Craft training

By Joel Levitt

The Problem: The skills needed to run today's factories and buildings are changing faster than most people can assimilate. Jumps of technology disorient even the most dedicated worker.

Case in point:

Factory manufacturing fuel control systems: Chief of field service, Calvin Smith was 55 years old. The work force consisted of nine technicians. He was required to do service himself and usually took (or was brought) the most challenging problems. He was the best and most highly skilled troubleshooter through the transistor era (he actually started with relay logic).

The company moved to CMOS integrated circuits. Now each integrated chip replaced an entire board. After a painful learning process he came up to speed on CMOS. He never developed the comfort level with integrated circuits that he had with transistors. Instead of knowing and following the entire logic of the board he associated certain chips with certain faults and replaced the chips until the board worked. Toward the end of the 2 years his expertise was quite good. His attitude had recovered.

After two years of CMOS new microprocessors first started to show up in the designs. He started over, but the difference between microprocessors and CMOS was much wider than the difference between CMOS and transistors. He never understood the concept of programming or the dynamic nature of the data and address bus. He couldn't understand how to trouble shoot a dynamic system such as a typical microprocessor board.

Our dedicated field service manager took very early retirement feeling that the world had passed him by. The company lost his expertise. He lost his sense of mastery and feeling that he was part of an important field. He now does odd jobs (he started as an electrician) in his neighborhood. Interestingly, his old subordinates still bring him problems which he throws himself at with relish.

This was a waste of human resources. Proper training might have saved this person. While the company spent money to train the engineering staff it didn't think to include the service staff. The design lag time (it took 2 years to get the first Microprocessor product off the drawing board) would have been more than adequate to train the entire staff.

A world class auto manufacturer requires 96 hours a year of training for everyone in the organization. They feel that they will not maintain their world class status unless they continue to invest in their people. The need for training is driven by new people, new equipment, new operating requirements, new operating expectations, competition, modernizing old equipment, new diagnostic techniques, new management strategies, team building or new financial goals.

Today all of these are ongoing realities.

Coaching or Counseling?

Always ask yourself the question, Does this person need training or some kind of counseling? Many attitude problems stem from inadequate training and the personal defense of a lack of competence. Some problems may be the result of a problem with co- workers, home life, or a lack of aptitude. No amount of training will overcome these problems.

Three types of training are different

In training terms there are three types of learning that apply to this situation; Knowledge, Skill, Attitude. For higher level jobs (such as chief service person) all three must shift to competence. Many types of training address one or other of these types of learning without regard for the other. Maximum effectiveness in this case must shift all three areas.

TYPE   OBSERVABLE   PERFORMANCE
                   BEHAVIOR   LEVEL

Knowledge	be able to describe diagram, argue, etc.	answer X of 10 questions correctly

Example of this domain would be questions like what is the process to heat treat steel to a particular spec, describe the steps to obtain a hot permit in this facility, how would you program a cascade pumping arrangement with a Allen Bradley PLC. The knowledge domain is what is taught in most schools. Generally it is easy to test in this domain. Sometimes you will find mechanics that can do something but don't know what or why they are doing it. They are deficient in the knowledge area.

Skills	demonstrate, show perform, solve	do ... in x minutes with no mistakes

Example of this domain would be demonstrate welding two pieces in this position, make off MI cable connection to at least 3 meg ohm resistance to the casing. Most on-the-job training consists of skill training. In maintenance we admire skilled mechanics. If you have the proper set-up this is also easy to test. Many people have the knowledge without the skill. We say they can talk a good game... but can they weld, etc.!

Attitude	comfort, without hesitation	to your own satisfaction

Example of this domain would be to discuss their comfort level with a particular technology or their own work ethic. This is very difficult to test for. Someone could conceal their discomfort. You occasionally run into trade's people that have the skills and knowledge but lack the will or the confidence to do the work.

Let's analyze chief service technician problem from a training perspective. Calvin needs competencies in all three areas to be a good chief technician. He lacks certain knowledge that could show him what is happening on the board. He lacks some specific skills to help him fix

the boards. His biggest problem now is a negative mental attitude (a secondary development). His attitude stands in the way of his gathering the skills and knowledge. The attitude will be the last to be fixed and will follow mastery of the skills and knowledge.

Steps in Process to develop Training:

Step 1: Look at the job to be done. Determine what knowledge, skills, and attitudes are needed for the job. Before we can look into teaching anything we have to see what is needed. Look at the job as it is today, forecast where the job is going in the short term. The big picture of competencies is called the General Learning Objective (GLO). The concrete and specific skills, knowledge, and attitudes required to do the job are called specific learning objectives or SLO's. If properly designed a person achieving these SLO's would be successful in this job.

What is needed to trouble shoot and repair microprocessor boards? We must also decide what level of competence is appropriate for a service chief in servicing these boards. Examine job requirements form. This form should be designed for and kept with job descriptions for the Chief's job (and other jobs that have the same requirements) for future reference. Note that this is the microprocessor part of the job only. The chief's job has many other facets.

Step 2: Evaluate the trainee's (or trainee group's) current skills, knowledge and attitudes. A direct supervisor might be able to make an educated guess. If the trainee has good insight they might know where they are weak. See trainee evaluation form (2nd form following this section). Most situations require some kind of testing (either observation on the job or more formal written or bench tests). The testing should be designed to uncover the skills, knowledge and attitudes on your required list from step 1 (from job requirements form). The testing should also uncover those people that do not have the aptitude to learn the new information.

It is important to note that success on the test should correspond to success on the job. Testing that does not reflect job requirements is said to be invalid. The Anti- Discrimination Act (ADA) and related legislation are clear that the test must not discriminate against any group, disability, or condition. For example, if the worker must lift 100# in the test, the job must call for heavy lifts where equipment cannot easily be used.

We must evaluate our service manager's skills, knowledge and attitudes. After we make a list of specifics we rate (or test) him/her in each area. The result would be tailored to this individual. Trainee evaluation form would be kept in a personnel or training file for the individual.

Step 3: Translate the voids in skills, knowledge and attitudes of the potential trainee uncovered in step 2 above from the required list, to develop a training lesson plan. The training plan should list all of the types of learning that this person/group needs. Training prescription form summarizes the skills, attitudes and knowledge that Calvin Smith lacks and needs for the job. The form also recommends possible exercises and resources to provide the learning that Calvin needs. The Training Prescription Form also estimates the time requirement for the trainee and the requirement for any supporting staff.

You might go through this exercise for all related jobs. The service technician might have related SLO's that can be economically incorporated into this training.

Step 4: The last step of training is to post test and verify that the skills, knowledge and attitudes have shifted to competence. As you can imagine this step is missing or glossed over in many training situations.

Job Evaluation Form   Page 1 of 2   JEF-001

Date 2-23-9X   Dept: Field Service

Job evaluated: Chief Service Technician

GLO (General Learning Objective) Skills, knowledge, attitudes (noted S, K, A) needed by Chief Technician:

Chief Service technician should be comfortable and competent in working with all types of faults on microcomputer circuit boards in a field service environment. She/he should also be able to teach the other service techs.

SLO's (Measurement of the SLO included in description.)

1. (S) Use of test equipment, VOM, scope. Must be able to demonstrate competence with each piece of test equipment by choosing the correct tester for the problem, setting it up correctly for the problem, and interpreting the results correctly.

2. (S) Be able to locate specific pins on the chips (power, ground, address, data, reset, enable, etc). Test would include pin identifications on all chips used on board. Pin-out chart allowed.

3. (K) Explain what the pins do. Explain and test for normal state of pin such as power, reset, select, address, etc. Trainee should be able to describe the function and normal states of every pin on all chips used on boards. Use meter or scope to verify knowledge

4. (K) Know basic chip types and their uses: Micro, RAM, refresh circuits, ROM, PIA's, specialized drivers, etc. Describe function of all chips on board in normal operation.

5. (K) Be able to explain the interaction of the different chips on the board. Explain addressing, parallel/serial data movement, timing, etc. Show timing on a clock cycle basis, show addressing and chip select logic, describe data movement via PIA (Async) to parallel data bus.

Date 2-23-9X   Dept: Field Service

Job evaluated: Chief Field Service Technician

6. (S) Be able to write simple programs. In particular, can write programs that exercise the various functions of the board. Write a program that tests all input and output ports, all memory locations and reports a defective condition.

7. (S, K) Be able to figure out whether the software has a bug or the hardware has a fault.

8. (S) Be able to set-up an exercise fixture, download a program to test and exercise the board.

9. (A) Develop a comfort level with and interest in microprocessors.

10. (K, S) Develop logic for dealing with common problems (reset held down, address line grounded, RAM chip bad, etc.)

11. (S) Be able to trouble shoot 10 boards with random faults in a day.

12. (A) Feel that they can cope with the new technology.

Dept: Field Service

Job evaluated: Chief Field Service Technician

TRAINING NEEDS Name: Calvin Smith

Reference GLO/SLO coding #JEF-001

Evaluate trainee's competence in the SLO's determined to be job requirements SLO's

1. (S) Use of test equipment, VOM, scope

 Demonstrated knowledge of test equipment

2. (S) Be able to locate specific pins on the chips (power, ground, address, data, reset, enable, etc).

Can locate specific pins if given a Pin-out chart, note that memorizing pin locations is not an objective

3. (K) Explain what the pins do. Explain and test for normal state of pin such as power, reset, select, address, etc.

Needs some work on identifying normal state and signature of address/data pins

4. (K) Know basic chip types and their uses: Micro, RAM, refresh circuits, ROM, PIA's, specialized drivers, etc.

Knows some chips (from earlier) needs training in others

5. (K) Be able to explain the interaction of the different chips on the board. Explain addressing, parallel/serial data movement, timing, etc.

Needs some help here; can explain some of the interactions such as chip select, reset.

6. (S) Be able to write simple programs, in particular programs that exercise the various functions of the board.

Needs help here

Date 2-23-9X   Dept: Field Service

Job evaluated: Chief Field Service Technician

Name: Calvin Smith

Reference GLO/SLO coding #JEF-001

Evaluate trainee's competence in the SLO's determined to be job requirements

SLO's

7. (S, K) Be able to figure out whether the software has a bug or the hardware has a fault.

Needs a lot of help here

8. (S) Be able to set-up an exercise fixture, download a program to test and exercise the board.

Has built many test fixtures, needs to be shown how to download a program

9. (A) Develop a comfort level with and interest in microprocessors.

Needs help here

10. (K, S) Develop logic for dealing with common problems (reset held down, address line grounded, RAM chip bad, etc.)

Needs some help, has done this for other technologies

11. (S) Be able to trouble shoot 10 boards with random faults in a day.

Needs help here

12. (A) Feel that they can cope with the new technology.
Needs help here

Date 2-23-9X   Dept: Field Service   Reference Form JEF-001

TRAINING AGENDA   Job evaluated: Chief Service Technician

Candidate evaluated: Calvin Smith

(GLO) Skills, knowledge, attitudes (noted S, K, A) needed by Chief Technician to trouble shoot microprocessor boards to a component level (Only SLO's where a deficiency is found are to be included):

Time Estimate: 1 Hour every other day in morning for 6-10 months plus 6 full days to build fixtures and test boards
Engineer: 45 hours preparation plus 1 hour/week for review

Preliminary Cost Estimate:

Student (108 hr.) at $35		$3780
Engineer (71 hr.) at $45		$3195
Outside Course		$ 400
Inside materials		$ 600
3 day seminar afterwards		$ 925
Misc.		$ 100
Total cost		$9000.

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3. (K) Explain what the pins do. Explain and test for normal state of pin such as power, reset, select, address, etc.

Purchase a Micro-Processor Lab (be sure the lab uses the same processor as we do. If not find a similar kit that uses our processor). Review course which includes training in the normal state of pins. Have engineer's add an exercise to have Calvin plot the normal states of all important pins on one of our boards. Test and verify the correctness of his chart. Keep this chart as part of the training program

4. (K) Know basic chip types and their uses: Micro, RAM, refresh circuits, ROM, PIA's, specialized drivers, etc.

Add information for any chip that we use not covered in course. Design short test for our chip set.

Date 2-23-9X   Dept: Field Service   Reference Form JEF-001

TRAINING AGENDA   Job evaluated: Chief Service Technician

Candidate evaluated: Calvin Smith

5. (K) Be able to explain the interaction of the different chips on the board. Explain addressing, parallel/serial data movement, timing, etc.

Review tests at the end of chapter to see if Calvin understands information. Add questions in areas not well covered.

6. (S) Be able to write simple programs, in particular programs that exercise the various functions of the board.

Course includes several programming exercises. Add one exercise. Exercise: design a program that tests all of the functions of our board

7. (S, K) Be able to figure out whether the software, or hardware has a fault.

Engineer to introduce known problems into several boards including hardware faults and software bugs. Calvin to build a test fixture and work through logic of diagnosis to the satisfaction of engineer and Calvin. These boards, fixture and logic notes should be kept as part of the training program

8. (S) Be able to download a program to test and exercise the board.

Will be covered by engineer in #7

9. (A) Develop a comfort level with and interest in microprocessors.

Ask Calvin, from time to time, how his comfort level is with the new technology. We expect it to increase as he gains mastery. Get Calvin subscription to Microprocessor process control magazine. Ask him to report on new developments

Date 2-23-9X   Dept: Field Service   Reference Form JEF-001

TRAINING AGENDA   Job evaluated: Chief Service Technician

Candidate evaluated: Calvin Smith

10. (K, S) Develop logic for dealing with common problems (reset held down, address line grounded, RAM chip bad, etc.)

Have Calvin review work requests and interview engineers to determine probable failure modes. Create these modes in production boards and analyze symptoms. Add these boards to training kit.

11. (S) Be able to trouble shoot 10 boards with random faults in a day.

Obtain 20 failed boards from the field. Repair boards and prepare logic diagram of repair/diagnoses process. Do 3 the first day, 7 second day and 10 the third day. Review logic for each board with engineer at the end of each day. Save logic analysis for training kit.

12. (A) Feel that they can cope with the new technology.

Question Calvin about attitudes toward new technologies. It might pay at this point to wait 3-4 months and then send Calvin to an outside 2-3 day intensive seminar in Microprocessor trouble shooting. He will see how far he has progressed.

13. Last assignment. Work with engineer to organize training materials. Build a storage case and instructions for use. Include the successful logic path to repair all of the sample boards with faults.
        This kit will be the nucleus of a kit to be used for training new engineers, service people and certain production people. We maximize the use of the program. For good measure if space for a desk (bench) is available have Calvin set up a small training area and design training into all service tech jobs (1 hour a week?)

Organizing the training effort:

Your department (if not the whole company) should set training goals for all people. Look at where they are now, where you need to go, and what is missing. Budget at least 1% (20hr per year) training for each person per year. Firms in rapid change or with a significant deficit of skills need 5% (100hr per year) or more to keep skills current.

If your firm does not have a formal training department you could set one up for your department, area or even workgroup. The training director can be one of the people in the department and could rotate among different people every year.

Set-up files for each person and each job with the GLO's needed. Review the GLO's with available time, business cycle and funds. Be sure to act with the full input of the workers and supervisors. Once underway review every file every 6 months and be sure everyone gets an opportunity for training.

Some non-craft topics are: your industry, quality, safety, CPR, fire fighting, toxic material handling, toxic waste regulations, your maintenance information system, statistics, filling out paperwork, PM, scheduling, project management, report writing, shop math, drafting, CAD, computers, engineering, cost accounting, your end products, what it's like to operate your machines, job cross training. The list is endless. Your people will be the better for the attention and the training

Who should develop forms?

Using an expert in the subject: Pick someone who is knowledgeable about the needed information and who already has competence in the GLO's/SLO's being taught.

Give them time and support to develop Job Evaluation Form. Help them learn how to test someone's competence in the SLO's. Let them monitor the whole education process.
1. Develop SLO's complete detailed requirements form
2. Test SLO's complete training needs form
3. Develop lesson plan complete training agenda form
4. Complete training
5. Evaluate results and make changes where appropriate

Using someone who is an expert in training: Pick someone who has demonstrated competence in the training process. They will pick a knowledge expert to question to develop needed competencies. Steps are then the same except the training expert will choose experts as needed.

Sources of training and training materials

Training is big business for a large number of organizations. Specific sources follow in the appendix. Here are some ideas:

1. Your staff is your first choice of potential trainers. In excess of 80% of all maintenance training takes place on the job. You are already in the training business in a big way. I recommend investing energy to manage the effort. Within your staff there are several possible people to consider as trainers. Please note that being a trainer should be viewed as a job enhancing project. Time should be given for preparation of materials. During preparation of materials and delivery of the training the trainer should be relieved of other duties.

     a. Tap your soon to retire people as trainers. This group has significant experience that should be channeled into the next generation. In some organizations people who have already retired are recruited to return as part time teachers. Stay away from people with negative attitudes toward the organization or they might infect their students.

     b. Use the internal guest instructor concept. In this concept a staff member would be treated as a guest (lunch, clerical support, off-site for longer training, relief from other duties)

     c. Tour training is an excellent team building exercise. Once a month you tour a section of your facility and the most experienced maintenance person plays `show and tell' about the problems and successes in his/her area.

     d. Video technology has rocketed ahead so that most firms can afford a quality video camera, recorder and an editor. New equipment set-up, construction documentation, and specific machine training are popular first subjects. Craft training is a more difficult but rewarding area. After expertise is obtained any topic can be recorded to good effect. One firm hired a producer from a small local cable station to put the training tapes together. The video professional guided the companies' employees in how to produce what they had in mind.

     e. Look to other parts of the organization such as human resources, data processing, engineering, production for expertise useful to your upgrading effort. Topics could include your process, your industry, interfacing to other groups, etc.

     f. The supervisor, lead person or leader (where qualified) should be a logical choice for trainer. Consider sending them to `Train the Trainer' classes locally. A small amount of formal training in adult education will significantly improve your training effectiveness.

2. There are many excellent companies that provide craft training. These firms can provide professional instructors, testing rigs, work books and video/audio tape. The quality and appropriateness to your operation may vary, so check several vendors.

     a. In-house courses are available on a wide variety of maintenance topics. Most appropriate if many people need the same training. Costs are about $2000 to $5000 per day.

     b. Public seminars are very useful for training one to three people. Expect seminars to

cost $500 to $2500 and last 1 to 5 days. Try to get recommendations of the better seminars from people in your industry. One big advantage is the interaction with maintenance professionals from other organizations. Some seminars (particularly if they are sponsored by vendors) are very good buys because they are subsidized. Avoid the sales pitch seminars for training purposes..

  c. Many organizations sell videos/ animated videos. Expect to spend $50 to $500 for video training in a wide variety of areas.

  d. At the very top of their video product lines are interactive videos that lead a trainee through a series of lessons which retrain when necessary. Expect to pay $250 -$500 for a rental and up to $8000 to purchase a complete course. Custom designed interactive videos are as expensive as films to produce. Large manufacturers pay $250,000 or more for a custom project.

  e. Test beds are excellent training tools since the actual equipment can be seen, touched and worked on. The company can program the test bed to simulate faults and train your people how to uncover them. Popular with PLC's, hydraulics, pneumatics, etc.

  f. The largest organizations in the information business are the library systems. All of these systems have videos for loan. Many of them have extensive sections on craft training. Visit the main branch of your county or city library, you might be pleasantly surprised. You can also purchase videos that are missing and donate it to them. That way they manage the lending aspect of training.

3. Equipment manufacturers. This is a growing area. Equipment manufacturers have a vested interest in a trained user base. Many of them subsidize training and charge it to marketing expense. Time and time again it has been shown that trained users are happier users.

  A. Negotiate training into all equipment purchase contracts.
  B. Excellent low cost training is usually available from vendors of predictive maintenance hardware.
  C. Immediately call all vendors of equipment you own and ask if they have free videos on maintenance or operations. Develop a scoring system for the quality and applicability to your facility. Have mechanics volunteer to view and rate them.
  D. Also ask for free parts CDs for your computer.

4. Trade and professional associations. These groups are striving to increase their value to their membership. One of the traditional ways is to provide industry specific training in either traveling seminars or at workshops during trade shows. If your association does not provide training that you believe is needed in your industry why don't you volunteer to put a seminar package together for the association. The AIPE plant engineering show in Greensburg, S.C. in 1995 had 25 seminars on many important aspects of maintenance management. Could you imagine the positive effects of 2 or 3 technicians being rewarded with attendance to a show and exhibition.

5. Internet based training. Some of the vendors provide Internet training sold by the hour or

module. These systems train in electricity/electronics, pneumatics, building trades, business subjects, computer subjects, basic science and many other areas.

6. Tech Schools are an excellent source for trade training. Get to know the people running your local tech schools. Visit and walk through the facility. Many companies set-up specific labs, benches or workshops with equipment so that the tech school can provide equipment specific training to train students on. Many tech schools are very open to negotiate training contracts for some or all of your technical training needs.

7. Community Colleges, Colleges, Universities are frequently looking for new markets. These institutions have significant expertise in teaching more advanced subjects to adults. Many of them have entered into instruction contracts with private industry in areas including computerization, robotics, regulation, automation, business skills and other areas.

8. Unions are looking at their traditional roles. Many see that skill needs are shifting and have decided to lead the trend by setting up training for their members. This might be an interesting subject to be discussed if your union is not doing this already.

9. Insurance Companies can cut claims by conducting certain types of training. Some firms will send risk managers through your facility and provide specific training in areas such as safety, risk management, liability reduction, fire safety, storage and handling of chemicals, record keeping for maintenance, safety, and accidents.

10. Governmental Agencies provide seminars and workshops on a wide variety of topics including environmental issues, hazardous materials, access for disabled, waste disposal, safety, record keeping, dealing with overseas vendors and many others.

Checklist for selection:

1. Is this resource the best available to achieve the learning objectives. Is the scope matched to the size of the training problem? In other words, are we trying to bring down an elephant with a sling shot?

2. Is this resource consistent with the style of the department and organization? A freewheeling department will not respond well to a formal authoritarian lecturer. A more traditional department will not respond well to some of the more far out team building exercises. What is the style and history of successful training endeavors in the past?

3. Will this resource satisfy the expectations of the trainees? The trade's people have expectations that must be addressed. These expectations are sometimes hidden. Remember some people respond to training with hostility because it might seem that you are saying that they are deficient.

4. Can we afford this resource in terms of both time and out of pocket expense. It is a bad

practice to pull people out of training for anything less then an emergency.

5. Are there other benefits beyond this training from this resource.

6. If it is an outside vendor:
    a. How stable is the organization? How long in this business?
    b. How knowledgeable is the actual trainer in areas useful to you? How effective are they in training your level people? Can you meet the actual trainers (as opposed to the sales staff)?
    c. Will they guarantee results. Can the results be tested?

Some methods to consider for training:

Lecture	Trainer tells trainee material to be learned
Coaching, OJT	1 on 1 training and encouragement (use the technique Tell, show, have them explain, have them do)
Case Method	Analyze a specific incident, problem, situation or company
Correspondence	Home study of a commercially produced course of study. Can be adapted to tailored training within a firm.
Demonstration	Trainer shows trainee how to do something
Laboratory	Experiments designed to teach material by discovery
. Programmed learning	Trainee goes through material at their own speed. Accommodation for trainees who need more material in some texts.
Role Play	Trainee plays the role and learns from their reaction and the reaction of the other role players.
Simulation and games	Trainee is presented with a realistic scenario and the trainee works through problems and situations

Running the training itself, consider the following:

1. Materials called educational software which includes books, work sheets, etc.
2. Staff time scheduling, contingency plans if key players cannot attend. Replacement on shop floor.
3. Outside firms needed for guest speakers, professional trainers, turn-key training, slides, video production, audio taping.
4. Trainees have been sent invitations and have RSVP. Be sure to avoid shutdown days.
5. Structure of training might include break-out sessions, hands-on bench work, access to

computer, classroom.

6. Aids including overheads, flip charts, voice amplification, slides, videos, satellite link-ups

7. Facilities are adequate for the number of trainees and are comfortable. Who is the contact person? Who has the keys? How do you turn everything on and off?

8. Accommodations for trainees who are traveling in from another facility.

9. Food and refreshments help make people more receptive. Remember people have different tastes. Only 40% of people drink coffee in the morning, plan for your group.

10. Check dates for conflicts with vacations, holidays, hunting seasons, schedules, bad weather.

11. If people are traveling by air or train coordinate pick-ups, tickets, vans, etc.

12. Use promotion techniques to sell the program, persuade people to want to go.

13. Timing can make or break a program. A giant reorganization before a training can be a good thing but one afterwards can be devastating.

Return on Investment

"There is no substitute for being the best at what you do. We are so happy being mediocre it makes me sick." Ross Perot, founder of EDS, was the largest stock holder in GM after he sold EDS to them (he has since been bought out by GM and no longer sits on the board).

The training is designed and ready to go except for the important go/no-go question? Is this training worth the investment? Is the investment of about $9000 worth the probable returns. The returns come in two areas:

What is Calvin Smith worth as a chief technician? He has 8- 10 years before probable retirement that would be spent with our company (we presume, but cannot guarantee). We have no guarantee that this program will work and Calvin will learn what he has to know to feel successful. Is his specialized knowledge built up in 12 years with us and the rest of his experience of value. There is a training cost for his replacement. Keep in mind that servicing of microprocessor boards is only a small part of the job of Chief Technician. If we are successful in training Calvin we might have a good prospect to be instructor to the rest of the field service staff.

We also have a continuing asset in the training program that has been assembled. Lets inventory this program:

- o One microprocessor training set
- o Chart of normal state of pins
- o Added information on our chip set
- o Additional questions added to test knowledge of use to us several boards with known problems in software and hardware
- o Test fixture
- o Program that exercises micro board
- o Boards with common modes of failure
- o Logic diagrams for diagnosis of problems for 20 boards

All this is packed up in a case ready for use.

Advice for trainers: 22 Guideposts for adult training

There many `rules of thumb' in the teaching of adults. The more rules the supervisor follows the more likely the training will be successful. Larry Davis' leading book on adult training and education Planning, Conducting, and Evaluating Workshops [10] gives 22 rules for teaching adults which sum up the best thinking on the topic:

1. Adults are people who have a good deal of firsthand experience. Effective training taps into the adult's existing store of experience. Use the people's expertise. In this mode be a facilitator rather than a pure teacher.

2. Adults are people with relatively large bodies subject to the stress of gravity. Effective training allows the adults to take breaks, move around, and change pace. Figure breaks every 60-85 minutes (depending on time of day). Active activities in the afternoons are usually effective.

3. Adults are people who have set habits and strong tastes. Effective training is sensitive to adult habits and tastes and tries to accommodate to as many as possible. For example in the south, soft drinks are served in the morning along with the coffee. If you host people from around the country inquire into their habits and tastes.

4. Adults have some degree of pride. Successful training is careful with the ego's of the participants and helps develop greater abilities and independence in the areas being trained. Acknowledge people with long years on a job. Lean on them to contribute their `hard won' expertise.

5. Adults are people with things to lose. Good training is concerned with gain and not with proving inadequacy. The most effective training has 100% success ratio's. Stay away from graded exercises. Let everyone succeed.

6. Adults are people who have developed a reflex toward authority. Good trainers (and good supervisors too) know that each adult has a different style of dealing with authority and don't take any of it personally. Ice breakers and humor in the beginning help people get over many negative attitudes toward trainers and `school'.

7. Adults are people who have decisions to make and problems to solve. Effective training is problem-solution oriented and entertaining. Mix theory with actual demonstration, concrete application. The why is interesting and the how is critical.

8. Adults are people who have a great many preoccupations outside of a particular learning situation. Effective training does not hog the adult's time. Training should achieve a balance between tight presentation and time needed for learning integration. It is sometimes necessary and rarely effective to run long hours in full day training. Consider 6 to 7 hours contact time a full day.

9. Modern adults may be bewildered by all of their options and opportunities. Effective workshops assist them in selecting what is important at this time. Review of the available options is good and your recommendation for the best choice is even better.

10. Adults are people who have developed group behaviors consistent with their needs. Effective training concerns itself with satisfying these needs and allowing many different behaviors. Some people contribute by being loud, other by being quiet, some talk all the time other have to be drawn in. Allow for the different styles.

11. Adults are people who have established emotional frameworks consisting of values, attitudes, and tendencies. Training denotes change. Change puts people's framework at risk. Effective training assist adults in making behavior changes. Effective training assist adults in becoming more competent. Build on what is good. Start from where people are and proceed from there. The behavior change desired should be logical and defensible from the trainee's point of view. Arguments could be provided to allow the trainee to sound good in the new change.

12. Adults are people who have developed selective stimuli filters. Effective training is designed to penetrate the filters. Penetrating agents include dramatic presentation, logical arguments, humor, involvement, role playing, games, conversation and other techniques.

13. Adults are people who respond to reinforcement. Some respond to positive reinforcement. All occasionally need negative reinforcement. Effective training is built on appropriate reinforcement. Exercises give reinforcement, instructors give reinforcement and the peer group give reinforcement.

14. Adults are people who are supposed to appear in control and who therefore display restricted emotional response. Sometimes intense training loosens up these restricted responses. Effective training is prepared for emotional release if it occurs. Set-up a supportive training situation (in maintenance you can't be too obvious about this).

15. Adults are people who need a vacation or time off from work. Effective training provides some time away from the grind. One of the best outcomes of training is that people have time to think about their working situations. This time away can be very motivating. In our public maintenance sessions getting away with other maintenance professionals is very useful.

16. Adults are people who have strong feelings about learning situations. Effective training is filled with successes. Everyone can succeed in one way or another in a successful training.

17. Adults are people who secretly fear falling behind and being replaced. Effective training allows people to keep pace with the field and grow with confidence. It is important to show the context of new technology to maintenance. All maintenance professionals are faced with an increasingly difficult task of keeping up with the technology. One way to help is to show how the technology fits in. The technology changes but the context stays the same.

18. Adults are people who can skip certain basics. Effective training starts with where the adult is today and builds on that. After knowing where the people are in understanding your topics certainly skip or skim over basics. Check this out before trying.

19. Adults are people who more than once find the foundations of their world stripped away. Effective training reminds them of their ability to learn and start again. Maintenance is changing so rapidly that the trainee might be reluctant to put themselves at risk. Once at risk they feel that they might have to start over.

20. Adults are people who can change. In the last analysis people change and like it after its over.

21. Adults are people who have a past. Effective training is concerned with the development of new competencies. The why's of the past are someone else's concern.

22. Adults are people who have ideas to contribute. Effective training leaves room for their contribution. Training that takes peoples ideas builds ownership and positive feelings for the trainees.