Measuring Overall Craft Effectiveness (OCE)

Part II: How OCE Impacts Your Bottom Line

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Craft Labor-A Terrible Thing to Waste: Improving Overall Craft Effectiveness is very key question we need to answer. Getting maximum value from craft labor resources and higher craft productivity requires measurement and knowing where you are now. Maintenance operations that continue to operate in a reactive, run-to-failure, fire fighting mode and disregard implementation of today's best practices will continue to waste their most valuable asset and very costly resource - craft time. Typically, due to no fault of the craft work force, surveys and baseline measurements consistently show that only about 30 to 40 percent of an eight-hour day is devoted to actual, hands-on wrench time. It is very important to understand; "How your valuable craft time can slip away" as illustrated in Figure 2. Best practices such as effective maintenance planning/scheduling, preventive/predictive maintenance, more effective storerooms and parts support all contribute to proactive, planned maintenance and more productive hands on, "wrench time". Measuring and improving overall craft effectiveness (OCE) must be one of many components to continuous reliability improvement process and total asset management. As we discussed in Part I, OCE includes three key elements very closely related to the three elements of the OEE Factor.

Overall Craft Effectiveness (OCE)	Overall Equipment Effectiveness (OEE)	Elements of OEE and OCE
1. Craft Utilization or Pure Wrench Time (CU)	Asset Availability/Utilization (A)	Effectiveness
2. Craft Performance (CP)	Asset Performance (P)	Efficiency
3. Craft Service Quality (CSQ)	Quality of Asset's Output (Q)	Quality

Craft Utilization

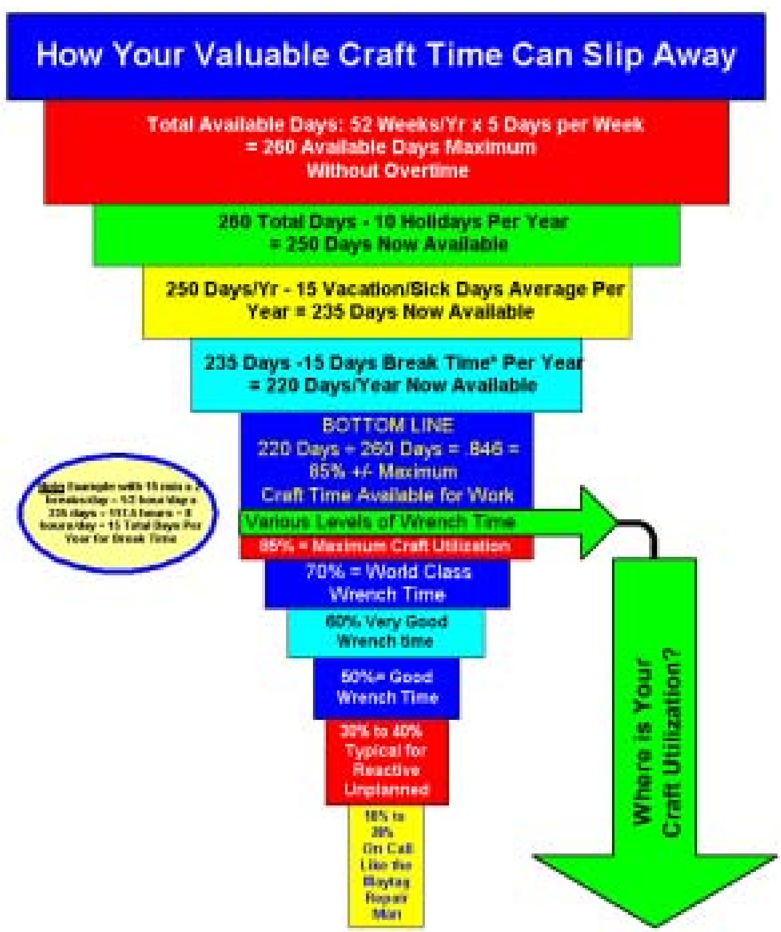
Craft Utilization (CU): The first element of the OCE Factor is Craft Utilization or pure wrench time. This element of OCE relates to measuring how **effective** we are in planning and scheduling craft resources so that these assets are doing value-added, productive work (wrench time). Effective planning/scheduling within a proactive maintenance process is key to increased wrench time and craft utilization. It's having an effective storeroom with the right part, at the right place in time to do scheduled work with minimal non-productive time on the part of the crafts person or crew assigned to the job. Figure 2 shows; "How your valuable craft time can just slip away".

Pure wrench time is just that and does not include time caused by the following;

1. Running/traveling from emergency to emergency in a reactive, fire fighting mode
2. Waiting on parts and finding parts or part information
3. Waiting on other asset info, drawings, repair instructions, documentation etc.
4. Waiting for the equipment to be shut down
5. Waiting on rental equipment or contractor support to arrive at job site
6. Waiting on other crafts to finish their part of the job
7. Traveling to/from job site
8. Make-ready, put away or shop clean up time
9. Meetings, normal breaks, training time and excessive troubleshooting due to lack of technical skills
10. Lack of effective planning and scheduling

Craft Utilization (or wrench time) can be measured and expressed simply as the ratio of:

CU% = <u>Total Productive (Wrench Time)</u> / Total Craft Hours Available & Paid x 100



Improve Wrench Time First: Go on the attack to increase wrench time in your operation even if you do nothing to improve the other two OCE Factors; Craft Performance and the Craft Methods and Quality level. As we will see in the following examples, very dramatic and significant tangible benefits can be realized with just focusing on increasing wrench time. Improvement of from 20 to 30 percentage points can typically be expected just from more effective maintenance planning and scheduling. Let's now look at several examples showing the value of craft utilization improvement within a 20-person work force with an average hourly rate of $18.00 and see the significant benefits that a 10 percent increase in craft utilization can provide.

Gained Value of 10% in Wrench Time: What if through better planning and scheduling, good parts availability and having equipment available to fix it on a scheduled basis, we are able to increase actual wrench time by 10 percent? What is the gained value to us if we get wrench time increase across the board for a 20- person crew being paid an average hourly rate of $18 per hour? First let's look at what it is really costing us at various levels of wrench time

Total Craft Hours Available and Annual Craft Labor Costs for Crew of 20 Crafts

20 Crafts x 40 Hrs./wk. x 52 wks./yr. = 41,600 Craft Hours Available

41,600 Craft Hours @ $18/hr. = $748,800 Craft Labor Cost/Year

Wrench Time and Actual Costs Per Hour at Various Levels of Craft Utilization

Level of Craft Utilization	Total Wrench Time (Hours)	Actual Hands On Cost Per Hour	Average Wrench Time Hours Per Craft Position
30%	12,480	$60.00	624
40%	16,640	$45.00	832
50%	20,800	$36.00	1040
60%	24,960	$30.00	1248
70%	29,120	$25.71	1456
80%	49,920	$22.50	1664
***85%**	**35,360**	**$21.18**	**1768**
90%	37,440	$20.00	1872
100%	41,600	$18.00	2080

Table 3:

Note: Maximum possible Craft Utilization is ≈ 85 percent (as shown in Figure 2) considering paid holidays, vacation time, breaks, clean-up, employees meetings, craft training, etc.

Example: What If Wrench Time is 40%? With effective planning and scheduling we can achieve at a minimum a 10 point improvement in craft utilization from our current baseline. Starting from a baseline of 40 percent up to a level of 50 percent, we in effect get a 25 percent increase in craft capacity for actual work.

- **Total Hours Gained in Wrench Time: 4,160 hours gained**
  20,800 hours @ 50% - 16,640 hours @40% = 4,160 hours gained
- **Total Gain in Equivalent Number of Crafts Positions: 5**

4,160 Hours Gained / 832 Average Wrench Time Hours @ 40% = 5 Equivalent Craft Positions

- **Total Gained Value of 5 Equivalent Positions: $187,200**

5 equivalents x 40 hrs./wk. x 52 Wks/yr. x $18.00/hr. = $187,200 Gained Value

Valuable Craft Time Can Slip Away: For the 20 person craft work force, just a 10% improvement up to 50% wrench time is 4,160 hours of added wrench time. This gain represents a 25 percent increase in overall craft labor capacity. The maintenance best practice for planning and scheduling requires a dedicated planner(s). An effective maintenance planner can support and plan for 20 to 30 crafts positions. With only a 10 percent increase in craft utilization for a 20-person craft work force, we can get more than a 5 to 1 return to offset a maintenance planner position.

Example B: What if Wrench Time is 30%? For many operations wrench time is only about 30%. Again with effective planning and scheduling, good PM/PdM and parts availability we can eliminate excessive non-wrench time. An improvement of at least 20 points in craft utilization is very realistic. If we begin from a baseline of 30% up to a level of 50% we are in effect getting a 67% percent increase in craft capacity for actual hands on work.
Let's look at the gained value we can get from going from 30% up to 50% wrench time.

- **Total Hours Gained in Wrench Time: 8,320 Hours Gained**
  20,800 hours @ 50% - 12,480 hours @30% = 8,320 hours gained

- **Total Gain in Equivalent Number of Crafts Positions: 13**

8,320 Hours Gained / 624 Average Wrench Time Hours @ 30% = 13.3 Equivalent Craft Positions

- **Total Gained Value of 13.3 Equivalent Positions: $497,952**

13.3 equivalents x 40 hrs./wk. x 52 Wks/yr. x $18.00/hr. = $497,952 Gained Value

Valuable Craft Time Can Be Regained: Tremendous opportunities are available for the 20 person craft work force with wrench time currently in the 30% to 40% range. Just a 10% to 20% improvement up to 50% wrench time can be from 4,000 to 8,000 hours of added wrench time. This gain represents a 25% to 67% increase in overall craft labor capacity. There are a number of best practices to help you regain valuable craft resources. The maintenance best practice for planning and scheduling requires a dedicated planner(s). An effective maintenance planner can support and plan for 20 to 30 crafts positions.

Use your CMMS/EAM as a mission-essential information technology tool that supports planning and scheduling, better MRO materials management and effective preventive maintenance, three best practices for improving craft wrench time. Bottom line results that give us 5 to 13 more equivalent craft positions and up to $500,000 in gained value of more wrench time with existing staff, can be dramatic proof that internal maintenance operations can be profit centered.

CRAFT PERFORMANCE

Craft Performance (CP): The second key element affecting Overall Craft Effectiveness is craft performance. This element relates to how **efficient** we are in actually doing hands-on craft work when compared to an established planned time or performance standard. Craft performance (CP) is expressed as the ratio of:

$$CP\% = \frac{\text{Total Planned Time (Hours)}}{\text{Total Actual Craft Hours Required}} \times 100$$

Craft performance is directly related to the level of individual craft skills and overall trades experience as well as the personal motivation and effort of each craftsperson or crew. Effective craft skills training and technical development contribute to a high level of craft performance.

Craft Performance Calculation: The planned time for a minor overhaul or PM procedure is 10 hours based on a standard procedure with parts list, special tools, permits required, etc.

- If the job is completed in 12 hours, then Craft Performance = $\frac{10}{12} \times 100 = 83\%$
- If the job is completed in 9 hours, then Craft Performance = $\frac{10}{9} \times 100 = 111\%$

An effective planning and scheduling function requires that reasonable estimates and planning times be established for as much maintenance work as possible. Since maintenance work is not highly repetitive, the task of developing planning times is more difficult. However there are a number of methods for establishing planning times for maintenance work including:

- Reasonable estimates: A knowledgeable person either a supervisor or planner uses their experience to provide their best estimate of the time required. This approach does not scope out the job in much detail to determine method or special equipment needed.

- Historical data: The results of past experience are captured via the CMMS or other means to get average times to do a specific task. Overtime, a database of estimated time is developed which can be updated with a running average time computed for the tasks.
- Predetermined standard data: Standard data tables for a wide range of small maintenance tasks have been developed. Standard data represents the building blocks that can then be used to estimate larger, more complex jobs. Each standard data table provides what the operation is, what is included in the time value and the table of standard data time for the variables that are included. The Universal Maintenance Standards (UMS) method used back in the 1970's represents a predetermined standard data method.

The ACE Team Benchmarking Process: As a means to overcome many of the inherent difficulties associated with developing maintenance performance standards, the ACE (A Consensus of Experts) Team Benchmarking Process. This process was developed back in 1978 by Ralph W. "Pete" Peters, founder of The Maintenance Excellence Institute (MEI). This method, based upon principles of the Delphi Technique, relies primarily on the combined experience and estimating ability of a group of skilled crafts personnel. The objective is to determine reliable planning times for a number of selected "benchmark" jobs. This team based process using skilled craft people places a high emphasis on continuous maintenance improvement to reflect improvements in performance and methods as they occur.

Generally, the ACE Team Benchmarking Process parallels the UMS (Universal Maintenance Standards) approach in that the "range of time concept" and "slotting" is used once the work content times for a representative number of "benchmark jobs" have been established. The ACE Team Benchmarking Process focuses primarily on the development of work content times for representative "benchmark jobs" that are typical of the craft work performed by the group (Peters 1978).

Once a number of benchmark job times have been established, these jobs are then categorized onto spreadsheets by craft and task area and according to work groups which represent various ranges of times. Spreadsheets are then set up with 4 work groups/sheet with each work group having a time slots or "range of time". For example, work group E would be for benchmark jobs ranging from 0.9 hours up to 1.5 hours and assigned a standard time (slot time) of 1.2 hours. Like wise, work group F would be for benchmark jobs ranging from 1.5 hours up to 2.5 hours and assigned a standard time of 2.0 hours. Spreadsheets include brief descriptions of the benchmark jobs and represent pure wrench time. Work content comparison is then done by an experience person, typically a trained planner to establish planning times within the 95% confidence range. A complete users guide complete with step by step procedure, forms and the recommended ACE Team charter for establishing the ACE Team Benchmarking Process is available free by contacting The Maintenance Excellence Institute at www.Pride-in-Maintenance.com or via E-mail: info@Pride-in-Maintenance.com.

<u>Planning Times Are Essential:</u> Planning times provide a number of key benefits for the planning/scheduling process. First, they provide a means to determine existing workloads for scheduling by craft areas and backlog of work in each area. Planning times allow the maintenance planner to balance repair priorities against available craft hours and to realistically establish repair schedules that can be accomplished as promised. Secondly, planning times provide a target or goal for each job that allows for measurement of Craft Performance. Due to the variability of maintenance type work and the inherent sensitivity toward measurement, the objective is not so much the measurement of individual craft performance. The real objective is measurement of the overall performance of the craft work force as a whole. While measurement of the individual crafts person is possible, Craft Performance measurement is intended to be for the entire maintenance work force that is doing skilled type work.

Craft Service Quality

Craft Service Quality (CSQ): The third element affecting Overall Craft Effectiveness relates to the relative quality of the repair. This element includes quality of the actual work, where certain jobs possibly require a call back to the initial repair thus requiring another trip to fix it right the second time. However, Craft Service Quality can be negatively impacted due to no fault of the crafts person when hasty repairs, patch jobs or inferior repair parts/materials create the need for a call back

We can measure call backs via the CMMS with special coding of call back work orders. Typically, the CSQ element of OCE is a more subjective value and therefore it must be viewed accordingly in each operation. However, the Craft Service Quality level does affect overall craft labor productivity and the bottom line results of the entire maintenance process. When reliable data is present for all three elements of OCE, then the Overall Craft Effectiveness Factor can be determined by multiplying each of these three elements:

OCE =	**CU%**	**x**	**CP%**	**x**	**CSQ%**
	Craft Utilization	x	Craft Performance	x	Craft Service Quality

What Overall Craft Effectiveness Can You Expect? Since OCE is a rather new concept there are actually a limited number of case studies outside the real world experiences of MEI staff and Alliance Members. Some organizations try to measure just wrench time and it is accepted that 30 to 40% is typical and 70% is great. Other organizations may measure and track craft performance if a sound planning process and reliable planning times are in place. Also other consulting firms shy away from the often sensitive issue of measuring craft labor in anyway, especially within a Union environment.

MEI feels strongly that measuring and improving productivity of craft labor resources is essential to profit centered maintenance and continuous reliability improvement. Measuring and improving OCE must be addressed by today's in house maintenance operation. Likewise, we feel that the Range of OCE Element Values shown in Table 4 represents the High, Medium and Low combinations for OCE. Successful operations can expect an OCE Factor in the High range of 65% or more.

	Range of OCE Element Values		
OCE Elements	**Low**	**Medium**	**High**
1. Craft Utilization	30%	50%	70%
2. Craft Performance	>80%	90%	95%
3. Craft Service Level	>90%	95%	98%
The OCE Factor	**22 %**	**43%**	**65%**

Table 4: Range of OCE Element Values and OCE

All Three Elements of OCE are Important: Maintenance craft labor may be very efficient with 100 percent craft performance and still not be effective if craft utilization is low and craft service quality are poor.

- Overall Craft Effectiveness = Craft Utilization x Craft Performance x Craft Service Quality
  30% x 100% x 70%
- Overall Craft Effectiveness = .3 x 1.00 x .7 = .21 x 100
- Overall Craft Effectiveness = 21% OCE

Since the nature of determining the value of Craft Service Quality can be subjective, this element is typically not used for calculating OCE. When this element is not used in determining Overall Craft Effectiveness, it is still an important part of effective planning and scheduling. One key part of planning is determining the scope of the repair job and the special tools or equipment that is required for a quality repair. A continuing concern of the maintenance planning function should be on improving existing repair methods whether by using better tools, repair procedures, or diagnostic equipment and using the right skills for the job. Providing the best possible tools, special equipment, shop areas, repair procedures and craft skills can be a key contributor to improving Craft Service Quality. And Craft Service Quality can often still be a key performance indicator (KPI) that is determined from periodic review of call backs, customer complains and customer surveys. Therefore MEI feels that the Overall Craft Effectiveness Factor is best determined by using just two elements for the OCE Factor calculations:

OCE = Craft Utilization x Craft Performance

The Impact of Improving Both Craft Utilization and Performance: Improved craft utilization through more effective planning of all resources will increase available wrench time. Improved performance results from the fact that work is planned and the right tools, equipment, and parts are available made by planning the right craftsperson or crew for the job with the type of skills needed. Improving craft performance is a continuous process with a program for craft skills training and methods improvement to do the job right the first time in a safe and efficient manner. The ACE Team Benchmarking Process mentioned earlier provides reliable planning times based upon “a consensus of experts” and a tremendous repair methods improvement effort as benchmark jobs are analyzed.

Example C: What if We Increase Wrench Time from 30% to 50% and Craft Performance from 80% to 90%

When we look at the combination of improving both craft utilization and performance, we see an even greater opportunity for a return on investment. Let's now look at a very realistic 20 point improvement in Craft Utilization and a 10 point increase in Craft Performance for the same 20-person craft work force shown back in Table 3 and having an average hourly rate of $18.00.

- **Baseline Cost Per Direct Maintenance Hour @ 30% Utilization and 80% Performance**
  20 crafts x 40 hours/week x 52 weeks/year x .30 (CU) x .80 (CP) = 9,984 Direct Craft Hours/Year
  = 499 Direct Hours/Craft Position
  Baseline Cost: $748,800 ÷ 9,984 Direct Hours = $75 Cost Per Direct Craft Hour
- **Improved Cost Per Hour With 50% Craft Utilization and 90% Craft Performance**

  20 crafts x 40 hours/week x 52 weeks/year x .50 (CU) x .90 (CP) = 18,720 Direct Craft Hours/Year
  = 936 Direct Hours/Craft Position
  Cost Per Direct Craft Hour @ 50% Craft Utilization and 90% Craft Performance = $40
  $748,800 ÷ 18,720 Direct Hours = $ 40 Cost Per Direct Hour

- **Total Direct Craft Hours Gained = 8,736 Total Direct Hours Gained (87% Increase)**
  18,720 Hours – 9,984 Hours @ Baseline = 8,736 Direct Craft Hours Gained
  8,736 Hours Gained ÷ 9,984 Hours @ Baseline = .87.5 x 100 = 87% Gain in Direct Craft Hours

- **Total Gain in Equivalent Number of Craft Position: 17 Equivalent Craft Positions**
  20 crafts x .87 (%Hours Gained) = 17.4 Equivalent Craft Positions
  8,736 Hours Gained **-:-** 499 Hours/Craft Baseline Average =17.4 Equivalent Craft Positions
- **Total Gained Value = $655,200**
  Gain of 8,736 Direct Craft Hours x $75 Baseline Cost/Direct Hour =$655,200 Gained Value
  $655,200 **-:-** $748,800 = 87 % Gain from a Baseline of 30% Wrench Time and 80% Craft Performance

Summary of Our Previous Examples: The previous examples have illustrated that increasing OCE provides greater craft capacity and gained value from increased wrench time. Improving Craft Performance in combination with improving Craft Utilization simply compounds our return on investment; an astronomical amount of 87% as shown in Example C.

Examples	Baseline	Improve To:	Craft Labor Gain	Gained Value
A	CU @40%	CU@50%	5	$187,200
B	CU@30%	CU@50%	13	$497,952
C	CU@30% & CP@80%	CU@50% & CP@90%	17	$655,200

Where Can We Apply OCE Gained Value: Maintenance operations that continually fight fires and react to emergency repairs never have enough time to cover all the work (core requirements) that needs to be done. Overtime, more crafts people or more contracted services typically seem to be the only answers. Improving craft utilization provides additional craft capacity in terms of total productive craft hours available. In relation to OEE, OCE is increased people asset availability and capacity. It is gained value that can be calculated and estimated and then measured. The additional equivalent craft hours can then be used to reduce overtime, devote to PM/PdM, reduce the current backlog and attack deferred maintenance which doesn't go away. Figure 2 shows; "How your valuable craft time can just slip away".

Typically, operations that gain productive craft hours desperately need to invest the time elsewhere. Likewise, we can not automatically and indiscriminately reduce head count when we improve overall craft effectiveness. Indiscriminate cutting of maintenance is killing the goose that lays the golden egg. If an organization is not achieving core requirements for maintenance the cutting of craft positions to meet budget is like using blood letting as a new cure for a heart attack. It just will not work.

Just like the high cost of low bid buying, gambling with maintenance costs can be fatal. Long-term stabilization and reduction of head count can occur. Attrition can absorb valid staff reductions that may result over the long-term. We also may regain our competitive edge and get back some of the contract work we lost previously to low performance and productivity. We cannot indiscriminately cut craft labor resources when we increase OCE.

Think Profit-Centered: Today's maintenance leaders and crafts people must develop the "maintenance-for-profit" mindset that the competition uses to stay in business. Measuring and improving Overall Craft Effectiveness and the value received from improving our craft assets an important part of total asset management. Profit-centered in-house maintenance in combination with the wise use of high quality contract maintenance services will be the key to the final evolution that occurs. There will be revolution within organizations that do not fully recognize maintenance as a core business requirement and establish the necessary core competencies for the maintenance. The bill will come due for those operations that have subscribed to the "pay me later syndrome" for deferred maintenance. It will be revolution within those operations that have gambled with maintenance and have lost with no time left before profit-centered contract maintenance provides the best financial option for a real solution.

Maintenance is Forever: Contract maintenance will be an even greater option and business opportunity in the future. Again we must remember - Maintenance is Forever! Some organizations today have neglected maintaining core competencies in maintenance to the point that they have lost complete control. The core requirement for maintenance still remains but the core competency is missing. In some cases, the best and often only solution may be value-added outsourcing. Maintenance is a core requirement for profitable survival and total operations success. If the internal core competency for maintenance is not present it must be regained. Neglect of the past must be overcome. It will be overcome with a growing number of profit-centered maintenance providers that clearly understand Overall Craft Effectiveness and providing value added maintenance service at a profit.

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Bio of Ralph W. "Pete" Peters

Pete Peters, founder of The Maintenance Excellence Institute and President of Ralph W. Peters and PEOPLE Inc has over 30 years of practical engineering expertise, operations management and maintenance responsibilities in both the public and private sectors. He has helped operations such as the University of NC-Chapel Hill, Boeing, Heinz, General Foods, Consolidated Stores, Marathon Ashland Oil, Polaroid, Great River Energy, Wyeth-Ayerst, Cooper Industries, National Gypsum, Lucent and Carolinas Medical Center achieve success in plant, fleet and facilities maintenance operations. Pete is a senior member of the Institute of Industrial Engineers, the Association of Facility Engineers and the Society of Maintenance and Reliability Professionals.

He has served two manufacturing operations as a Plant Manager and as Director of Facilities Management where he managed a 225-employee physical plant operation with over $30 million annual budget and eight million square feet of facilities including the State Capitol of North Carolina. Responsible for all physical plant operations, construction renovation, planning and inventory management. Responsible for commissioning three major office buildings and a new central steam plant without significant staff additions.

Also served as Director, Productivity Management, NC Department of Transportation and helped establish the first fleet maintenance management system in US for measuring, planning and scheduling of fleet maintenance work with operator-based preventive maintenance, planner selection and training, maintenance performance reporting and team-based maintenance improvement. During his NC Army National career, directed maintenance operations at company, battalion and brigade levels to include command of a direct support maintenance and supply company in combat zone (Vietnam). Certified as a Total Quality Management facilitator for the National Guard Bureau.

He is also retired from the US Army Corps of Engineers/NC Army National Guard (1995) with 28 years of concurrent service and serving in Viet Nam and during Desert Storm. Pete is author for the upcoming books*; Profit-Centered Maintenance* and *PRIDE in Maintenance: I, II and III* and was editor/primary author for *The Guide to Computerized Maintenance Management Systems*, Scientific American Newsletters LLC, author of the maintenance chapters in *The Warehouse Management Handbook* and *The Future Capable Company* from Tompkins Press and John Wiley's new 2001 *Handbook of Industrial Engineering*, *3rd Edition*.

A recognized leader in the areas of implementing maintenance best practices, profit-centered maintenance strategies, performance measurement, and providing value-added total operations consulting. He is also the author of over 200 articles and publications and as a frequent speaker has delivered presentations on manufacturing and maintenance-related topics worldwide.

Pete received his BSIE and MIE from North Carolina State University and is a graduate of the US Army Command and General Staff Course and the Engineer Officers Advanced Course.