employee's expiration date, that employees were violating company procedures (TA-024) without knowledge of doing so.

Performance Measurement

The process for measuring performance was presented in the fourth step of the 7-step methodology. The employee certification process did not possess methods of certification control to meet the performance expectation. As a short term solution, actions were taken to stress management intervention with the goal of performance improvements. To adequately determine the need for additional process changes, compliance to the process had to be established. Management must make certain all first line managers send their employees to training when notified to do so in a timely manner. An action plan was put into place to measure this process and to determine any additional requirements which could lead to process changes. The action plan called for a report from technical training

showing certifications expiring within a certain time interval (i.e.. 60, 30 10 days) (Appendix A). Another chart indicating the quantity of certifications expired, including a report by employee's names and with expired certifications, was also developed (Appendix A). The manager's responsibility was to inform his coordinator to schedule appropriate classes based on the technical training report. The specific actions taken included the Quality Assurance clerk) being responsible for providing the 60 and 30-day reports on expiring certifications to all managers on a weekly basis. Senior managers will receive copies. A 10-day report will be provided to Senior managers and will be cause for action to the manager for job completion. Department clerks will assign and coordinate training with managers and the managers in turn will be responsible for sending employees to training. Production certification copies will be forwarded to manufacturing Senior managers for appropriate action. Failure to meet the timelines on certification by production will potentially result in a request for corrective action, surveillance increase on certified operations, potential reinspection of the aircraft as well as suspension of product acceptance until corrective action is deployed. These actions are to be implemented immediately and considered a punitive measure in order to establish control of the process. Management intervention should force discipline into the process.

Process Optimization

The fifth step in the 7-step process was optimization. Creating and analyzing a "Should Be" process flowchart will identify any additional improvement potential (PVR

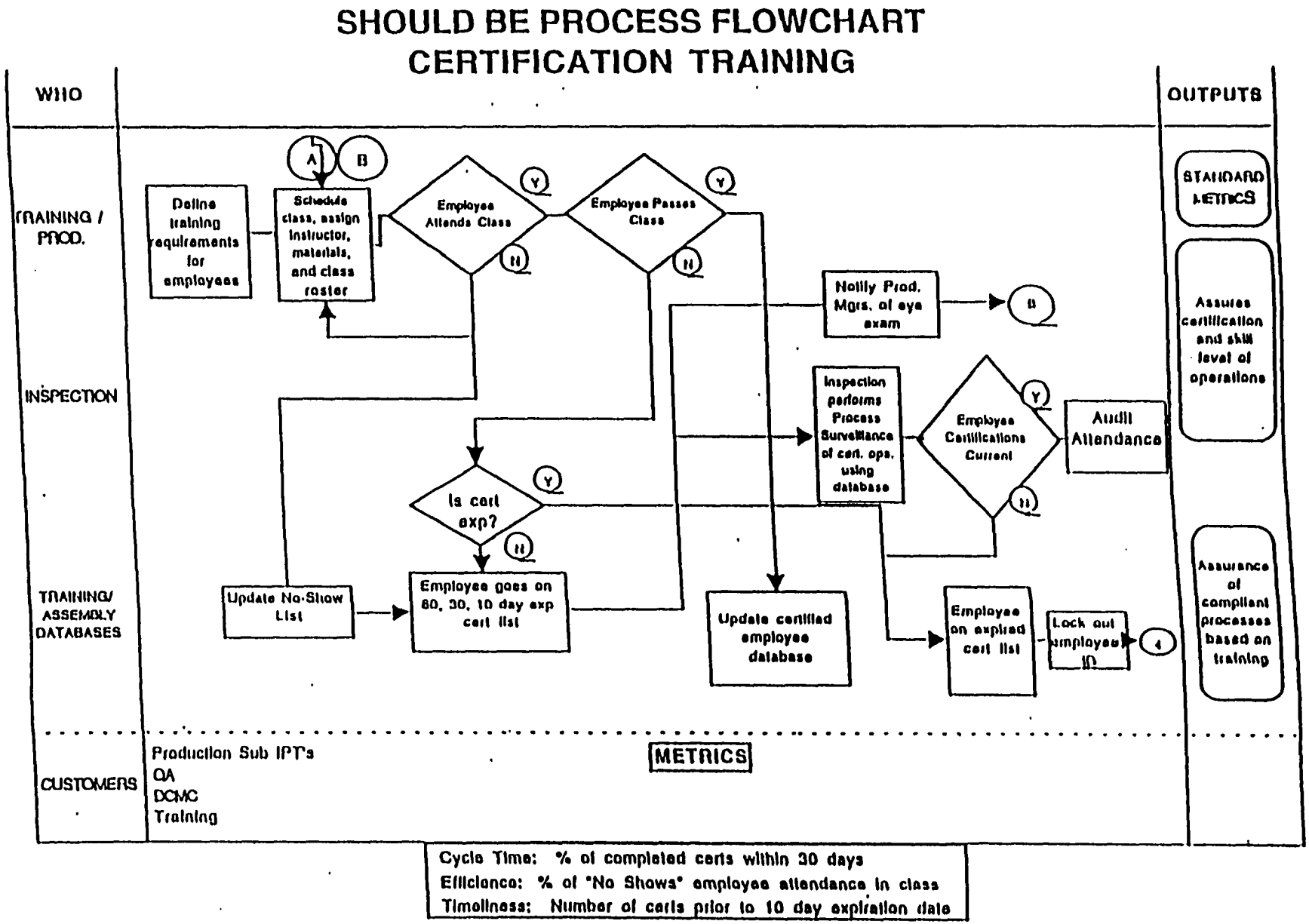


Figure 12. Should Be Process Flow Chart:

Engineer, November18,1998)(Figure 12). This new process removed all unnecessary steps or processes and streamlines the actions for greatest efficiency. A comparison of the "As-Is" and the "Should-Be" process flows showed a need for an automated process that effectively communicates to the employee, the manager and the Technical Training Department the current status of employee certifications in a timely manner. The need to eliminate the possibility of an employee not currently certified performing a certified operation had to be eliminated. Most process specifications require the identification of causes of variation in a process. They define common causes as something which may occur as a normal outcome and should be expected as in the case of human error. Special causes, on the other hand, are occurrences which are based on variables that are not expected such as bad material in a manufacturing process. The current systems used to maintain employee certifications are a combination of three elements. The first is an employee certification database which maintains status of employee certifications. The second is a simple report program which uses the database to compile the 30,60 and 90 day expiring certification reports used by management. The third is Shop Floor 2000 which is the automated database of actual assembly instructions used by the mechanics during their work assignments. Since there was no method of checking for current certifications at the assembly instruction level (SF2000), the mechanic could perform the operation without knowing about his expired certification. Implementation of automating the SF2000 database to automatically identify the operation as one requiring a specific certification and then to validate the operator by referencing against the training database

would be the first major improvement in automating the process. Secondly, if the employee were not certified for the operation, disallowing him to sign on to perform the operation or "locking-out" would be initiated. This would effectively eliminate any chance of an employee performing work on the aircraft when not certified. The next adaptation to SF2000 would be to have an expired date reminder starting at 90 days that would remind the operator that his certification is about to expire. Additionally a notification of a class schedule for him to be recertified would be a valuable enhancement. Assigning the responsibility of current certifications to the individual employees increases efficiency in the process by eliminating management's requirement for notification. In the light of self-directed work teams, this approach was well received by the mechanics interviewed. Since the certification database now maintained and informed the employees of their certifications, it could be used as the means to schedule classes in advance and accurately predict rescheduling without management requests. Class rosters would be automatically generated and provided to management well in advance to allow for production schedules. Technical Training would have to stagger their employees from various departments to avoid production impacts. Management now becomes responsible for notifying Technical Training when there are shifts in the workforce and support Technical Training in their class rescheduling process. The implementation of an automated system using automated databases to remind the user of his imminent expired certification is a logical solution to the certification process. Until an automated process could be implemented, the training department developed a process improvement plan

structured to meet the needs of the employee and developed for each metric measurement; quality (Figure 13), timeliness (Figure 14), efficiency (Figure 15) and cycle time (Figure 16)(Process Based Management, 1997). The Technical Training Department made significant efforts to help meet the needs of customers by attempting to tailor its process to conform to the requirements of a production schedule. Training had made the necessary changes to adapt to the demands of a production schedule. A request to look at root cause and alternative solutions by Technical Training was completed (Figure 17) and a metric measurement of registered certification training no-shows was developed to show the level of compliance by production to meet the training schedule (Appendix B). It was the intent of Technical Training to provide their customer with improvements to the current process by utilizing metric measurement. This method of process improvements had proven effective in correcting problems associated with production assembly and should produce similar results with employee certification (Process Based Management, 1998).

PROCESS IMPROVEMENT PLAN

Process Name: Provide Required Technical Training	Process #: 8.01.05
Process Owner:	Date: 1-16-98

Goal:	Action Description (including objectives and measures)
Improve Quality.	Improve course material comprehension / retention for students first time pass. Improve instructor classroom presentation and focus on indivlual student classroom needs.

Implementation Steps	Responsibility	Milestones					
		Nov	Dec	Jan	Feb	Mar	Apr
Update training material for classroom comprehension and ease of retention							
Monitor instructor presentation tecgniques of instruction and suggest changes in behavior where appropriate							

Figure 13. Process Improvement Plan, Quality

PROCESS IMPROVEMENT PLAN

Process Name: Provide Required Technical Training
Process Owner:
Process #: 0.01.05
Date: 1-16-98

Goal:
Improve Timeliness.

Action Description (including objectives and measures)
Cross train department technical instructors to insure adequate ability to provide quality training staff when required.

Implementation Steps	Responsibility	Milestones					
		Nov	Dec	Jan	Feb	Mar	Apr
Define resources available on a weekly basis to meet customer requirements for formal training.		▬	▬	▬			
Identify changes in media to keep all instructors informed in latest technology and skills.		▬	▬	▬			

Figure 14. Process Improvement Plan, Timeless.

PROCESS IMPROVEMENT PLAN

Process Name: Provide Required Technical Training	Process #: 8.01.05
Process Owner:	Date: 1-16-98

Goal:	Action Description (including objectives and measures)
Improve Efficiency by 1.5%.	Discussing fifteen, thirty, sixty day certification expiration reports with managers. Discussing training requirements with dept. training coordinators and managers. Raise level awarness of certifications impact on production to management.

Implementation Steps	Responsibility	Milestones					
		Nov	Dec	Jan	Feb	Mar	Apr
Prepare 60 day report for managers / SDWT's for anticipated cert expirations							
Prepare 30 day report for Senior managers / SDWT's for anticipated cert expirations							
Prepare 15 day report for Directors / SDWT's for anticipated cert expirations							

Figure 15. Process Improvement Plan, Efficiency

PROCESS IMPROVEMENT PLAN

Process Name: Provide Required Technical Training	Process #: 8.01.05
Process Owner:	Date: 1-16-98

Goal:	Action Description (including objectives and measures)
Improve Cycle Time.	Discussing training requirements with dept. training coordinators and managers. Raise level awarness of certifications impact on production to management.

Implementation Steps	Responsibility	Milestones					
		Nov	Dec	Jan	Feb	Mar	Apr
Define resources available on a weekly basis to meet customer requiremnts for formal training							
Define customer needs through weekly training coordinator meetings.							
Tri weekly meetings with lower level management to assess changes to training needs and provide a timely response to those needs							

Figure 16. Process Improvement Plan, Cycle Time

Root Cause & Alternative Solutions

Process Name: Provide Required Technical Training Process Owner:		Process Number: 8.01.05 Date: Sept. 02,1997
Area of Improvement		
4 M, P, & E Category	**Root Cause**	**Potential Alternative Solutions (s)**
People	No control over production to schedule their mechanics for recertification *(efficiency)*	Continued direct communication with Production Managment to include distribution of 30-60 Day Expiration and No Show Reports.
People	No control over production to schedule their mechanics for formal instruction.*(Cycle Time)*	Continued coordination with training coordinators and management to schedule classes requested in a timely manner.

Figure 17 Root Cause and Alternative Solutions

CHAPTER 7

RESULTS AND DISCUSSION

Improvement Plan Development

The PVR methodology provides a sixth step; this is the development of an improvement plan. This improvement plan (fig.18), called the Employee Certification Database Automation Project, was created by the author to develop and test an automated database which performs the responsibility of employee certification control. The improvement plan involved linking the operator certification database maintained by technical training to a specific list of jobs requiring a certified employee maintained by quality planning within the SF2000 program. A program written within the SF2000 database would then validate the operator's certification when that employee attempted to assign himself to a certified operation. Only operators who are certified for the specific operation called out on the job sequence would be allowed to complete the sequence. All of the operators who are not certified would be suspended from signing on to the job. This process would eliminate the possibility of an uncertified employee performing a certified operation and make the C-17 program continuously 100 percent compliant to the certification process. Additionally, reports could be generated from the same system enhancements that would show the certifications that a mechanic possesses with valid expiration dates, and a departmental summary for all the employee's certification for

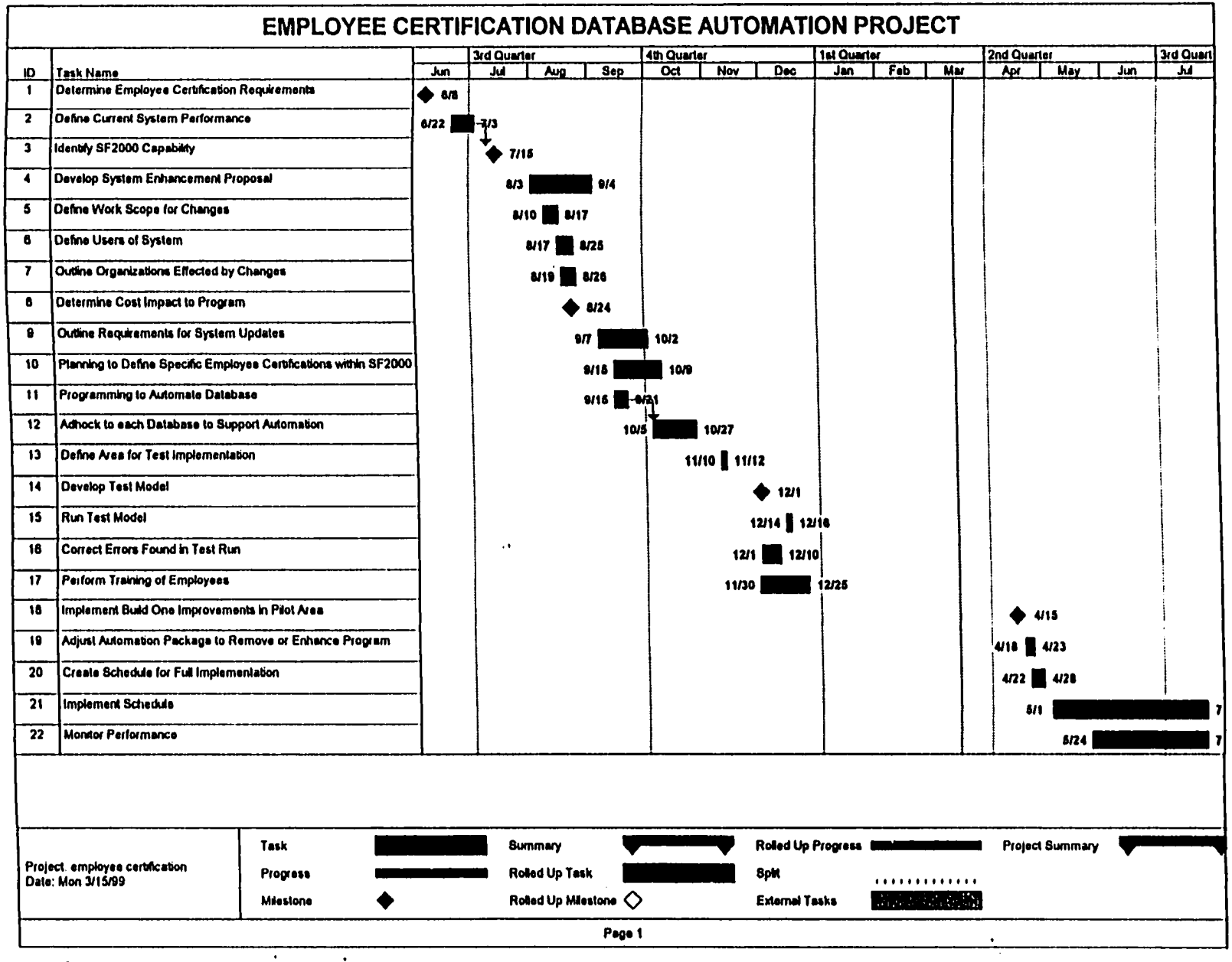


Figure 18. Employee Certification Database Automation Project.

management review. The author believes allowing the employee to be aware of his certification status allows for an increase in personal ownership of his performance. The improvement plan developed a consistent baseline, which supports the PBM metrics and maximizes performance.

Step Seven

The last and final step in the 7-step PVR methodology requires implementing improvements according to plan. Management had identified a need to make numerous system enhancements to the SF2000 database to increase the program's efficiency. These enhancements would be implemented into the database on a project assignment called the Build One package. This project would allow a perfect opportunity to incorporate the employee certification automated database improvement plan into the build one package and automate what was once a manual process. Department 17 N, which is responsible for the assembly of the forward fuselage, was chosen as the pilot area for implementation. The beta version of the program will be pretested on April 5, 10 days prior to actual adaptation in 17 N. Testing results are expected to show that the program would perform its required functions without any complications or compatibility issues. Full implementation is scheduled for April 15 (Quality Manager, October 10, 1998).

CHAPTER 8

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The general rule which states that the simpler a process, the more efficient it can be seems to relate directly to employee certifications. The use of databases in the manufacturing process has shown great advances in efficiency. Applications such as electronic blueprints that can be viewed at the same time an operator is being assigned his job task have made significant performance improvements by the convenient accessibility of information. The same application of using databases for employee certifications will have the same effect on production and training performance efficiencies. The author believes that operators do not intentionally perform certified operations with the knowledge that they do not possess the proper certifications. It is the lack of convenient accessibility to information that allows for occurrences to happen. By implementing a method in which the operator can not accept a certified operation without possessing the valid certification, the majority of the problems involving employee certifications are eliminated (Sr. Specialist / Information Technology, August 20, 1998).

Additional improvements to the automation process should be to simplify the recertification of employees. The first improvement would be to implement the ability to notify the employee of the date his certification would expire electronically when he attempts to sign on to a certified operation. Since the production cycle time of aircraft

attempts to sign on to a certified operation. Since the production cycle time of aircraft assembly in most departments is 30 days, a period for notification of a pending expired certification beginning at 60 days which would then count down in time as the days draw closer to expiration would be a valuable reminder. Employees are now made aware of their personal training and will take the responsibility to update their certifications. Management will still have the ability to monitor the process from the reports the database will generate. The benefit of continuous reminders will allow recertification training to evolve into a normal process rather than a critical event that occurred using a manual system.

The next suggested improvement would be to allow the operator to take a recertification test right on the same computer he has been using to sign on to his job tasks. Technical Training would develop the database of testing right in the program that maintains the employees certifications and would allow completion, a pass or fail score correction and a real time update to the employees certification based passing test scores. This would be a great advantage to the operator as well as to production performance as the employee does not have to leave his work area in order to take the certification test. Allowing the operator to read the training handbooks at his own convenience prior to taking the on line tests would increase his chances for passing grades. This has been an approved practice since it as proven to keep the operator's skills and knowledge at peak performance (Team Leader / Quality Inspector, July 10, 1998).

The two additional improvements to the employee certification process are being reviewed for incorporation into the next SF2000 database enhancement project, called the Build Two. Current status indicates that it will be accepted into the project proposal. It is solutions that look for simple adaptations to a process that seem to make the greatest improvements. Trying to develop a complex means of manual record keeping where continuous management intervention is required to maintain conformance to the set plan does nothing more than waste resources and inflict failure into the process. Allowing the employee the opportunity to be aware of his certification status and have the ability to update his status without the necessity of management and technical training intervention allows the process to be simple and effective. Since the employee will not be able to perform work in an out of compliance condition, the automated database improvement plan is a guaranteed success. Attributes in business which can be measured and allow the owners of the process to have authority for their own performance get the greatest results.

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APPENDIX A

REPORT: FTDDAYS
RUN DATE: 03/12/98 06:52:12

TECHNICAL TRAINING CERTIFICATIONS

CERTS EXPIRING IN 10 DAYS

PAGE NO: 001
SORT SEQ: EXP PER,DPT,SFT NAME & CRS CODE

DEPT	SFT	EMPLOYEE NAME	EMP NO	JOB CODE	COURSE CODE	COURSE TITLE	TEST DATE	EXPIRE DATE	HOURS	GRD	EMP STAT	DAYS TO EXPIRE
OBEX	1			J5Q1	771080	EYE-WITH CORRECTION	03/20/97	03/20/1998	0.0	P	A	8
* TOTAL CERTS FOR DEPT OBEX ===>				1								
OBE1	1			J5Q1	772040	PHYS RESP/SAFE TANK	03/21/96	03/21/1998	0.0	P	A	9
OBE1	1			J5Q1	772060	PHYSICAL DUST MASK	03/21/96	03/21/1998	0.0	P	A	9
* TOTAL CERTS FOR DEPT OBE1 ===>				2								
OBE2	1			J5Q1	551610	C17 SEAL MTH & NAT	03/12/97	03/12/1998	1.1	PD	A	
OBE2	1			J5Q1	558200	C17 SEAL INSPECT	03/21/97	03/21/1998	2.9	P	A	9
* TOTAL CERTS FOR DEPT OBE2 ===>				2								
OBE6	1			J5Q1	558200	C17 SEAL INSPECT	03/21/97	03/21/1998	2.8	P	A	9
OBE6	1			J5Q1	558200	C17 SEAL INSPECT	03/21/97	03/21/1998	2.9	P	A	9
* TOTAL CERTS FOR DEPT OBE6 ===>				2								
OBK2	1			J5E1	771080	EYE-WITH CORRECTION	03/21/97	03/21/1998	0.0	P	A	9
OBK2	1			J5Q1	771080	EYE-WITH CORRECTION	03/21/97	03/21/1998	0.0	P	A	9
* TOTAL CERTS FOR DEPT OBK2 ===>				2								

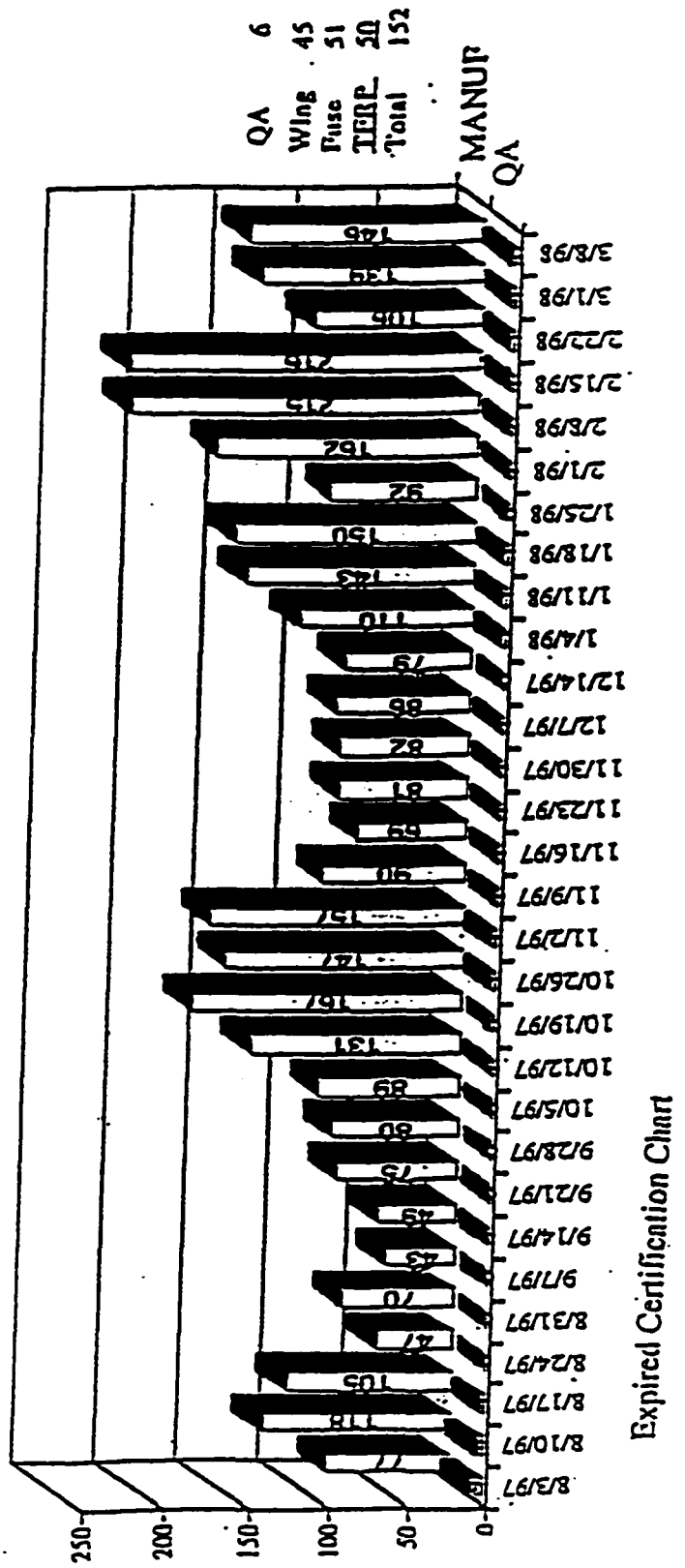
INSTRUCTIONS FOR MANAGERS/SDWT TEAM LEADS:
1. REVIEW LISTING
2. IF CERT IS STILL REQUIRED, SEND EMPLOYEE TO THE EMPLOYEE TEST ROOM IN TALA 150, RM 3 FROM 6:30AM TO 10:00AM OR FROM 12:00AM TO 1:30PM (FOR 2ND AND 3RD SHIFT CONTACT RICHARD SMITH FOR APPOINTMENTS AT 591-1812.
3. IF CERT IS NO LONGER REQUIRED, COMPLETE THE ATTACHED FORM AND SEND TO B. VERHULST IN THE EMPLOYEE TEST ROOM AT MAILCODE TA-0641-T150-21.

GRADE: F=FAIL, P=PASS, PD=PASS DELETED, PE=PASS EXPIRED, PF=PASS FAILED, PR=PASS REQUEST, PP=PASS PRE-REQ

DEPARTMENTS SELECTED: OBE2 OBE6 OBEX OBE1 OBK2 OBE1

Expiring Certification List

Expired Certifications



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RUN DATE: 03/08/98

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017A			REPAIR SURFACE DEFEC	551180	1	K2J3	03/07/96	03/07/1998	PE	1.0	____
			HOT/COLD STRAIGHTING	551700	1	K2J3	02/23/95	02/22/1998	PE	1.0	____
			PEH CRAN/RIG & LIFT	553560	1	K2J3	03/04/96	03/04/1998	PE	2.0	____
			RADIO CRAN & CAT 800	553220	1	K2J3	03/05/96	03/05/1998	PE	0.6	____
			REPAIR SURFACE DEFEC	551180	1	K2J3	03/07/96	03/07/1998	PE	0.9	____
			017 SAFE TANK ENTRY	552000	2	K2J3	02/16/96	02/15/1998	PE	0.8	____
			PEH CRAN/RIG & LIFT	553560	1	K2J3	03/04/96	03/04/1998	PE	1.9	____
			RADIO CRAN & CAT 800	553220	1	K2J3	03/05/96	03/05/1998	PE	0.6	____
			017 SEAL HTH & HAT	551610	1	K2J3	02/20/97	02/20/1998	PE	3.9	____
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			017 SEAL HTH & HAT	551610	2	K2J3	03/06/97	03/06/1998	PE	3.6	____
			TORQUE *	551420	2	K2J3	02/21/95	02/20/1998	PE	1.5	____
			ELEC SLD MILITARY	551330	1	K2Q3	03/05/97	03/05/1998	PE	2.7	____
			017 SEAL HTH & HAT	551610	2	K2J3	03/06/97	03/06/1998	PE	3.5	____

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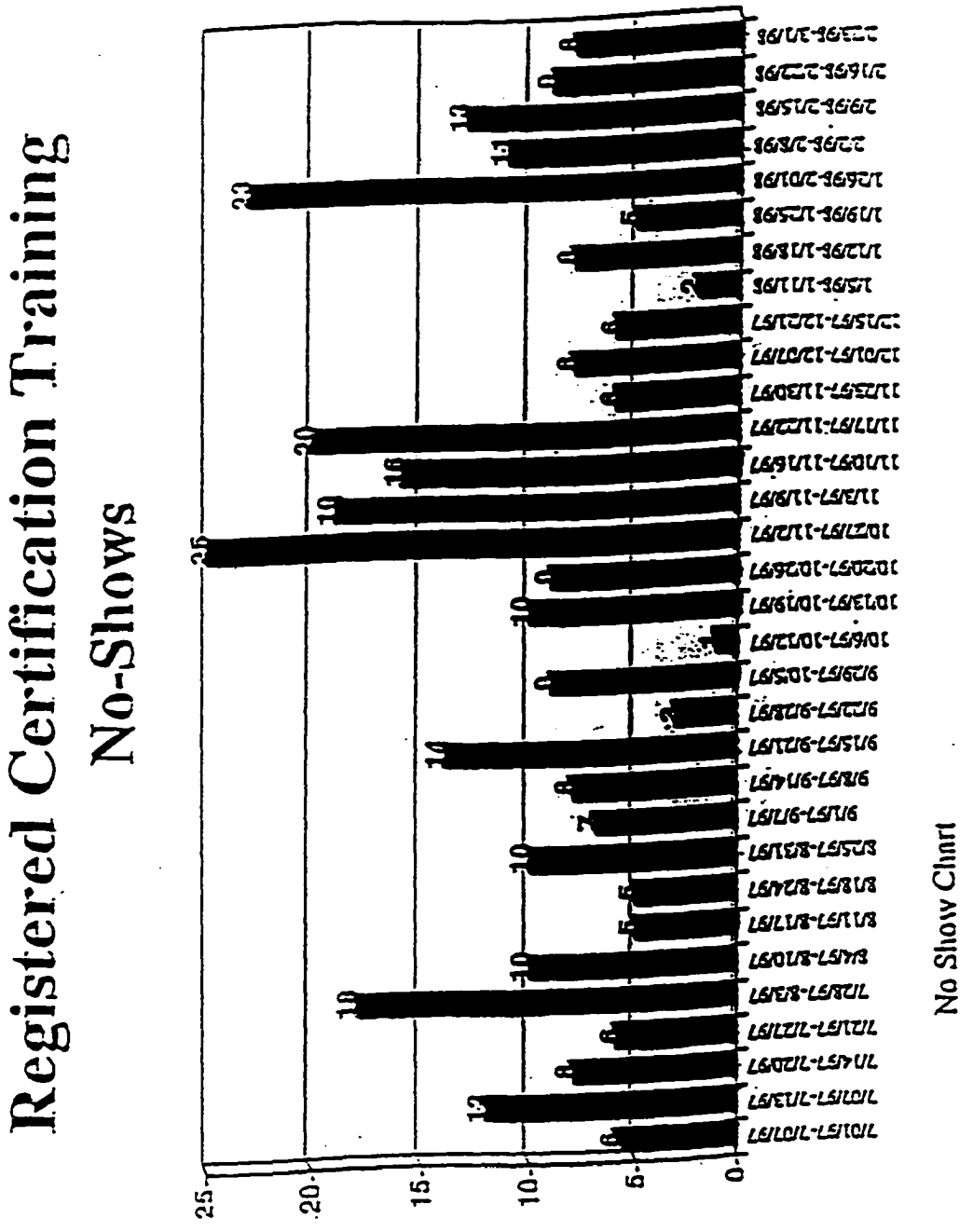
Expired Certification List

PREPARED BY LTAPD

APPENDIX B



DATE: 01/04/98

LT&PD / NOSHOW REPORT
REPORTING PERIOD
02/23/98 TO 03/01/98

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						02/24/98	02/25/98	15:00	23:30	REGISTERED	EL
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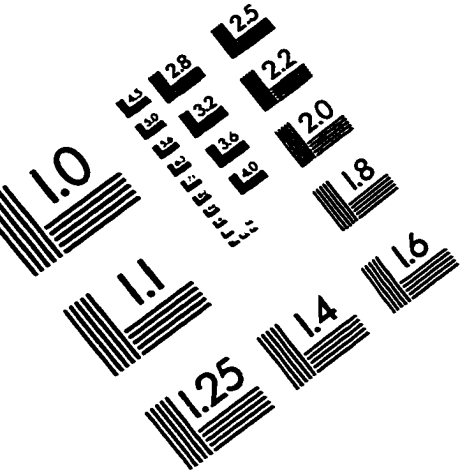

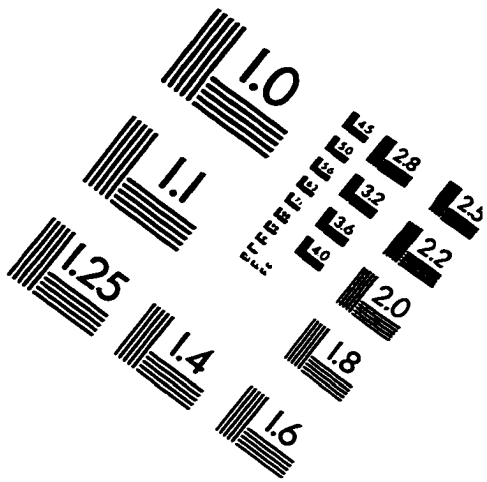

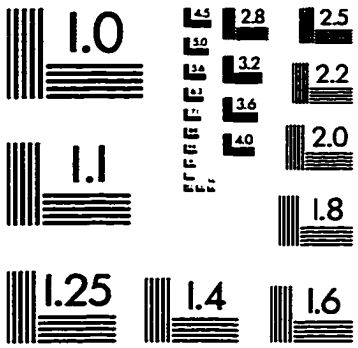

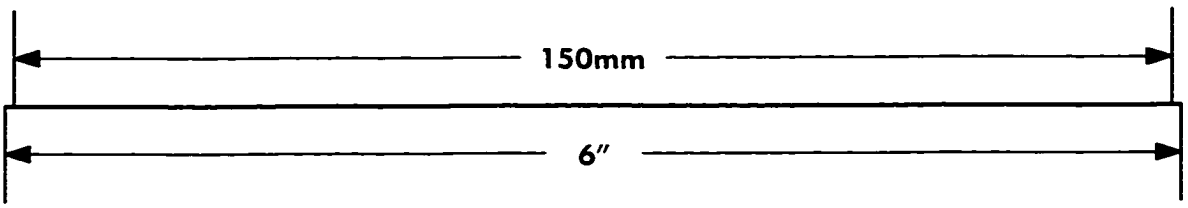

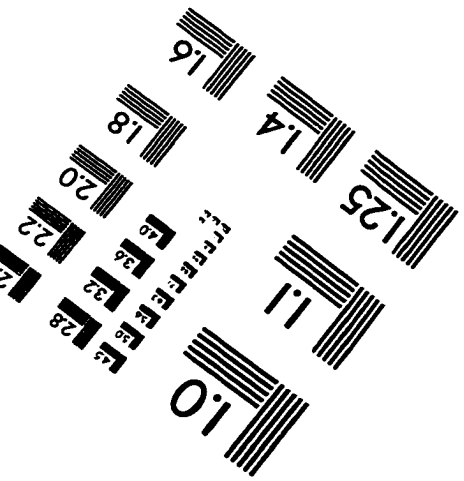

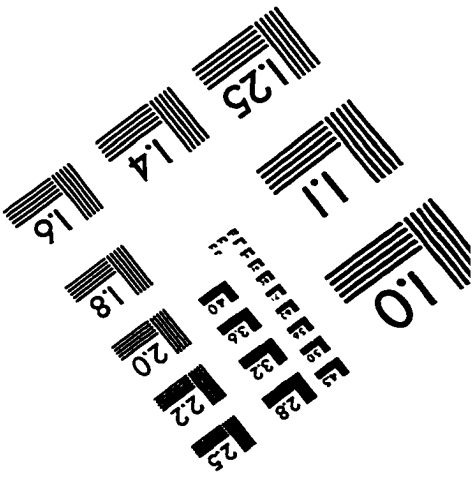

APPLIED IMAGE, Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989