THE MARINE CORPS MASTERY LEARNING PROJECT: NEW DIRECTIONS IN TRAINING

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ABSTRACT

The Mastery Learning Project at the Marine Corps Communication-Electronics School in Twentynine Palms, California is the Marine Corps' test bed for the development of a self-paced, mastery-learning strategy. This strategy is viewed as the way to improve personnel and training readiness by providing complex technical instruction in less time, with less academic attrition, and with no degradation in quality. The key to success lies in the emphasis placed on offering closer, more personalized instructor attention to those students who require it. A computer-based management information system provides essential automated support for instructional personnel as well as for all the administrative and managerial functions within the school, thereby permitting substantial reductions in training overhead costs. Experience gained thus far has shown that students are achieving mastery of all learning objectives in 70% of the conventional training time, with academic attrition approaching zero.

Since World War II, the Iwo Jima Memorial, located just outside of Washington, D.C., has been a symbol of Marine Corps valor. But more than that, it has stood as a reminder of our country's readiness to meet and conquer any threat to national security and to those values and principles we cherish. In recent months, however, our readiness has become a matter of grave concern--can we still respond militarily in time of crisis? This leads to the question: What is readiness?

Very simply stated, readiness is the synthesization of equipment, people, and training. The most sophisticated equipment in the marketplace, along with the necessary people to operate and maintain it, will not produce readiness without an effective training system. In a certain sense, then, we can say that readiness equates to training.

As we enter the 1980s, military training is becoming much more challenging. Specialized skills training, in particular, demands more imaginative responses to constantly changing requirements. The test bed for a long-range Marine Corps program to examine new directions in training which will respond to this challenge is the Computer Based Education (CBE) Project at the Marine Corps Communication-Electronics School in Twentynine Palms, California.

The conventional, lockstep, class-oriented approach to instruction has traditionally been the standard way of conducting training in the Marine Corps. It has served its purpose well, but it is rapidly becoming ineffective in the face of demands being placed upon it by three major factors: technology, manpower, and money. Let us examine each of these.

Technology is changing the world we live in moment by moment. However, the change is insidious. It is happening so fast that it blurs into a gradual continuum and is upon us before we know it. As with our children, growth occurs a little each day and we never notice it... until one evening when we sit down to the dinner table, we find they are no longer there. We are astounded that they have become adults--overnight! How many people still use a wristwatch with a stem winding mechanism? The numbers are rapidly diminishing. And it seems only yesterday that the first electronic calculator fairly dominated the entire surface of a double pedestal desk. Now you can fit one in your wallet. When did this all happen? No question about it, the technology explosion has vastly expanded our operational capabilities, but it has created a dependence at the expense of self-reliance. For some, the deprivation of the automatic garage door opener or the remote TV tuner would be a shattering experience. The pricetag for technology does not end there. The more complex systems--such as those used for military command and control systems--cost dearly and require more highly trained personnel. In short, technology is a double-edged sword. But then, you don't get nuthin' fer nuthin'!

It has been humorously commented that if the safety pin were invented today, it would have two transistors, a regulator, an off-on switch, and would require a service check every six months. This is not meant to poke fun at technology, but merely to underscore the fact that everything is becoming more complex nowadays. How does technology impact on national defense? The U.S. has made the decision not to compete with the Soviet Union in the production of conventional arms. Accordingly, it can only maintain its operational edge--sustain its "essential equivalency"--through the use of technology. This means that greater and greater numbers of multi-purpose, technologically sophisticated weapons systems are entering the military equipment inventory. Just as the cannon was developed to breach forts and later on the tank was invented to breach static defenses, now a whole new generation of military capabilities is being created...which in turn will breed counter capabilities...and so on. These new systems are not merely product improvements on existing systems but are in many cases totally new, add-on systems which further expand the number of equipment end items to operate and maintain. The greater sophistication of these systems makes their operation and maintenance tasks much more complicated and difficult to master and leads to a greater diversification of skills. The generalist is fast giving way to the specialist. In short, greater numbers of more complicated systems require greater numbers of more highly skilled personnel to support them...essentially fewer and fewer "pick and shovel jobs".

One very grave implication of the rapid advances being made by technology is that the individual is given greater control over his environment. Where once the archer could control anything within range of his arrow, and then the pilot had control over anything within range of his aircraft, now the missileman can control those targets within range of his Inter-Continental Ballistic Missile (ICBM). Although this is an impressive operational advancement, it carries with it the serious burden of increased consequences due to human error. What does this mean? Simply that we cannot afford to have poorly or partially trained individuals--each individual must be 100% proficient in his specialty. In summary, technology is generating greater and more complex training requirements.

Manpower is the second factor which is driving the requirement to investigate new directions in training. There are three elements to be considered...Quantity... Quality...and Attitude.

We have been operating without the Draft since 1973, and the validity of the All Volunteer Force is being seriously questioned. Why? Studies have shown that in order to maintain the 2-million plus standing force, approximately 340,000 recruits must be enlisted each year. This equates to about 1300 recruits per working day...a lot of volunteers! Paradoxically, the manpower pool from which these volunteers must be drawn is rapidly declining--there are simply fewer 17-18 year olds than in the past few decades. It has been estimated that by the mid-1980s, one out of every three qualified 18-year-old must be enlisted in order to support the All Volunteer Force. To compound the manpower quantity problem is the fact that retention of mid-career military professionals is becoming more and more difficult...especially among the so called "hard skills" such as electronics maintenance. The lure of higher-paying, less-demanding civilian jobs is hard to combat.

The second element of the manpower issue is quality. Bluntly, fewer and fewer new recruits have the necessary math or verbal skills to successfully complete demanding technical training. Since 1957, the scores registered by high school students on the Scholastic Aptitude Test (SAT) have been plummeting. This lack of qualifications further narrows the manpower pool. It is not that the young people of today are stupid--they are just poorly educated. You can read about it every day in your newspapers and periodicals. One Ohio State University study revealed that approximately 25% of a recent freshman class had to take remedial reading--nearly one-third had to take make-up math! Another study indicates that almost 13% of all 17-year olds are functionally illiterate. This leads to the irrefutable conclusion that the high school diploma is not what it used to be. And again... among the qualified, many are lured away by more profitable careers.

The final aspect of manpower which features into the set of considerations which represent the training challenge is attitude. The Marine Corps seeks individuals who fit the adage: When the going gets tough, the tough get going! However, we are seeing an ever-increasing incidence of an attitudinal problem among our young enlistees which the Commandant of the Marine Corps has very aptly dubbed the "failure stick syndrome." This is reflective of the growing need within our society for instant gratification by the easiest route--a manifestation of the TV-oriented, fast-food mentality. Just like the "hired gun" in the old western movies, who carved a notch in his gun each time he killed someone, many young people today seem to take some sort of perverse pride in the number of notches they can carve in their "failure sticks"--to be success at failure, as it were. The obvious implication this has in our discussion is that technical training and learning do not take place effortlessly, a high degree of mental toughness is required. Consequently, we find more and more cases of students who simply quit because the learning tasks appear to be too difficult and demanding. Mind you, many of these have the necessary cognitive abilities to be successful; their failures can only be attributed to poor attitude and lack of motivation.

The third major factor which contributes to the situation facing the military training establishment is money. In the first place, a shift has taken place since the early Vietnam days in terms of the budget outlays provided to the Department of Defense and the amounts set aside for various human resource programs. Defense spending has fallen from 42% to 23% of the Federal Budget while human resource allocations have climbed from 29% to 53%. The current Iranian crisis has exposed potential weaknesses within the Department of Defense and resulted in calls to raise defense spending. Although the military now enjoys a slightly larger slice of the Gross National Product (GNP), pressure on the Congress to balance the 1981 budget is constant. As a result, any improvements may be short lived. As though proportionate quantitative cuts in the DOD budget were not enough, double digit inflation compounds the matter even further... as it does in every walk of life. Thus, the defense budget is hit from two sides...and within the defense budget, the high acquisition costs of complex weapons systems normally cause a concomitant reduction in dollars available for training.

A major military training center, such as the Marine Corps Communication-Electronics School, is faced with the challenge of providing expanded and more complex training to fewer, less qualified, and less motivated students for less money. M-C-C-E-S or C-and-E School, as it is called in the vernacular, is an expansive facility with the mission of providing training ...electronics fundamentals...operational communications...air control/anti-air warfare operations...and communication-electronics maintenance. Very broadly, C & E School is responsible for training approximately 85% of the personnel who operate or maintain the Marine Corps' command and control communications systems. It conducts 45 courses of instruction leading to 37 Military Occupational Specialities (MOSs)...with several more courses under development. M-C-C-E-S has a yearly input of more than 6000 plus students with a peak load exceeding 2100. The average daily student load is approximately 1700 Marines. C & E is authorized a permanent staff of 51 officers, to becoming better educated in the area of computer based training, to conducting research, and to developing a solid 5-year plan for the acquisition and implementation of our future system. We studied all the significant literature we could get our hands on, we attended seminars and conferences, and we visited most of the major civilian and military institutions involved in similar programs. We also received solicited and unsolicited visits by a number of highly respected experts in the fields of instructional technology and educational psychology. All very willingly lent their professional opinions and confirmed that we were on the right track.

One resounding note which rang loud and clear in all this effort was that any such system as the one we were contemplating had to be based on a marriage of CAI and CMI-with the emphasis on CMI. To avoid possible confusion, which we perceived could arise due to the varying definitions of the terms CAI and CMI which abound, we adopted the umbrella term Computer Based Education (CBE) for future reference to our project. Our 5-year plan laid out our objectives with milestones--as we saw them then-and set forth the essential elements of our CBE system. These consisted of six major subsystems, each containing various application programs. The Training subsystem, of course, reflects the basic requirements for the CAI/ CMI system set forth in our systems specifications; Staff Management addresses the accountability and allocation of our human resources; Resource Allocation does the same thing for our material resources; Instructor Evaluation provides the quality control over our instructors--still the key element in our instructional strategy; *Student Management automates the myriad* administrative tasks which must occur from the time we learn of a student's assignment to the school to the time he leaves; and Courseware Development is designed to facilitate the monumental task of updating course material. These six subsystems embrace all of the functions which we define as the "educational process" and represent the framework for our CBE system.

There is nothing new about these functions--they all are being performed currently. They are all crucial to our mission. However, our performance of these functions is fast becoming ineffective in an educational environment built on the traditional, lockstep method of instruction. Why? Because the entire approach to training is no longer responsive to the new demands being placed upon it by those external conditions over which we have no control.

Let's take a look at just why lockstep instruction no longer answers the mail. Very simply: it fails to train fully all students and it is fraught with high academic attrition. The major reason for this is that it is based on a *Fixed Time/Variable Mastery strategy. A* course is conducted over a set time period, and those students who do graduate attain anywhere between 70% and 100% mastery of the learning objectives. Instruction is of necessity geared to the average student. This means that it is too slow for approximately the top one-third of the class and too fast for the bottom one-third. *The highly qualified student is capable of* mastering all of the learning objectives in much less time than it takes the course to run to completion, whereas the slow student becomes hopelessly lost before he ever gets started. The good students get bored, many never realizing their full potential, some actually becoming "academic" attritions themselves. And the most serious consequence is that we are sending men into the field who may be as low as 70% trained. I doubt if anyone of us would like to be treated by a doctor who was 70% qualified ...or fly with a pilot who was great on take-offs but so-so on landings! What's the answer?

We believe the solution has its foundation in Mastery Learning theory. Pioneered by Dr. Benjamin Bloom of the University of Chicago and further promoted by a number of his disciples, Mastery Learning holds that "all can learn." The implication is that by adapting our instructional approach to the learning capabilities of the student, we can bring *all--or nearly all--up to the level of mastery* now normally attained by the top 10%. We are confident that this can be achieved. But how will it work?

The educational strategy which supports Mastery Learning is virtually a reversal of that which drives lockstep instruction. Whereas lockstep strategy is based on Fixed Time/ Variable Mastery...Mastery Learning strategy is based on Fixed Mastery/Variable Time (FM/VT). In the FM/VT approach, mastery of all learning objectives is a fixed requirement, the time to master varying according to the unique learning capabilities of each student. When full mastery is attained--measured along the way by successful completion of a series of formative exams and at the end by passing a final, summative exam-the student moves on. The key to control under the FM/VT strategy--and that ingredient which prevents Marines from becoming "career students"--lies in the interactive testing scheme. This disallows a student to exit a question on an exam with the wrong answer. The student is given immediate feedback, and problem areas are identified, *signalling the need for instructor intervention.* As opposed to the image conjured up by the term "self-paced" instruction, which pictures a student isolated in an antiseptic room, alone with his computer--FM/VT emphasizes the need for the ever-present instructor, and allows him...to employ the one-to-one Socratic method of instruction with those students who need it. Since this age-old, ideal *mode of instruction* is impossible to employ on a mass scale, FM/VT permits us to implement it "by exception."

On September 1st, 1979, M-C-C-E-S launched into Phase II of the project--the Implementation Phase. With announcement of the system's vendor imminent and delivery of the first increment of the system hardware approximately a year away, we knew we had much work to do to prepare for its arrival. The project team was augmented by additional personnel and restructured into four functional "tracks" under the direct management of the Commanding Officer.

Track 1 was designated the Hardware Track, responsible for making all the preparations necessary to accommodate the equipment when it arrived. It was also tasked to handle all the supply and maintenance requirements for the

463 enlisted personnel, and 48 civilian employees to support this immense training responsibility. However, normal staffing runs at a somewhat reduced level based on the availability of various ranks and MOSs within the Marine Corps.

The inpact of Technology, Manpower, and Money on M-C-C-E-S can be driven home by the example of a radar repairman. Fifteen years ago he could fix all of the radars in the Marine Corps inventory with one toolbox...now, radar repair requires a whole array of skills and equipment. Very simply, the increased complexity of technology...and the greater diversity of more sophisticated systems are vastly expanding the range and level of technical skills required by the Marine Corps....with a commensurate increase in the number of personnel who must be trained.

One final aspect of technology which has manpower and money implications and which impacts on the training mission at M-C-C-E-S is the increasing speed of technological change. Scientific advances are hurtling forward in geometric leaps and bounds...to the extent that the effectiveness span of an individual's knowledge, skill, and training is greatly reduced; simply stated, technical training has a built-in decay factor. This requires more frequent updating of training and higher costs. For example, during the decades between 1930 and 1950, tube technology was the existing state of the art. For the most part, a technician who entered the service in 1930 could still operate effectively 20 years later without much, if any, formal retraining. Then in the late 1950s we advanced to minitubes. By the early 1960s we had moved into the world of transistors and medium discrete components...the first attempts at integrated circuits. 1965 found integrated circuits in full bloom...and saw the introduction of layered hybrids...analog techniques being replaced by digital concepts. By 1970 we had reduced multi-integrated circuits to a single chip... and were compressing layers of separate circuitry into multilayer boards by the mid-70s...and this level of technology is now obsolete! Thus, as technological advancements rapidly accelerate on the one hand, and the pool of "first choice" Marines steadily declines on the other hand, C & E School must teach a more complicated array of subjects to lesser quality students. This reduction in quality leads to higher attrition and longer training times, increased in part by the requirement to provide remedial training. The increased pressure to learn greater amounts of more difficult course material also takes its toll in attrition among the qualified but poorly motivated Marines. The higher pay of staff personnel and students leads to higher training overhead costs, especially in the manpower-intensive conventional lockstep method of instruction. Inflation, too, is increasing operating costs at C & E School without an increase in productivity... which, in turn, breeds further inflation. Therefore, the expanded training burden brought about by technological progress, juxtaposed with the depressed manpower situation, creates higher training costs...all at a time when money is becoming more scarce. Our only recourse is to train quicker, better, cheaper.

From the point of view of the trainer, this poses what appears to be an insurmountable problem. We have no control over the march of technology... we have no control over the quantity, quality, and attitude of the manpower we receive...and we have no control over the money we are allocated. What, then, can we possibly do? On the surface it appears that we are faced with an insoluable situation imposed on the training establishment by the factors of Technology, Manpower, and Money. This situation did not develop overnight--as long as ten years ago, the Marine Corps perceived that something had to be done to improve training. It did not view it as a problem, however, but rather as a challenge--and it did something about it--it turned to... AUTOMATION! The reasoning appeared obvious-we needed a better tool. And we got the tool that everyone was starting to get excited about...we acquired a Computer Aided Instruction (CAI) system. It seemed patently clear that the age of television was upon us and that the younger generations related much better to this medium than to the printed word. It stood to reason, then, that students would learn better and faster if they could be taught by television. Therefore, we acquired television-like equipment and started to work.

For six years M-C-C-E-S actively developed CAI lessons, conducted studies and economic analyses, prepared automated data processing (ADP) plans, and so on. We were very busy and enthusiastic. But all we created was a lot of smoke-and no heat. Nothing happened. We failed to produce any tangible results. However, our efforts were not totally in vain. We learned something-we learned what we did not want. Thinking that TV would somehow equate to learning, we had become enamored with the hardware and had leapt right into a hardware solution-without adequately defining the problem. So we restudied our needs and submitted a new set of system requirements to the Commandant of the Marine Corps. And in July of 1976, the Commandant gave the go-ahead to acquire a new system which would be precisely tailored to our needs.

In April of 1977, the CAI Project Team was formally established. It was a pick-up team, comprised solely of in-house personnel--no outside experts were used. As such, it was sort of a sand-lot approach to systems development. But it was effective, in large part because we observed one of the cardinal rules of sound project management--we dedicated this team exclusively to the project under the direction of a full-time Project Officer. The Project Team's first task was to develop a detailed set of system specifications based on the needs assessment that had been submitted to CMC. Two significant aspects of this document were: (1) it was expressed in terms of functional requirements--educational requirements, not hardware preferences; and (2) it included a requirement for Computer Managed Instruction (CMI). Although our mind-set at this time was still primarily oriented to CAI, we had learned enough in the intervening years to know that it was the total management of the educational process--not merely the use of the computer as an instructional medium--which held the greatest promise of economic savings. We were definitely progressing. But we knew that we had much more to learn. So, we devoted 1978 and most of 1979 system. Site preparation and coordination with the system acquisition agency back in Washington, D.C. were its major activities. As an interim measure, necessitated by unexpected-but typical--delays in the system acquisition process, Track 1 undertook negotiations to lease a temporary, low-cost computer system to serve as a training device for our unskilled personnel who would have to function as programmers and system analysts for the CBE system when it was installed. Additionally, it would provide the much needed computer support for development of the various application programs and for our initial endeavors in converting courses to the FM/VT strategy. We were intent on being ready to produce immediate results on any future CBE system as soon as it was installed and operating.

Software-that is, data base design and application program definition, description, and development-was the function assigned to Track 2. This was a most crucial activity if we were to employ the CBE system as more than just an instructional device. The results of this effort would be the ones which would yield our most immediate pay-off in terms of automating mundane, manual tasks in the educational process and reducing the requirement for training support personnel. Coordinating with the various functional sectors of the school, Track 2 succeeded in developing the rudiments of our CBE system. The six major subsystems have been defined and described and their operating algorithms designed--and within each, the top priority applications have been programmed and are operating. One, in particular, has given us our first glimpse of potential personnel savings. Once it is fully implemented, the Automated Order-writing Program will enable MCCES to reduce its Personnel Administration Center staff by four people. A small beginning, but a lot of promise!

Track 3 was charged with the responsibility of developing FM/VT course material. It was toward this effort that M-C-C-E-S received its first outside assistance--augmentation of its staff by a Marine Reserve Colonel, holder of a PhD in Educational Psychology with over 15 years experience. A staunch advocate of FM/VT, he has spearheaded the attack in this endeavor. Although courseware development was ultimately to become a collaborative effort between M-C-C-E-S and outside contractors, the contractual process involved lengthy negotiations. Unable to sit idle while these transactions were completed, the School launched its own program. We were to learn much in this process--*indeed, our full perception about the* FM/VT approach did not mature until we had actually ventured into the arena ourselves. During this effort, we were also to revise our thinking regarding the role to be played by courseware contractors. We began on a small scale, with plans for progressively expanded courseware conversions.

Our first endeavor actually had its beginnings during the Summer of 1979 with a series of four experiments involving the Fundamentals of Digital Logic Course (FDLC)--a two-week block of instruction at the tail end of our Electronics Fundamentals Course. A small, easily managed instructional package, which all telecommunications and electronics repairmen have to take, it provided the ideal starting point for our FM/VT development. The success of the four experiments, which were conducted rigorously, with control groups taught in lockstep providing the comparison, prompted the school to adopt the FM/VT strategy for this sub-course on a full scale in December 1979. Since the FDLC experiments were first started, a total of 929 students have received instruction under the FM/VT method. 2,878 training days have been saved vis-a-vis the training time which would have been required to train the same number of students under lockstep instruction. This averages out to approximately three training days saved per student. 100% mastery has been achieved in all cases, and there has been zero attrition! The courseware originally developed by M-C-C-E-S has since been smoothed out by a professional courseware firm and is now in active use.

A major disadvantage of the FDLC package which presently exists due to the fact that it is merely a preparatory course, is that once it is completed, students must return to the lockstep environment to pursue their follow-on courses. Tolerating this for the time being in order to gain experience in FM/VT training, M-C-C-E-S proceeded to the next logical step--development of an FM/VT course from which a student could be assigned a Military Occupational Specialty (MOS) and be transferred to the field. It chose to attempt this with the Ground Organizational Radio Repairer Course (GORRC), itself a pilot program in the Marine Corps aimed at redesigning maintenance training to include a level for organizational repair-men-those limited duty repairmen assigned to combat organizations. If conducted in lockstep, this course would have taken approximately 70 training days. However, under the FM/VT strategy the average training time was 49 days--a savings of 21 training days per student. A total of 30 students went through the first class with 100% mastery and no attritions. The total training days saved was *630-just for the first iteration of only one* course. Incidently, the graduates of the pilot GORRC have been sufficiently well-received in the field to prompt the Marine Corps to convene a second class in June 1980.

The third phase of our FM/VT development was to apply it to a total training pipeline-that is, to a series of courses leading to a complex technical MOS. We chose for this effort MOS 2841, the full-blown Ground Radio Repairman, a perenially short MOS. Recognizing that the chain of courses--Electronics Fundamentals, Radio Fundamentals, and Ground Radio Repair courses--leading to this MOS contained certain unnecessary and redundant blocks of instruction, our first step was to analyze the requirements and redesign the series into a single, "terminal" course of instruction. The second step was to revise the training material for the FM/VT approach. Comparison of the times required to train a single Ground Radio Repairman reveals that under the current method--the training pipeline approach--it takes 39 weeks. The redesigned, stand-alone course reduces his training time to 20 weeks--if taught under lockstep instruction. But--if taught under FM/VT, it would take approximately 14 weeks-if our past experience in achieving a 30%

reduction in training time is borne out. Translating this into dollar savings, we can expect that the following economies are to be realized for a single student. It costs $6,038.00 to train one student under the current lockstep method--this cost made up of both his salary and his share of the course costs. The redesigned lockstep course would cost approximately $3,100.00. But...if conducted under the FM/VT approach, the costs would dip to roughly $2,170.00. Projecting this time and money savings over a full year, training 480 students as Ground Radio Repairmen, we find that the redesigned lockstep course would reflect a 49% savings in both training dollars and student manyears. The redesigned course under FM/VT would reflect a 64% savings in these costs. The redesigned lockstep course would, indeed, reflect a 49% savings...but it would still result in variable mastery and high attrition. The redesigned FM/VT course, however, would result in even greater savings...and would result in total mastery and no attrition--or close-to zero attrition.

Simple arithmetic tells you that multlipied out over 45 courses of instruction offered by MCCES for the 6,000 plus students per year, the potential savings, in both time, money and manpower is enormous.

The pilot courses for the FM/VT version of the Ground Radio Repairmen now convened on 10 June 1980.

Track 4-last of the implementation tracks--was assigned the responsibility of analyzing the Human Factors requirements which we had learned were so crucial to the success of a computer based training project. To be sure, failure to adequately address these considerations had revealed itself to be the "Achilles Heel" of many other such endeavors. Paramount among these were: the changing role of the instructor; the changing role of the student; and "predictive analysis" of student learning potential. We were well aware of the fact that we could expect much apprehension--and possibly resistance--on the part of the instructor regarding CBE. If we did not handle it properly, he could easily begin to feel that he was going to become subordinate to the computer--perhaps even replaced by it. After all, the very nature of lockstep instruction is that it is instructor-centered. Therein, the instructor functions much like an actor on a stage--he learns his lines and he delivers them from a stage to an audience of students. We knew that we had to reassure him that his role was not going to be diminished or eliminated--but rather, that it was going to be expanded and enriched with a great deal more satisfaction than he had known before. He was no longer going to be that actor on the stage, but more the director of the entire production. We have been highly successful in progressively "transforming" our lockstep instructors into FM/VT instructors by involving them, individually and in small groups, totally in the conversion to FM/VT training. We have learned that "involvement" does not merely mean informing them of what is being done or even soliciting their opinions and suggestion--often the furthest extent to which "participative management" is ever pursued. On the contrary, it means having them roll up their sleeves and dig right in under close supervision. It means everything from designing the course material, to actually serving as the instructors in the FM/VT course they have worked on, to finally evaluating the product and revising the courseware based on their evaluations. We are confident that the "heart and mind" of the instructor will not be won by handing him a set of materials developed by outside "experts" with the expectation that he supportively and enthusiastically use it. The "Not Invented Here" syndrome is a fact of life which we must fully recognize.

Hand-in-hand with the changing instructor role is the new and different role of the student. Whereas in the lockstep, instructor-centered mode of instruction he is--to a great extent--an anonymity sitting in the audience, in FM/VT training he becomes the actor in a student-centered production. Each actor has his unique talent--some can dance and some can sing. In the same manner, each student has his unique capabilities--some are better verbally, some have greater mathematical skills, and so on. As it is the job of the director to know the various talents of his actors and to orchestrate them to obtain the very best performance, so it is the job of the FM/VT instructor to know the capabilities of his students and manage them to achieve peak performance.

To assist the instructor in this task, we have attempted to get a better handle on predicting student learning potential. Our first experiment with this took place with the pilot Ground Organizational Radio Repairer Course. Using the Electronic Aptitude (EL) and General Technical Aptitude (GT) scores from the Armed Services Vocational Aptitude Battery (ASVAB) test, we devised a Cognitive Aptitude (C) value for each student, scaled from zero to 3. To this we added a Psychomotor Ability (P) value, based on a very rudimentary, locally-developed psychomotor test. And finally, we ascribed to each student an Affective Traits (A) value derived from scores made on Rotter's Internal-External Locus of Control scale. It was theorized that the A-value would give some indication of a student's probability of perservering through the more complex course material under FM/VT instruction. Realizing that our measurement instruments were very crude at best, we nevertheless used them to develop a Probable Completion Time (PCT) for each student. The results of this initial effort are, of course, inconclusive. Much more extensive work has to be done, and the measurement instruments certainly have to be much further refined. However, we did show that the PCTs for each student were fairly accurate. This has convinced us that we can, in time, become more adept at predicting a student's potential for mastering a set of learning objectives within a certain time frame. Once we can do this with accuracy, we can move one step further toward matching students to programs of instruction that are most within their range of capabilities. In short, we--as directors--can better cast our actors!

In summary, the Marine Corps' CBE system being developed at M-C-C-E-S is a marriage of three basic diciplines: Educational Strategy, Management Theory, and Computer Technology. A review of its salient features reveals that it is...an interactive educational system based on a self-paced, mastery-learning strategy--that is...FM/VT. It emphasizes the importance of the instructor, placing the computer in a subordinate, supportive role which offers... *computer data base management that* supports the educational strategy.

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